ECOLOGICAL ECONOMICS AND SUSTAINABLE FOREST MANAGEMENT:

DEVELOPING A TRANSDISCIPLINARY APPROACH FOR THE CARPATHIAN MOUNTAINS

Edited by I.P. Soloviy and W.S. Keeton

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Contemporary scientific concepts and approaches in ecological economics and sustainable forestry are presented in this book. Attention is given especially to the possibility of integrating these concepts with the objective of solving important ecological and economic problems facing mountain regions and their sustainable development. The book proposes a number of sustainable forest management approaches using the Ukrainian Carpathian Mountains as a case study.

The book will be a useful source for scientists, students, professionals, and policy makers in the fields of forest and environmental policy, forest economics and management, sustainable forestry, and nature conservation.

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ЕКОЛОГІЧНА ЕКОНОМІКА ТА МЕНЕДЖМЕНТ СТАЛОГО ЛІСОВОГО ГОСПОДАРСТВА:
РОЗВИТОК ТРАНСДИСЦИПЛІНАРНОГО ПІДХОДУ ДО КАРПАТСЬКИХ ГІР

За науковою редакцією **І. П. Соловія та В. С. Кітона**

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Екологічна економіка та менеджмент сталого лісового господарства: розвиток трансдисциплінарного підходу до Карпатських гір // за ред. І.П. Соловія, В.С. Кітона. Монографія – Львів : РВВ НЛТУ України, Видавництво ТзоВ "Ліга-Прес", 2009. – 432 с. : іл. 28, табл. 67, бібліогр. 686.

У монографії, підготованій міжнародним авторським колективом, розкрито сучасні наукові концепції та підходи екологічної економіки та сталого лісового господарства. Особливу увагу звернено на можливості інтегрування цих концепцій у контексті вирішення еколого-економічних проблем гірських територій. Обґрунтовано шляхи досягнення сталого розвитку лісового господарства в умовах Українських Карпат.

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The Ukrainian language editor, Volodymyr Dudok, deserves special acknowledgement for his critical evaluations. Finally, we would like to thank to Mariana Dushna, UNFU Institute of Ecological Economics, for technical support throughout the editing process.

Preface

As Director of the Fulbright Program in Ukraine, it is with great pleasure that I write the preface to this important volume of essays on sustainable forest management in Ukraine and the Carpathian Mountains. I am pleased for a number of reasons. First, the volume brings together the work of a number of representatives of international organizations – universities, research institutes, NGOs, government agencies, natural resource planners and managers from four different countries - engaged in a topic very important to the future of our planet and to the present and future ecological health of Ukraine – the maintenance and sustainable development of forests and forest lands. Second, the effort is one that the Fulbright Program in Ukraine has actively supported since its establishment in 1991. To date eleven Ukrainian and U.S. students and scholars have been granted Fulbright awards in the Scholar, Faculty, Specialist, and Graduate Student programs in topics related to forestry, sustainable forest management, and forestry economics. Nearly another dozen have received awards to study a wide range of topics in ecological and environmental sciences in the U.S. and Ukraine. The Fulbright Program in Ukraine has also provided financial support for numerous seminars and conferences in these fields, and joined with the following organizations to support the *Atelier on Ecological Economics and Sustainable Forest Management in the Ukrainian Carpathians* and the publication of this volume. Partners included the Trust for Mutual Understanding; Pennsylvania State University, Woskob International Research in Agriculture Program; Institute of Ecological Economics, Ukrainian National Forestry University; Rubenstein School of Environment and Natural Resources and Gund Institute for Ecological Economics, both at the University of Vermont; and the U.S. Embassy in Ukraine.

The *Atelier*, held in Lviv and in locations throughout the Carpathian Mountains from September 22-October 1, 2007, was the platform for the presentation and discussion of many of the articles in this volume by a diverse gathering of stakeholders. Participates represented communities in the Ukrainian Carpathians; forest resource managers and forest industry; developers; non-governmental organizations; environmentalists and policymakers; local, state and federal government agencies; and scholars, students, and researchers. I was also privileged to be among those in attendance, albeit only for the first several days of the program.

The Carpathian Mountains are Europe's last great wilderness area, and are home to over half of the European population of wolves, bears and lynx. While the Carpathian Mountains in Ukraine constitute only 10 % of the entire Carpathian Mountain chain stretching across seven countries of Central and Eastern Europe and 3.5% of Ukraine's forest lands, the forests of the Ukrainian Carpathian Mountains have and will continue to play an important role in the historical, economic, social, and cultural development of the region and its peoples. These forests possess a number of unique characteristics, including the largest contiguous stand of old-growth European beech (*Fagus sylvatica*) forest in the world, designated in 2007 to the United Nations (UNESCO) List of World Cultural and Natural Heritage together with similar stands in Slovakia. The region has the highest degree of endemism in Europe; it harbors some of the last remaining populations of large European mammal species, including predators; and is home to the rich, traditions-based Ukrainian ethnographic sub-cultures of the peoples of the Hutsul, Boiko, Bukovyna, Transcarpathian, and Lemko regions.

For the past decade the Government of Ukraine has been actively working to protect these forests and to reform its forestry management bodies and regulations. In 2001, United Nations Environment Programme / Regional Office for Europe UNEP/ROE was requested by the Government of Ukraine to service a regional co-operation process aiming at the protection and sustainable development of the Carpathians. The result of this cooperation was the ratification by the governments of Ukraine and its six partner countries of the *Framework Convention on the Protection and Sustainable Development of the Carpathians*. It is within this context of international cooperation that the 2007 *Atelier on Ecological Economics and Sustainable Forest Management in the Ukrainian Carpathians* took place, largely through the initiative of a number of U.S. and Ukrainian Fulbright Program alumni and current Senior Specialists working on preserving the forests of Ukraine and promoting sustainable forest management policies through broad international co-operation. The Fulbright Program in Ukraine will continue to support these goals through our academic exchange programs and through the encouragement and support of the international collaborative activities of our U.S. and Ukrainian Fulbright alumni.

Myron O. Stachiw

Director, Fulbright Program in Ukraine
Kyiv, Ukraine
November 29, 2008

Introduction

Ecological economics is a relatively new field of knowledge that developed towards the end of 20th century during a period of great scientific and technological progress. Along with many benefits to humanity, technological progress brought large scale impacts to Earth's natural systems, including depletion of natural resources and degradation of the environment. Today, humankind is beginning to understand that market economics, in its classical form, is unable to solve global problems like the biodiversity crisis and the pressing need for environmentally sustainable development. Ecological economics is a trans-disciplinary science based on principles and methods of economic theory, integrated economics, ecology, and other natural and social sciences in applied in a novel approach.

The idea for this book was initiated during an atelier (or problem solving workshop) entitled *"Ecological Economics and Sustainable Forest Management in the Ukrainian Carpathian Mountains"* organized by the Gund Institute for Ecological Economics and the Rubenstein School of Environment and Natural Resources at the University of Vermont, and the Institute of Ecological Economics at the Ukrainian National Forestry University. The atelier was held from September 22nd through October 1st, 2007 in Lviv, Ukraine and in the Carpathian Mountains of western Ukraine. The atelier approach was successfully applied in Ukraine through the combination of theoretical presentations, intensive working group discussions of real ecological, economic, and social problems, and broad local stakeholder involvement throughout the process. The international atelier was devoted to the idea of introducing ecological economics principles into forest management in the Carpathian Mountains. It promoted mutual understanding among scientists from different countries, and facilitated advancement of new models of sustainable development for mountain territories. This is important because many of the challenges facing sustainable natural resource use in montane ecosystems are shared throughout mountain regions in Ukraine, Europe, and worldwide.

At the same time, the conceptual basis for formation and realization of sustainable development policies for a given region should be based on national strategies. These, in turn, should encourage socially conscious economic development in combination with protection and sustainable use of natural resources and the environment. According to views expressed in this book, national and regional sustainable development programs should be based on a unified natural (or ecological) and managerial (or economic) system, integrating ecological imperatives comprehensively into economic mechanisms and governance systems. Authorities at all levels of governance and the private sector should evaluate their activities based on both ecological and economic efficiency criteria. This means that a scientifically grounded approach to formulation and implementation of sustainable development policy should be based not on maximizing short term economic productivity but on long-term societal interests. Planning for economic production should anticipate and thereby avoid harmful environmental impacts, allowing rather for positive societal outcomes. Underestimation of the possible negative consequences of economically productive activities has the potential to accrue environmental externalities and the costs needed to recover destroyed ecological potential. Thus, there is a need for problem solving approaches that facilitate both economic productivity and environmental sustainability.

Ecological and economic sub-systems of the unified ecological-economic system are related by positive and negative feedback relationships. Development, stabilization, or degradation of one sub-system can have related influences on the other. Degradation of the ecological subsystem leads to degradation of economic subsystem and often vice versa. Therefore, every economic participant carries a financial responsibility for the ecological consequences of their activities and, at the same time, has a responsibility to minimize harmful influences on the environment and human health. Ecological economics as a discipline provides a basis for exploring these relationships and responsibilities.

This book presents ideas for integrating ecological economics and sustainable forest management using the Ukrainian Carpathian Mountains as a case study. We hope that this book will be useful for professionals, scholars, students, and everyone who is interested in sustainable forest management, which provides society with critical ecosystem goods and services.

Yuriy Y. Tunytsya

Rector, Ukrainian National Forestry University
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Lviv, Ukraine
December 15, 2008

Вступ

Екологічна економіка – це відносно нова наукова галузь, яка на вимогу часу сформувалася наприкінці XX ст. Побічним ефектом науково-технічного прогресу, попри позитивні зрушення, стало, як відомо, великомасштабне навантаження на природну систему Землі, виснаження її ресурсів і деградація природного життєвого середовища. Людство починає усвідомлювати, що ринкова економіка у класичному вияві нездатна вирішувати проблеми збереження життя і подальшого сталого розвитку цивілізації. Лише екологічна економіка, як міждисциплінарна наука, котра базується на принципах і методах економічної теорії, прикладної економіки, екології та інших природничих наук, спроможна дати відповідь на виклики цивілізації.

Ідея написання цієї книги визріла під час міжнародної науково-практичної конференції "Екологічна економіка і менеджмент сталого лісового господарства в Українських Карпатах", організованої Інститутами екологічної економіки Національного лісотехнічного університету України та Університету Вермонта у м. Львові, Сколе, Хусті, 22 вересня – 1 жовтня 2007 р.). Конференція, для вирізнення якої вживають слово "atelier", поруч із теоретичними викладами вперше в Україні запропонувала детальне ознайомлення з практичним застосуванням трансдисциплінарного підходу.

Міжнародна науково-практична конференція з проблем сталого розвитку лісового господарства Карпат на засадах екологічної економіки спонукала науковців із різних країн звернути погляди на потребу нових підходів до розроблення моделі сталого розвитку гірських регіонів, оскільки сучасні проблеми збалансованого використання й відтворення природо-ресурсного потенціалу Карпат характерні й для інших гористих територій України та Європи загалом.

Водночас розробленню концептуальних засад формування та реалізації політики сталого розвитку того чи іншого регіону повинна би передувати загальнонаціональна концепція сталого розвитку, метою якої є соціально спрямований економічний розвиток у поєднанні з охороною та раціональним використанням ресурсної бази і природного довкілля.

На наш погляд, національна та регіональні програми сталого розвитку мають базуватися на органічному поєднанні природної (екологічної) та господарської (економічної) систем, це потребує залучення екологічних імперативів в усі ланки господарського механізму та в систему управлінських структур. Усі без винятку владні й виробничі структури – центральні, регіональні, галузеві – повинні орієнтуватися на критерій еколого-економічної ефективності замість традиційного критерію економічної ефективності.

Це означає, що основою вироблення науково обґрунтованого підходу до формування та реалізації політики сталого розвитку мають бути не найближчі економічні результати виробничо-господарської діяльності, а довготривалі суспільні інтереси. Для планування виробничо-господарської діяльності треба уникати екологічних прорахунків, тобто непередбачуваних шкідливих наслідків змін природного довкілля, які можуть звести нанівець позитивні зрушення. Недооцінка можливих негативних наслідків впливу виробничо-господарської діяльності людини на природне довкілля повертається як додатковими витратами на відновлення зруйнованого екологічного потенціалу, так і на вирішення посталих проблем.

Між економічною та екологічною підсистемами єдиної еколого-економічної системи існує причинно-наслідкова кореляційна залежність. Розвиток, стабілізація та деградація однієї з них неминуче позначаються на іншій. Деградація екологічної підсистеми призводить до деградації економічної підсистеми. Тому усі суб'єкти господарювання мають нести економічну відповідальність за екологічні наслідки своєї діяльності та за якість продуктів споживання і, водночас, мати стимули до зменшення шкідливого впливу на природне життєве середовище і здоров'я людини. Такі критерії застосовують в екологічній економіці.

У запропонованій книзі відображено результати конкретних досліджень зазначеної проблематики на прикладі лісового господарства Українських Карпат. Сподіваємось, що вона стане корисною для фахівців, науковців і студентів, зрештою для усіх, хто цікавиться питаннями сталого розвитку однієї з суспільно важливих галузей економіки – лісового господарства.

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PART I

ECOLOGICAL ECONOMICS AS A TRANSDISCIPLINARY APPROACH TOWARDS SUSTAINABILITY

ЧАСТИНА І

ЕКОЛОГІЧНА ЕКОНОМІКА ЯК ТРАНСДИСЦИПЛІНАРНИЙ НАУКОВИЙ НАПРЯМ У КОНТЕКСТІ СТАЛОГО РОЗВИТКУ

Chapter 1

Ecological Economics: Creating a Sustainable and Desirable Future

Robert Costanza[1]

The economies of China and India are growing at an enormous clip. But they seem to be making all the same environmental mistakes that western countries made during their development – with a vengeance this time, given their enormous populations. And their "real" economic improvements, once the non-marketed costs of environmental and health damages are subtracted, may turn out to be negligible. Is this an inevitable by-product of development that they will eventually "grow out of"? Or is there something inherently wrong with the basic mainstream model of development? Is there a better way?

The mainstream model of development (also known as the "Washington consensus") is based on a number of assumptions about the way the world works, what the economy is, and what the economy is for (Table 1.1). These assumptions were created during a period when the world was still relatively empty of humans and their built infrastructure. In this "empty world" context, built capital was the limiting factor, while natural capital and social capital were abundant. It made sense, in that context, not to worry too much about environmental and social "externalities" since they could be assumed to be relatively small and ultimately solvable. It made sense to focus on the growth of the market economy, as measured by GDP, as a primary means to improve human welfare. It made sense, in that context, to think of the economy as only marketed goods and services and to think of the goal as increasing the amount of these goods and services produced and consumed.

But the world has changed dramatically. We now live in a world relatively full of humans and their built capital infrastructure. In this new context, we have to reconceptualize what the economy is and what it is for. We have to first remember that the goal of the economy is to sustainably improve human well-being and qual-

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ity of life. We have to remember that material consumption and GDP are merely means to that end, not ends in themselves. We have to recognize, as both ancient wisdom and new psychological research tell us, that material consumption beyond real need can actually reduce our well-being. We have to better understand what really does contribute to sustainable human well-being, and recognize the substantial contributions of natural and social capital, which are now the limiting factors to sustainable human well-being in many countries. We have to be able to distinguish between real poverty in terms of low quality of life, and merely low monetary income. Ultimately we have to create a new vision of what the economy is and what it is for, and a new model of development that acknowledges this new full world context and vision (Table 1.1).

Table 1.1 Basic characteristics of the current development model and the emerging sustainable and desirable "ecological economics" development model

	Current Development Model: the "Washington Consensus"	***Sustainable and Desirable Development Model: an emerging "Green Consensus"***
Primary policy goal	More: economic growth in the conventional sense, as measured by GDP. The assumption is that growth will ultimately allow the solution of all other problems. More is always better.	Better: Focus must shift from merely growth to "development" in the real sense of improvement in quality of life, recognizing that growth has negative by-products and more is not always better.
Primary measure of progress	GDP	GPI (or similar)
Scale/ carrying capacity	Not an issue since markets are assumed to be able to overcome any resource limits via new technology and substitutes for resources are always available	A primary concern as a determinant of ecological sustainability. Natural capital and ecosystem services are not infinitely substitutable and real limits exist
Distribution/ poverty	Lip service, but relegated to "politics" and a "trickle down" policy: a rising tide lifts all boats	A primary concern since it directly affects quality of life and social capital and in some very real senses is often exacerbated by growth: a too rapidly rising tide only lifts yachts, while swamping small boats
Economic efficiency/ allocation	The primary concern, but generally including only marketed goods and services (GDP) and institutions	A primary concern, but including both market and non-market goods and services and effects. Emphasizes the need to incorporate the value of natural and social capital to achieve true allocative efficiency
Property rights	Emphasis on private property and conventional markets	Emphasis on a balance of property rights regimes appropriate to the nature and scale of the system, and a linking of rights with responsibilities. A larger role for common property institutions in addition to private and state property
Role of Government	To be minimized and replaced with private and market institutions	A central role, including new functions as referee, facilitator and broker in a new suite of common asset institutions
Principles of Governance	Laissez faire market capitalism	Lisbon principles of sustainable governance

1.1 Some History

The World Bank (WB) and the International Monetary Fund (IMF), founded at the Bretton Woods conference at the end of World War II, were chartered to speed economic development, stabilize the world economy, and end poverty. These institutions have relied largely on "the Washington Consensus" as described above and in Table 1. The inability of these institutions and the World Trade Organization (WTO) to achieve their original goals of improving lives in the developing world and stabilizing the global economy has given rise to many critics, who are no longer marginalized voices of the displeased but include former World Bank economists, the G-77, and the thousands of people in borrowing countries that have taken to the streets in protest all over the world. These policies include removing barriers that check corporate access to a country's resources, often including the removal of social and environmental legislation. They are antithetical to the goal of developing in a way that is sustainable and equitable. They are by no means a "consensus", but rather dictates of a few powerful countries and their attendant organizations. Driven by lending countries and their economists, borrowing nations have had little say in policies attached to loans – cuts to government salaries, and privatizing social services. In short, the execution of this model of development has led to unemployment, falling worker wages, biodiversity loss, environmental degradation, and disintegration of the social fabric. For example, the conditional loans foisted on many Latin American countries resulted in massive unemployment and devastating economic crises.

Critics of the current model are many, and a coherent and viable alternative is sorely needed. Here I sketch a new model of development based on the world view and principles of ecological economics – the idea that growth and development are not always linked and that true development must be defined in terms of the improvement of quality of life, not merely improvement in material consumption.

1.2 Quality of Life, Happiness, and the Real Economy

There is a substantial body of new research on what actually contributes to human well-being and quality of life. This new "science of happiness" clearly demonstrates the limits of conventional economic income and consumption in contributing to well-being. Psychologist Tim Kasser in his 2003 book "The High Price of Materalism" points out, for instance, that people who focus on material consumption as a path to happiness are actually less happy and even suffer higher rates of both physical and mental illnesses than those who do not. Material consumption beyond real need is a form of psychological "junk food" that only satisfies for the moment and ultimately leads to depression, Kasser says.

Economist Richard Easterlin, has shown that well-being tends to correlate well with health, level of education, and marital status, and not very well with income beyond a certain fairly low threshold. He concludes in a recent paper in the *Proceedings of the National Academy of Sciences* that, "People make decisions assuming that more income, comfort, and positional goods will make them happier, failing to recognize that hedonic adaptation and social comparison will come into play, raise their aspirations to about the same extent as their actual gains, and leave them feeling no happier than before. As a result, most individuals spend a disproportionate amount of their lives working to make money, and sacrifice family life and health, domains in which aspirations remain fairly constant as actual circumstances change, and where the attainment of one's goals has a more lasting impact on happiness. Hence, a reallocation of time in favor of family life and health would, on average, increase individual happiness." British economist Richard Layard's 2005 book: "Happiness: lessons from a new science," synthesizes many of these ideas and concludes that current economic policies are not improving happiness and that "happiness should become the goal of policy, and the progress of national happiness should be measured and analyzed as closely as the growth of GNP."

Economist Robert Frank, in his 2000 book "Luxury Fever," also concludes that some nations would be better off – overall national well-being would be higher, that is – if we actually consumed less and spent more time with family and friends, working for our communities, maintaining our physical and mental health, and enjoying nature.

On this last point, there is substantial and growing evidence that natural systems contribute heavily to human well-being. In a paper published in 1997 in the journal *Nature*, my co-authors and I estimated the annual, non-market value of the earth's ecosystem services at substantially larger than global GDP. The recent UN Millennium Ecosystem Assessment is a global update and compendium of ecosystem services and their contributions to human well-being.

So, if we want to assess the "real" economy – all the things which contribute to real, sustainable, human well-being – as opposed to only the "market" economy, we have to measure and include the non-marketed contributions to human well-being from nature, from family, friends and other social relationships at many scales, and from health and education. One convenient way to summarize these contributions is to group them into four basic types of capital that are necessary to support the real, human-well-being-producing economy: built capital, human capital, social capital, and natural capital.

The market economy covers mainly built capital (factories, offices, and other built infrastructure and their products) and part of human capital (spending on labor, health and education), with some limited spillover into the other two. Human capital includes the health, knowledge, and all the other attributes of individual humans that allow them to function in a complex society. Social capital includes all the formal and informal networks among people: family, friends, and neighbors, as well as social institutions at all levels, like churches, social clubs, local, state, and national governments, NGO's, and international organizations. Natural capital includes the world's ecosystems and all the services they provide. Ecosystem services occur at many scales, from climate regulation at the global scale, to flood protection, soil formation, nutrient cycling, recreation, and aesthetic services at the local and regional scales.

1.3 Ecosystem Services

There is substantial and growing evidence that natural capital and ecosystem services contribute heavily to human well-being. In a paper published in 1997 in the journal *Nature*, my co-workers and I estimated that the annual, nonmarket value of the Earth's ecosystem services was at least $33 trillion globally, substantially larger than global GDP at the time. The recent UN Millennium Ecosystem Assessment is a global update and compendium of ecosystem services and their contributions to human well-being. This implies that the *real* economy, all those assets that contribute to human well-being, has major components that are outside the market in the form of natural and social capital.

In a paper published in the journal *Science*, Andrew Balmford, myself and several colleagues estimated that the overall benefit: cost ratio of an effective global program for the conservation of remaining natural capital is at least 100:1. This program consisted of expanding protected areas to cover 15 % of the land surface (from about 6 % currently) and 30 % of the ocean surface (from almost zero currently). The cost of such a program was estimated to be around $45 Billion/yr, but the benefits, in terms of the difference between the value of ecosystem services in the "wild" state minus the value of the most likely human-dominated alternative land use, was at least $4-5 Trillion/yr.

1.4 Agriculture and Ecosystem Services

In addition to preserving and restoring ecosystem services from natural ecosystems, we can make significant progress by *restoring and improving* ecosystem services in agro-ecosystems, without decreasing crop production. Agricultural landscapes represent a unique mix of natural and human-made capital. How these elements interact determines their overall productivity, value, and sustainability. Modern industrial agriculture has tended to ignore those ecosystem services that do not directly benefit crop production and which are external to the market, leading to significantly lower total social value than an approach which recognizes the value of ecosystem services from agricultural landscapes and tries to optimize that value in combination with marketable outputs. A better approach is one focused on the *total asset value* of the landscape (including both natural and human-made capital). Such an approach is more complex, biodiverse and sociodiverse, is less dependent on external subsidies of fuel, fertilizer, water, and machinery, and is more resilient.

Agro-ecosystem services have not been as well studied as services from natural ecosystems, but because of the large area of cropland around the world, improvements here can make a huge difference. For example, the total global cropland area has been estimated by Jon Foley and colleagues to be about 1.8 billion ha. If we can double the average ecosystem service value of these areas from $1000/ha/yr to $2000/ha/yr, with minimal to positive effects on crop production and value (a very viable goal I think) then we can increase the value of global ecosystem services by \$1.8 Trillion/yr

Establishing common property trusts for the public goods elements of agricultural landscapes and systems of payment for ecosystem services provided by agricultural landscapes can help achieve the desired transition.

1.5 Are We Really Making Progress?

Given these definitions of the real economy, are we really making progress? Is the mainstream development model really working, even in the "developed" countries? One way to tell is through surveys of people's life satisfaction, which have been relatively flat in the US and many other developed countries since about 1975. A second approach is an aggregate measure of the real economy that has been developed as an alternative to GDP called the Genuine Progress Indicator, or GPI.

Let's first take a quick look at the problems with GDP as a measure of true human well-being. GDP is not only limited – measuring only marketed economic activity or gross income – it also counts all of this activity as positive. It does not separate desirable, well-being-enhancing activity from undesirable well-being-reducing activity. For example, an oil spill increases GDP because someone has to clean it up, but it obviously detracts from society's well-being. From the perspective of GDP, more crime, more sickness, more war, more pollution, more fires, storms, and pestilence are all potentially good things, because they can increase marketed activity in the economy.

GDP also leaves out many things that *do* enhance well-being but are outside the market. For example, the unpaid work of parents caring for their own children at home doesn't show up, but if these same parents decide to work outside the home to pay for child care, GDP suddenly increases. The non-marketed work of natural capital in providing clean air and water, food, natural resources, and other ecosystem services doesn't adequately show up in GDP, either, but if those services are damaged and we have to pay to fix or replace them, then GDP suddenly increases. Finally, GDP takes no account of the distribution of income among individuals. But it is well-known that an additional \$1 worth of income produces more well-being if one is poor rather than rich. It is also clear that a highly skewed income distribution has negative effects on a society's social capital.

The GPI addresses these problems by separating the positive from the negative components of marketed economic activity, adding in estimates of the value of non-marketed goods and services provided by natural, human, and social capital, and adjusting for income-distribution effects. While it is by no means a perfect representation of the real well-being of nations, GPI is a much better approximation than GDP. As Amartya Sen and others have noted, it is much better to be approximately right in these measures than precisely wrong.

Comparing GDP and GPI for the US shows that, while GDP has steadily increased since 1950, with the occasional dip or recession, GPI peaked in about 1975 and has been flat or gradually decreasing ever since. From the perspective of the real economy, as opposed to just the market economy, the U.S. has been in recession since 1975. As already mentioned, this picture is also consistent with survey-based research on people's stated life-satisfaction. The US and several other developed countries are now in a period of what Herman Daly has called "uneconomic growth," where further growth in marketed economic activity (GDP) is actually reducing well-being on balance rather than enhancing it. In terms of the four capitals, while built capital has grown, human, social and natural capital have declined or remained constant and more than cancelled out the gains in built capital.

Is this really the model of development that "developing" countries should aspire to?

1.6 A New Sustainable, Ecological Model of Development

A new model of development consistent with our new full world context (Table 1.1) would be based clearly on the goal of sustainable human well-being. It would use measures of progress that clearly acknowledge this goal (i.e. GPI instead of GDP). It would acknowledge the importance of ecological sustainability, social fairness, and real economic efficiency.

Ecological sustainability implies recognizing that natural and social capital are not infinitely substitutable for built and human capital, and that real biophysical limits exist to the expansion of the market economy. Climate change is perhaps the most obvious and compelling of these limits.

Social fairness implies recognizing that the distribution of wealth is an important determinant of social capital and quality of life. The conventional development model, while explicitly aimed at reducing poverty, has bought into the assumption that the best way to do this is through growth in GDP. This has not proven to be the case and explicit attention to distribution issues is sorely needed. As Robert Frank has argued in his latest book: *Falling behind: how rising inequality harms the middle class*, economic growth beyond a certain point sets up a "positional arms race" that changes the consumption context and forces everyone to consume too much of positional goods (like houses and cars) at the expense of non-marketed, non-positional goods and services from natural and social capital. Increasing inequality of income actually reduces overall societal well-being, not just for the poor, but across the income spectrum.

Real economic efficiency implies including all resources that affect sustainable human well-being in the allocation system, not just marketed goods and services. Our current market al.location system excludes most non-marketed natural and social capital assets and services that are huge contributors to human well-being. The current development model ignores this and therefore does not achieve real economic efficiency. A new, sustainable ecological development model would measure and include the contributions of natural and social capital and could better approximate real economic efficiency.

The new development model would also acknowledge that a complex range of property rights regimes are necessary to adequately manage the full range of resources that contribute to human well-being. For example, most natural and social capital assets are public goods. Making them private property does not work well. On the other hand, leaving them as open access resources (with no property rights) does not work well either. What is needed is a third way to *propertize* these resources without privatizing them. Several new (and old) common property rights systems have been proposed to achieve this goal, including various forms of common property trusts.

The role of government also needs to be reinvented. In addition to government's role in regulating and policing the private market economy, it has a significant role to play in expanding the "commons sector", that can propertize and manage non-marketed natural and social capital assets. It also has a major role to play as facilitator of societal development of a shared vision of what a sustainable and desirable future would look like. As Tom Prugh, myself, and Herman Daly have argued in our book "The Local Politics of Global Sustainability," strong democracy based on developing a shared vision is an essential prerequisite to building a sustainable and desirable future. This new vision implies a core set of principles for sustainable governance.

1.7 Principles of Sustainable Governance

The key to achieving sustainable governance in the new full world context is an integrated (across disciplines, stakeholder groups, and generations) approach based on the paradigm of "adaptive management," whereby policy-making is an iterative experiment acknowledging uncertainty, rather than a static "answer". Within this paradigm, my colleagues and I, in a paper published in *Science* in 1998, identified six core principles (the Lisbon principles) that embody the essential criteria for sustainable governance. Some of them are already well accepted in the international community (for example, Principle 3); others are variations on well-known themes (for example, Principle 2 is an extension of the subsidiary principle); while others are relatively new in international policy, although they have been well developed elsewhere (for example, Principle 4). The six Principles together form an indivisible collection of basic guidelines governing the use of common natural and social capital assets.

- *Principle 1: Responsibility.* Access to common asset resources carries attendant responsibilities to use them in an ecologically sustainable, economically efficient, and socially fair manner. Individual and corporate responsibilities and incentives should be aligned with each other and with broad social and ecological goals.
- *Principle 2: Scale-matching.* Problems of managing natural and social capital assets are rarely confined to a single scale. Decision-making should (i) be assigned to institutional levels that maximize input, (ii) ensure the flow of information between institutional levels, (iii) take ownership and actors into account, and (iv) internalize costs and benefits. Appropriate scales of governance will be those that have the most relevant information, can respond quickly and efficiently, and are able to integrate across scale boundaries.

- *Principle 3: Precaution.* In the face of uncertainty about potentially irreversible impacts to natural and social capital assets, decisions concerning their use should err on the side of caution. The burden of proof should shift to those whose activities potentially damage natural and social capital.
- *Principle 4: Adaptive management.* Given that some level of uncertainty always exists in common asset management, decision-makers should continuously gather and integrate appropriate ecological, social, and economic information with the goal of adaptive improvement.
- *Principle 5: Full cost allocation*. All of the internal and external costs and benefits, including social and ecological, of alternative decisions concerning the use of natural and social capital should be identified and allocated. When appropriate, markets should be adjusted to reflect full costs.
- *Principle 6: Participation.* All stakeholders should be engaged in the formulation and implementation of decisions concerning natural and social capital assets. Full stakeholder awareness and participation contributes to credible, accepted rules that identify and assign the corresponding responsibilities appropriately.

1.8 Some Policies to Achieve Real, Sustainable Development

The conventional development model is not working, for either the developed or the developing world. It is not sustainable and it is also not desirable. It is based on a now obsolete empty world vision and it is leading us to disaster.

We need to accept that we now live in a full world context where natural and social capital are the limiting factors. We could achieve a much higher quality of life, and one that would be ecologically sustainable, socially fair, and economically efficient, if we shift to a new sustainable development paradigm that incorporates these principles.

The problem is that our entire modern global civilization is, as even President Bush has acknowledged, "addicted to oil" and addicted to consumption and the conventional development model in general. An addictive substance is something one has developed a dependence on, which is either not necessary or harmful to one's longer-term well-being. Fossil fuels (and excessive material consumption in general) fit the bill. We can power our economies with renewable energy, and we can be happier with lower levels of consumption, but we must first break our addiction to fossil fuels, consumption, and the conventional development model, and as any addict can tell you: "that ain't easy." But in order to break an addiction of any kind, one must first clearly see the benefits of breaking it, and the costs of remaining addicted, facts that accumulating studies like the IPCC reports, the Stern Review, the Millennium Ecosystem Assessment and many others are making more apparent every day.

What else can we do to help break this addiction? Here are just a few suggestions.

- Create and share a vision of a future with zero fossil fuel use and a quality of life higher than today. That will involve understanding that GDP is a means to an end, not the end itself, and that in some countries today more GDP actually

results in less human well-being. It will require an entirely new and broader vision of what the economy is, what it's for, and how it functions.
- Convene a "new Bretton Woods" conference to establish the new measures and institutions needed to replace GDP, the World Bank, the IMF, and the WTO. These new institutions would promote:
- Shifting primary national policy goals from increasing marketed economic activity (GDP) to maximizing national well-being (GPI or something similar). This would allow us to see the interconnections between built, human, social, and natural capital and build well-being in a balanced and sustainable way.
- Reforming tax systems to send the right incentives by taxing negatives (pollution, depletion of natural capital, overconsumption) rather than positives (labor, savings, investment).
- Expanding the commons sector by developing new institutions that can propertize the commons without privatizing them. Examples include various forms of common asset trusts, like the atmospheric (or sky) trust proposed by Peter Barnes coupled with payments for depletion of natural and social capital and rewards for protection of these assets.
- Reforming international trade to promote well-being over mere GDP growth. This implies protecting natural capital, labor rights, and democratic self-determination first and *then* allowing trade, rather than promoting the current trade rules that ride roughshod over all other societal values and ignore non-market contributions to well-being.

We can break our addiction to fossil fuels, overconsumption, and the current development model and create a more sustainable and desirable future. It will not be easy, it will require a new vision, new measures, and new institutions. It will require a redesign of our entire society. But it is not a sacrifice of quality of life to break this addiction. Quite the contrary, it is a sacrifice not to.

Екологічна економіка: творення сталого і бажаного майбутнього

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Домінуюча модель розвитку (також знана як "Вашингтонський консенсус") базується на низці припущень стосовно того, яким чином функціонує світ, чим є економіка і навіщо вона потрібна. Ці припущення сформувались впродовж періоду, коли світ був відносно ненаповненим людьми та їхню рукотворною інфраструктурою. У контексті цього "порожнього світу", рукотворний капітал був обмежувальним чинником, тоді як природний і соціальний капітал були у надлишку. У такому контексті логічним здавалось не переййматись надміру екологічними та соціальними зовнішніми ефектами, оскільки вони були передбачуваними, відносно невеликими і зазвичай вирішуваними.

У наш час ситуація кардинально змінилася. Ми живемо у світі, відносно наповненому людьми і їхніми інфраструктурами рукотворного капіталу. У цьому новому контексті мусимо концептуально переосмислити поняття і призначення економіки. Нова модель економіки, відповідна контексту "наповненого світу", повинна базуватись на засадах сталого людського добробуту. Для виміру прогресу потрібно застосовувати показники, які чітко визнають цю мету (тобто індекс справжнього прогресу GPI замість ВНП). У цій моделі має бути дотримано вимог екологічної сталості, соціальної справедливості та реальної економічної ефективності.

Якщо ми хочемо оцінити "реальну економіку" – всі аспекти внеску у реальний, сталий людський добробут – на противагу до суто ринкової економіки, тоді ми повинні оцінити та врахувати всі неринкові аспекти людського добробуту, пов'язані з природою, сім'єю, друзями та інші соціальні стосунки на багатьох рівнях – від здоров'я до освіти. Для того, щоб їх згрупувати, доречно виділити чотири типи капіталу, потрібні для підтримки справжньої, спрямованої на творення людського добробуту економіки: рукотворний, людський, соціальний і природний капітал.

Ми можемо позбутись залежності від надмірного споживання викопних паливних ресурсів та навіть від сучасної моделі розвитку і створити більш стале і бажане майбутнє. Це потребує нового бачення, нових заходів, нових інституцій та перебудови всього суспільства.

Chapter 2

Ecological Economics and Sustainable Forest Management

Joshua Farley[1]

Abstract Ecological economics and sustainable forest management both focus on the problem of allocating ecosystem structure among the economic and ecological benefits it can provide, now and in the future. Generally speaking, economic products derived from forests have fundamentally different physical characteristics from the ecological benefits they provide. In particular, timber and land can be exclusively owned, and use by one person leaves less for others to use. Many forest services in contrast cannot be exclusively owned, and one person's use does not leave less for others. Market forces play a large role in determining how forests are managed, and owing to the physical characteristics of forest resources, systematically favor the conversion of forest structure to economic products over its conservation for forest services. Markets also fail to signal the increasing scarcity of forest services and their rising marginal value. This chapter argues that optimal management/allocation methods for forests should be based on the physical characteristics of forest resources, and concludes that under current conditions, management by a common asset trust may well prove more sustainable, just and efficient than private management. In transition from a centrally controlled to a market economy, Ukraine has a unique to decide what are the most desirable ends of forest management and, given the physical characteristics of forest resources, what allocation mechanism is best suited to achieve these ends.

2.1 Introduction

The central problem in economics is how to allocate scarce resources among alternative desirable ends – how do we take what we have to achieve what we want?

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One could view the central problem in forest management in a similar fashion– how should forest resources be allocated among the many different benefits that forests can provide (Boyce 1997). To solve this problem, we must first determine what are the desirable ends to be pursued. Once desirable ends have been established, we must determine what scarce resources are required to attain them, and what are the physical and institutional characteristics of those resources relevant to allocation. How we ultimately allocate resources should depend on the answers to these earlier questions (Daly & Farley 2004).

Historically the market economic system has focused on how to allocate the raw materials provided by nature among different economic products in a way that maximizes monetary value, a proxy for utility. Traditional forest managers sought to maximize timber production or the net present monetary value of timber harvests, under the assumption that timber was the most desirable end use (Faustmann, 1849); while there are growing efforts to manage forests for non-timber benefits and legal and social requirements invariably mandate provision of non-market benefits, most management strategies still prioritize timber (Franklin 1997). Economists maintain that markets in theory will allocate timber from a forest towards the most valuable economic products, then allocate those products towards the consumers that value them most, achieving the goals of capitalist economics and traditional forestry.

The fact is however that the nature of scarcity changes over time. Since the dawn of the industrial revolution, human made goods and services have grown increasingly abundant, and the goods and services provided by nature increasingly scarce; for example, most houses today are much larger than houses from 200 years ago, and most forests much smaller. However, goods and services generated by nature have fundamentally different physical characteristics from those produced by humans, and, therefore, require different management strategies and allocative mechanisms. Economic systems and forest management must evolve in response to the evolving nature of scarcity (Daly & Farley 2004; Gowdy 1994; Norgaard 1994).

In forestry there is now a growing trend towards sustainable forest management (SFM), which seeks to manage forests ecosystems for the most desirable combination of numerous ecosystem goods and services, now and into the future, of which timber is only one. Unfortunately, economics for the most part remains trapped in the antiquated paradigm of market al.location to continuously increase consumption of market goods, and economic forces play a powerful role in determining how forests are managed. In may not be possible for SFM to emerge without dramatic changes in the market economy.

The Ukraine currently confronts the problem of deciding how to manage its forest resources in a rapidly evolving global economy (Nijnik 2001). The goal of this chapter is to help suggest appropriate allocation mechanisms for Ukraine's forests based on a careful assessment of the desired ends of forest management and the physical and institutional characteristics of its forest resources. We will use the example of forests to show how the nature of the scarcest resources has changed over the past centuries, while economic systems have failed to keep pace with these changes. As a result, the globally dominant market economy threatens to grossly misallocate many critical resources, including forests.

The inherent complexity of the ecological economic system, however, is such that a simple academic analysis of the forest economic problem is ultimately inadequate. While such analysis may serve to identify a variety of desirable ends, it cannot reveal the relative values of these ends to Ukraine's citizens. The simple analysis in this chapter also fails to consider the informal institutions that may influence forest allocation. In recognition of these constraints, the analysis in this chapter was primarily intended to provide useful background information for a problem-based transdisciplinary workshop/field-course on ecological economics and sustainable forest management in the Ukraine, known as a scientific atelier (Farley et al. 2005). This scientific atelier was designed to draw on insights from academia, government, business and civil-society stakeholders while integrating teaching, research and service. The atelier process and its results are described in chapter?.

2.2 Forest Economics on a Finite Planet

Forests can be managed in many different ways for many different desirable ends. One could strive to maximize raw material production, annual sustainable profits, net present value, or the contributions to human quality of life of a whole suite of ecological, social and environmental benefits generated by forest ecosystems and the land to which they can be converted. It is also possible to manage forests for the benefit of other species besides humans. In order to determine the best way to allocate forest resources, we must carefully examine the benefits they provide as well as their physical characteristics.

2.2.1 The Desirable Ends of Forest Resources: Ecosystem Goods and Services

There are three fundamentally different types of benefits that can be provided by forest ecosystems, each with different physical and institutional characteristics.

In the first place, forests provide a stock of raw materials, such as timber and non-timber forest products, which can be converted into a flow of benefits. We refer to these as ecosystem goods, or stock-flow resources (Georgescu-Roegen 1971). For many years, economists and forest managers focused primarily on timber harvests.

A second category of benefits provided by forests is known as ecosystem services, which are generally defined as the benefits people obtain from ecosystems. We can think of the forest as a fund that supplies a flux of ecosystem services over time; fund-flux resources (Georgescu-Roegen 1971). Ecosystem services are frequently split into four categories: "provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling." (Millennium Ecosystem Assessment 2005). Within these categories, the literature generally lists from 17 to 24 specific services, but these lists are far from comprehensive, as we often only discover a specific service after destroying the species or ecosystem that provides it (Farley 2008; Vatn & Bromley 1994). Over 100 years ago, Gifford Pinchot, founder and chief of the United States Forest Service, recognized that forests should be managed for both timber and other values, (Pinchot 1947). Economists in contrast paid little attention to the value of these services until the 1960s, and many still believe their values are minor (as discussed in Dasgupta 2008). Table 2.1 provides a partial list of ecosystem services generated by forests.

Table 2.1 Ecosystem services provided by forests (adapted from Costanza et al. 1997; Daly & Farley 2004; and Millennium Ecosystem Assessment 2005)

Ecosystem Services Provided by Forests	
Regulation services	
Gas Regulation	Trees store CO_2 and growing trees create O_2, forests can clean SO_x from the atmosphere.
Climate Regulation	Greenhouse gas regulation; evapotranspiration and subsequent transport of stored heat energy to other regions by wind; evapotranspiration, cloud formation and local rainfall; affects of shade and insulation on local humidity and temperature extremes.
Disturbance Regulation	Storm protection, flood control (see water regulation), drought recovery and other aspects of habitat response to environmental variability mainly controlled by vegetation structure.
Water Regulation	Tree roots aerate soil, allowing it to absorb water during rains and release it during dry times, reducing the risk and severity of both droughts and floods.
Waste absorption capacity	Forests can absorb large amounts of organic waste, and clean SOx from the atmosphere. Some plants absorb heavy metals.
Biological control	Forests harbor vertebrates, insects, fungi, bacteria and other species that eat or otherwise destroy a number of pest species
Pollination	Forests harbor a plethora of insects necessary for fertilizing wild and domestic species.
Erosion control & sediment retention	Trees hold soil in place, forest canopies diminish impact of torrential rainstorms on soils, diminish wind erosion
Provisioning services	
Water supply	Evapotranspiration can increase local rainfall. Forests can reduce erosion and hold stream banks in place, preventing siltation of in stream springs and increasing water flow.
Supply of timber and non-timber forest products, including wild animals	The ability of forests to reproduce their structural components.
Supply of biochemicals and genetic resources	Forests are sources for unique biological materials and products, such as medicines, genes for resistance to plant pathogens and crop pests, ornamental species, etc.

Supporting services	
Soil formation	Tree roots grind rocks and decaying vegetation adds organic matter.
Nutrient cycling	Tropical forests in particular are characterized by rapid assimilation of decayed material, allowing little time for nutrients to run off into streams and be flushed from the system.
Refugia or habitat	Forests provide habitat for migratory and resident species, and create conditions essential for the reproduction of many of the species they contain
Cultural services and information	
Genetic resources	Forests are sources for unique biological materials and products, such as medicines, genes for resistance to plant pathogens and crop pests, ornamental species, etc.
Recreation	Eco-tourism, hiking, biking, etc.
Cultural	Aesthetic, artistic, educational, spiritual and/or scientific values of forest ecosystems.

A third option is to convert forests to alternative land uses such as agriculture, housing and so on, or clear them in order to extract minerals that lie below them.

All of these benefits provided by forests are instrumental to achieving higher order ends. Conventional economists seek to maximize economic surplus, for which gross national product (GNP) conventionally serves as a proxy measure. For forests, economic surplus, roughly speaking, can be taken as the net present market value of final forest goods and services. Conventional economists and conventional forest managers have quite similar goals.

The emerging fields of sustainable forest management (SFM) and ecological economics (EE) in contrast seek to manage forests as intact ecosystems capable of supplying a broad array of market and non-market goods and services to humans and other species for the indefinite future (Daly & Farley 2004; Kimmins 2007). Ecological economists are perhaps more explicit than sustainable forest managers in identifying the desirable end as the best possible quality of life for this and future generations, for both humans and other species. To achieve this goal, forests must be used sustainably and their benefits must be distributed fairly. We must, therefore, carefully assess the physical characteristics of forest resources.

2.2.2 The Physical Characteristics of Forest Resources

Forest goods and services exhibit fundamentally different physical characteristics. We can think of forest goods – the raw materials they provide – as stock-flow resources, and of forest services as fund-flux resources (Georgescu-Roegen 1971). The other uses to which forests can be converted are also fund-flux in nature. We can consider five distinctly different physical characteristics of these two classes of resources that are highly relevant to economic allocation.

First, stock-flow resources are physically transformed through the act of production, and embodied into what is produced: timber for example can be transformed into a house, into furniture, or into fuel. This means that use by one person diminishes the amount available for use by another person, which in economic jargon means it is rival in consumption. In contrast, forests are not physically transformed in the process of producing ecosystem services, nor are the services physically transformed into the benefits they provide. For example, when a forest regulates water flows to prevent flooding (a regulating service), or generates the seeds necessary to reproduce (a provisioning service) the forest is not used up in the process. Fund-flux resources in general are worn out through the act of producing the services they generate rather than used up like stock-flow resources – a house for example wears out as it provides us with the service of shelter, but timber is used up when converted into a house. Forests however are not 'worn out' when they regulate water flows, provide habitat, or generate seeds, and in the absence of human intervention maintain this capacity to generate services by continuously capturing solar energy. For most ecosystem services, use by one person does not diminish the amount available for use by another person. For example, if a forested watershed protects my house from flooding during a storm event, it does not reduce the amount of flood protection left for my neighbor. In economic jargon, such ecosystem services are non-rival in consumption. When forests are converted to other land uses, however, the fund-fluxes those uses generate generally are rival. All stock-flow resources are rival, and all non-rival resources are fund-service, but not vice versa (Farley in press-a).

Second, it is often possible to create institutions that can prevent people from using stock-flow resources. In economic jargon, when such institutions are in place, the resource is excludable. When there are no institutions in place to make something excludable, or institutions exist but are not enforced, market institutions are unlikely to protect or provide the resource. For example, where no institutions exist capable of preventing anyone who wants to from harvesting timber from a forest, the typical result is harvest rates beyond the regeneration rate of the forest (Bromley 1991; Hardin 1968). Individuals may realize that this will eventually lead to the loss of the forest, but those who refrain from harvesting to protect future productivity shoulder all the costs of reduced harvest while sharing the benefits of future harvests with all others. While it is generally simple to create and enforce institutions that make stock-flow forest resources excludable, it can be quite difficult or impossible to create institutions that can prevent people from using ecosystem services (Daly & Farley 2004). For example, evidence suggests that some forests help regulate rainfall and local climates, and it is essentially impossible to prevent people living in a region from benefiting from these services. In economic jargon, many ecosystem services are non-excludable. If people cannot be prevented from using a service whether or not they pay for the service, they are unlikely to pay. Markets will not determine a price, and there will no market signal of increasing scarcity of non-excludable services (Farnsworth et al. 1983). Even if non-excludable forest services are more valuable to society than excludable forest goods, markets provide an incentive to harvest forest structure for sale rather than preserving forest services for the social good. When forests are converted to other land uses (e.g. farming or housing), the fund-fluxes those uses generate generally are also excludable, providing additional incentives to convert.

Third, stock flow resources can be stockpiled. We can stockpile timber as healthy trees in a forest, or as logs in a lumberyard. In contrast, fund-flux resources cannot be stockpiled. For example, a forested watershed may be capable of absorbing a certain amount of rainfall per day, thus buffering against flood events. If the region remains dry for a month, however, the forest cannot then absorb 30 times as much rain at the end of that month.

Fourth, and related to our third point, we decide the rate at which we want to use stock-flow resources – we can clearcut our forests today to provide timber for housing, or harvest small amounts periodically. In contrast, ecosystem services are provided at a given rate over time over which we have minimal control short of changing the size or quality of the fund (Daly & Farley 2004; Georgescu-Roegen 1971).

Fifth, there is little uncertainty concerning stock-flow resources – we know how many cubic meters of timber exist in a forest, and can estimate its rate of reproduction under current conditions. In contrast, there is considerable uncertainty concerning ecosystem services, as we often know very little about how they are generated and the impacts of human activities on their provision, and whether or not critical thresholds exists beyond which the system can no longer provide them (Farley et al. 2005).

As a result of their physical characteristics, stock flow resources fit nicely into the market model. In contrast, fund-flux services provided by forests typically have no market price and thus fail to fit the market model. Conventional economics fails to meaningfully distinguish between stock-flow and fund-service resources in spite of their dramatically different physical properties.

2.2.3 The Relationship between Stock-Flow and Fund Service: The Laws of Physics and Ecology

As we know from the first law of thermodynamics, it is impossible to make something from nothing. All economic production requires the transformation of resources provided by nature. Forests are a valuable source of raw materials, ranging from timber and non-timber forest products (NTFPs) to the valuable minerals that are often found beneath their soils. We know from the second law of thermodynamics that low entropy energy is required to do work, so all economic production requires energy. Fossil fuels are clearly the dominant form of energy in modern society, but as these fuels are depleted and their prices rise, forests will become an increasingly attractive energy source. Both raw materials and energy of course are stock-flow resources. The laws of thermodynamics also tell us that you can't make something from nothing, and that all economic production ultimately increases entropy. In other words, economic production inevitably creates high entropy wastes which must return to our global ecosystems. Forests can play an important role in absorbing wastes, such as nitrogen, phosphorous, sulphur dioxide, and carbon dioxide, though when flow rates exceed absorptive capacities, serious problems can occur.

Furthermore, we know from the laws of ecology that everything is connected to everything else, everything must go somewhere, nature knows best, and there is no such thing as a free lunch (Commoner 1971). All species in a forest interact as an interconnected system. The raw materials converted into economic products alternatively serve as the structural building blocks of forest ecosystems. Special configurations of forest structure generate forest function; those functions of value to humans are known as ecosystem services and include vital life supporting services essential to human society. In nature's solar powered systems, there is no such thing as waste, but a fossil fuel powered economy increases entropy faster than solar power can reduce it, resulting in a steady flow of high-entropy waste back into the environment. When we deplete, degrade, pollute or otherwise alter the ecosystem structure of forests, we generally damage ecosystem services. In fact, any human intervention in forest systems, fine tuned by natural selection for eons, is generally detrimental to ecosystem function. If forests are degraded too much, they may even lose the capacity to regenerate themselves, potentially leading to a catastrophic collapse of both forest services and raw materials (Farley in press-b).

2.2.4 Spatial Distribution of Forest Services

When deciding how to allocate, we must also pay attention to the spatial distribution of ecosystem services. Some services are only available *in situ*, and must be used where they are generated. Services in this category include micro-climate regulation (shade, windbreaks, and humidity and temperature regulation), soil formation, some types of nutrient cycling, and so on. Provisioning services are typically only available *in situ* (with the exception of migratory species) but the raw food, fiber and fuel provided can frequently be harvested and shipped to where they are needed. Many recreational and aesthetic values of forests are only available in situ, but beneficiaries such as tourists can flow to the service.

Services can alternatively be omni-directional or directional flow related. Local services with a directional flow include the role of forested watersheds in regulating water quantity and quality, with direct benefits such as flood control accruing to those in very specific downstream regions. Another example is the role of forests in protecting against natural disturbances, such as storms, by slowing wind and water. Forests can also generate regional flow related benefits, such as regulation of regional rainfall patterns, or the provision of habitat for migrating species. Local omni-directional services include pollination, some types of waste absorption, and so on. Global omni-directional benefits include global climate regulation, carbon sequestration, existence values, and so on (Boumans & Costanza 2007; Farley 2008).

2.2.5 How do We Allocate?

With some understanding of the desirable ends and the physical and institutional characteristics of forest resources, we can now turn to the problem of allocation. Transition economies such as the Ukraine are in a somewhat unique position concerning allocation – they have not yet fully abandoned social ownership of the means of production (i.e. socialism) nor fully adopted private ownership of the means of production (i.e. capitalism). Ukraine has experienced first hand the problems inherent to both approaches, and may, therefore, be open to adapting the strengths of each to the allocation problem.

It is extremely important to recognize that economic systems are complex, adaptive, and subject to co-evolutionary pressures. Successful economic systems must allocate whatever resources are most important to human survival, but as economic systems increase availability of some types of resources while decreasing and degrading others, the relative scarcity of resources is constantly changing. The dominant capitalist economic system emerged at the same time as the fossil fuel economy. The widespread use of cheap fossil fuel energy allowed unprecedented rates of conversion of ecosystem structure into economic products and waste emissions, and the consequent degradation of ecosystem services. The scarcity of forest goods and services relative to human made products has, as a result, steadily increased over the last two centuries. A basic rule in economics, known as the law of diminishing marginal utility, is that the more one has of something, the less an additional unit is worth. This suggests that the marginal value of ecosystem services has increased over time, while the marginal value of economic products created from ecosystem structure has decreased. When the marginal benefits of increased economic production come to outweigh the marginal costs as measured by lost or degraded ecosystem services, then continued growth of the economy is uneconomic. If forests and other ecosystems lose the capacity to reproduce the raw materials needed for economic production, our economy will collapse – absolute scarcity is also important (Daly 2007).

This change in relative scarcity is reflected in a change in the economic problem. Historically, the economic goal in both socialist and capitalist countries has been to convert ecosystem structure into the economic products that maximize human welfare. Capitalist systems measure welfare in terms of monetary values as reflected by GNP, with little concern for distribution. Socialist systems nominally paid more attention to distribution, but ultimately emphasized growth in GNP as well. Now, the economic goals must change to reflect the changes in relative scarcity and the emergence of absolute scarcity as a concern. Both ecological economists and sustainable forest managers have recognized that our new challenge is to decide how much economic structure (e.g. forest) can be converted to economic production, and how much must be left intact to provide vital ecosystem services. I refer to this as the macroallocation problem. Our new recognition of the limits of growth force us to pay attention to distribution issues as well – if the planet's wealth is finite, we must decide who is entitled to what, both within and between generations.

2.3 Market Shortcomings and Market Solutions

Markets have arguably become the dominant allocative mechanism on the planet. Furthermore, some global institutions advise to Ukraine to privatize their forest resources as a precondition for the emergence of successful markets. It pays therefore to examine market solutions to the macroallocation problem and their numerous shortcomings.

One problem is that markets are based on private property rights, or excludability. As mentioned earlier, market forces provide no incentive to protect un-owned (i.e. non-excludable) forest goods and services, as the costs of conservation efforts fall on whoever engages in conservation, while the benefits are shared with all who exploit the resource. As a result, in the absence of enforceable property rights, forests are often over-harvested.

The proposed market solution to this problem is typically private property rights. One problem, as we pointed out above, is that many ecosystem services cannot be privately owned. Private ownership of forest structure may also fail solve this problem. One possibility is that the growth rates of forests are lower than growth rates on the investment of harvest profits, in which case an owner maximizes profits by clearcutting the forest and investing profits in the stock market. Another possible outcome is that owners will have a market incentive to harvest and sell ecosystem structure, but no incentive to protect non-marketable ecosystem services, which are external to the owners' decision-making process. The harm their loss imposes on others is known as an externality. If the services are actually worth more than the harvested structure at the margin, the resulting resource allocation is inefficient. If the land underlying a forest plus the one time profits from clearcutting are more valuable than the net present value of sustainable timber harvest, but less valuable to society than the ecosystem services, private property rights can actually lead to a tragedy of the non-commons: without private property rights, there might be no incentive to clear forest, as the person clearing it would not have exclusive access to the land below, but with property rights there is an incentive to clear. The general problem is that market forces alone lead to the inadequate provision of non-excludable benefits (Farley in press).

Another unfortunate problem with the property rights solution is that markets are based on competition. While competition may be suitable for rival resources, many ecosystem services are non-rival, which is to say that use by one person does not reduce the amount available for use by someone else. For the most part, such non-rival benefits are also non-excludable and known as public goods. Even most conventional economists recognize that public goods require cooperative provision (Sandler 1998). However, the convention on biodiversity gives countries property rights to endemic plants and animals, including the genetic information they contain (Ten Kate 2002). This genetic information is non-rival, but countries can sell it. In this case, the price mechanism rations use of information to those who can afford to pay, which creates artificial scarcity. This is inherently inefficient. Take the example of Indonesia, which recently chose to sell a new strain of avian flu to a single corporation to work on developing a vaccine, on the condition that Indonesians would have access to the vaccine (McNeil 2007). Traditionally, countries gave new strains of a disease to the World Health Organization, which then made it available to anyone to work on a cure, so that we might have a hundred teams of scientists seeking a cure rather than one. Within the logic of the market however, Indonesia made the correct choice – if a private firm were to develop a vaccine based on this strain, it would take out a patent enabling it to sell the vaccine at a monopoly price, again using the price mechanism to ration access to information, creating artificial scarcity. If Indonesians and others proved unable to afford the vaccine, a large pool of individuals susceptible to the flu would increase the chances of a global pandemic. Similarly, some chemical compound provided by a forest plant might cure some lethal, contagious disease, in which case rationing use through the price mechanism would be inefficient. In other words, market forces lead to inadequate production of non-excludable resources, and inadequate consumption of non-rival ones.

In recent years, payments for ecosystem services (PES) have emerged as a more promising solution to the macroallocation problem. The basic premise, as it relates to forests, is that beneficiaries of forest services make contractual payments to the providers of ecosystem services conditional on their provision (Pagiola et al. 2002; Wunder 2007). Perhaps the most developed market currently is payments for carbon sequestration, whereby firms or countries wishing to reduce atmospheric carbon pay forest owners to increase biomass or soil carbons above and beyond what they would have been without the payment. As international treaties and national laws increasingly restrict the right to emit carbon, carbon is becoming excludable. As one person's use of the waste absorption capacity for carbon leaves less available for another person to use, it is also rival. Because climate change is a global problem and the carbon cycle plays out on a planetary scale, it does not matter where carbon is captured. As a result of these characteristics, carbon markets make sense.

PES has also been applied to water regulation, biodiversity conservation and the preservation of aesthetic landscapes, all of which are challenging because they are largely non-excludable and non-rival. In general, such PES schemes are facilitated by governments, ideally at the scale of the service (e.g. local governments for water regulation, national governments for biodiversity), which tax the beneficiaries of these services then pay the providers (Landell-Mills & Porras 2002; Wunder et al. 2008). With enough political will, such PES schemes could emerge on a broad scale. They demand, however, that we pay careful attention to the spatial flows of ecosystem services, so that those who benefit also pay. The real challenge is bringing about the international collaboration required to pay for global ecosystem services. A final form of PES is simply tourism, in which case the beneficiaries flow to the service, rather than vice versa. In many cases it is possible to exclude tourists from particular sites if they fail to pay.

2.4 Who Should Own the Forest?

Both market inefficiencies and market solutions based on property rights bring up the critical issue of who should own the forest. In most countries, this remains a largely academic question, as explicit property rights already exist. In Ukraine, however, while the state currently owns most forestland, the question is still open to debate.

In general, the worst form of ownership is none at all, in which case forests tend to be overexploited. There are typically two forms of justification used for private ownership of resources: the natural law argument and the instrumental argument. Perhaps the best know proponent of natural law theory was Locke (1690), who argued that we all have an inalienable right to our own labor, and are, therefore, entitled to the fruits of our labor mixed with the commons (which one can interpret in this case as resources belonging to the commonwealth) as long as we leave 'enough and as good' for others. However, on today's crowded planet, when people harvest timber or clear forests for land, they clearly do not leave 'enough and as good' for others. Conventional economists typically make the instrumental argument that private property rights lead to more efficient resource allocation, but as we have explained, private property rights are often only possible for ecosystem structure, and systematically favor the conversion to market products over the conservation for ecosystem services. In today's full world, ecosystem services are probably more important than increasing economic output (Daly 1997). In other words, market forces fail to solve the macroallocation problem. Private property rights to non-rival resources create artificial scarcity and suboptimal levels of consumption.

Since natural forests are not created by the labor, capital and entrepreneurship of individuals, they could be considered the shared inheritance of society, and commonly owned. In this case, they would theoretically be allocated on the principle of one person, one vote, at least in a democratic society. The problem is of course that democratic processes for allocating all forest products would be slow, cumbersome and probably quite expensive. Though they operate on the system of one dollar, one vote, and ignore the rights of future generations, markets can nonetheless be relatively efficient at the microallocation problem.

One potential solution to this problem is a common assets trust. Such a trust would represent a third sector, neither public nor private; it would be managed by a board of trustees with a legally binding mandate to promote the well-being of all citizens, including those not yet born (Barnes 2007). To protect the rights of future generations, harvest of renewable resources cannot continuously exceed the rate of regeneration, and emissions of wastes cannot continuously exceed waste absorption capacity (Daly 2007). If the forest were owned by all, then the loss of forest services caused by harvest of forest structure would no longer be an externality, as both benefits and costs would be shared by the owners.

Such common ownership is not incompatible with markets. For example, the trust could auction of harvest rights to net annual net primary productivity to the highest bidder, who could then allocate the raw material to its most profitable use. The auction revenue would belong to all citizens, and could be distributed equally or invested in other commonly owned assets, such as ecological restoration, built infrastructure, education and other public goods.

A common asset trust might under-provide some global ecosystem services. For example, the Carpathians harbor biodiversity and regulate climate in ways that benefit other countries, but the Trust would have little incentive to manage the forest services for those countries, possibility leading to inefficient allocation decisions on a larger scale. Sovereign resource rights obviously prohibit direct international participation in a common asset trust for forests. The trust would, however, dramatically reduce transaction costs in payment for ecosystem service schemes, as negotiations would only need to take place with the board of trustees, and not thousands of individual forest owners.

Other management options for Ukraine's forests are also possible. The point is, however, that the Ukraine has a unique opportunity to decide on ownership rights, and should do so based on a scientific analysis of the problem and interactive discussion with national stakeholders, rather than on ideological demands imposed by the advanced market economies.

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Екологічна економіка та менеджмент сталого лісового господарства

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Як екологічна економіка, так і менеджмент сталого лісового господарства зосереджують увагу на проблемі розподілу структури екосистеми між економічними та екологічними вигодами, які вона може забезпечити тепер і в майбутньому. Справедливим буде узагальнення, що економічна продукція, яку отримують від лісів, має фундаментально відмінні від екологічних вигід фізичні характеристики, які можуть забезпечити ліси. Зокрема, ліс та земля, на якій він зростає, можуть перебувати у виключній власності і використання їх однією особою означає, що для решти користувачів цих ресурсів залишиться менше. На противагу до цього, багато послуг лісів не можуть бути власністю однієї особи. Ринкові сили відіграють значну роль у виборі методів ведення лісового господарства, і з огляду на специфіку фізичних характеристик лісових ресурсів систематично спонукають до трансформації структури лісів в економічну продукцію за рахунок втрачених можливостей збереження послуг лісів. Ринки також дають збої і не подають сигналів щодо зростання дефіциту послуг лісів та їхньої граничної вартості. У цьому розділі наведено аргументи на користь ідеї, що оптимальний менеджмент та розміщення лісів повинні базуватись на фізичних характеристиках лісових ресурсів, а також зроблено висновок, що в сучасних умовах менеджмент за схемою "трасту зі спільними активами" може виявитись більш сталим, справедливим та ефективним порівняно з приватним менеджментом. На етапі переходу від централізованої планової економіки до ринкової Україна має унікальний шанс для прийняття рішення щодо найефективніших результатів лісового менеджменту і, виходячи з фізичних характеристик лісових ресурсів, визначити, який механізм їх розподілу є найсприятливішим для досягнення цих результатів.

Chapter 3

Transdisciplinary Paths Towards Sustainability: New Approaches for Integrating Research, Education and Policy

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Abstract For many of the most pressing problems society currently faces, such as how to manage forests sustainably, facts are uncertain, stakes high, decisions urgent and values important. The conventional scientific method alone is inadequate for solving such problems. Instead we need transdisciplinary approaches that bring together stakeholders from academia, business, government and civil society. While such approaches are beginning to emerge, the urgency of the problems are such that we must improve these approaches, apply them, and train a new generation of problem solvers skilled in these approaches simultaneously. This chapter describes one such approach, the scientific atelier. We address the atelier paradigm, ontology, epistemology, methodology and management practices, providing concrete examples from an atelier entitled Ecological Economics and Sustainable Forest Management in the Ukrainian Carpathians , which took place in Lviv and Transcarpathia in Fall 2007.

3.1 Introduction

The problem of sustainable forest management (SFM) is wickedly complex, involving natural systems, social systems and human values (Berkes 2004; Ludwig 2001). Complex systems exhibit emergent phenomena, surpises, positive and negative feedback loops, and other characteristics that cannot be well understood in the

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framework of the cause-effect paradigm (Kauffman 1995). Further complicating conventional research, forest managers may work with one unique forest system in an ever evolving ecological economic situation, resulting in a sample size of a single observation. Facts are uncertain. Forests provide a number of vital goods and services, ranging from timber and genetic resources to water and climate regulation, many of which may be essential to human survival. Stakes are high. Forest mismanagement can have lasting and even irreversible impacts, so decisions are urgent. Finally, the desirable ends for which forests should be managed and the beneficiaries for whom they should be managed are normative questions. Values matter. Under such circumstances, the conventional scientific approach is inadequate for making informed management decisions (Funtowicz & Ravetz 1994). We understand the problem of sustainable forest management and know (to some extent) what threats exist, but we do not know how to address these threats in the real world on the scale necessary to sustainably manage forests for both ecological and economic goods and services. Many other ecological economic problems exhibit similar characteristics.

Therefore, there is a demand for new methods of investigating and managing environmental problems, as well as new approaches and instruments needed to identify and discover impacts of human activity that cascade in complicated ways through the global ecosystem and potentially result in new environmental problems. Such epistemological tensions in science are well described in the scientific literature (e.g. Peter Söderbaum, 2000), and must be mirrored in methods for teaching and learning about sustainabiltiy issues. There is no single best method, and no single best path to developing effective methods. There are, however, a number of factors likely to contribute to acceptable solutions. First, we must recognize that sustainable forest management and most other environomental problems are multi-faceted. Humans are an integral part of ecosystems, and societies have co-evolved with them (Gowdy 1994; Norgaard 1994). Understanding the social-ecological system requires not only synthesis across the social and natural sciences, but also the integration of local knowledge from the communities most closely linked to specific ecosystems (Berkes & Folke 1998; Funtowicz & Ravetz 1993). Co-operative learning that integrates stakeholders' knowledge generates an improved understanding of environmental problems.

As a result, there is a strong call for transdisciplinary research in the area of sustainability science (see for example Czech 2002; Mascia et al. 2003; Sánchez-Azofeifa et al. 2005). Unfortunately, universities generally take a narrow, disciplinary approach to education. Analysis of textbooks and syllabi in sustainability science shows little evidence of interdisciplinary training (Niesenbaum & Lewis 2003), and interdisciplinary research continues to confront serious obstacles in academia (Campbell 2005). Successful forest management efforts must develop frameworks for transdisciplinary research and training. The problem is that educators who have not conducted transdisciplinary research have a difficult time training students to do so, and students educated within narrow disciplinary boundaries have a difficult time communicating with experts in other disciplines and engaging in interdisciplinary research.

Second, solving environmental problems requires inter-institutional collaboration: Viable conservation strategies require integrated efforts from scientists, conservation professionals, community stakeolders, the government, non-governmental organizations and the business sector (Farley, Erickson and Daly, 2005). At the same time that cooperative learning increases understanding, it also facilitates consensus reaching, conflict mitigation and the development of realistic scenarios for solving real-world problems faced by particular communities or regions. Unfortunately, sustainability scientists have largely failed to integrate their scientific knowledge into specific social, political, and economic contexts so that it actually leads to conservation (Bawa et al. 2004). The Millennium Ecosystem Assessment report (2005), and sustainability scientists have made a strong call for inter-institutional collaboration (Farnsworth 2004). What is lacking is the dissemination of an effective framework for its promotion.

Third, we must recognize the need for improved communication skills. Interdisciplinary research demands that scientists learn to communicate with each other. Unfortunately, the dominant approach in academia is to train separate disciplines to use mutually unintelligible language riddled with jargon (Farley, Erickson and Daly 2005). Scientists must learn to effectively communicate to decision makers and the broader public (Farnsworth & Ellison 1997), but public communication skills are rarely part of the scientific curriculum.

Fourth, we must recognize the limitations of conventional science in the field of conservation. As described above, we are dealing with systems in which facts are uncertain, decisions are urgent, stakes are high and values matter. In many cases, the systems most in need of conservation are unique, but baseline data are missing, and it is impossible to make statistically significant observations from a single sample. Under such conditions, uncertainty cannot be resolved, reducing uncertainty may take far more time than is available, and delaying decisions until data are gathered can be an irreversible choice. Typically, decisions concerning environmental problems have different impacts on different groups, including future generations, bringing up ethical questions of fairness, justice, and attitudes towards risk. Under such conditions there can be no objective decision-making rule, and the scientific method must be expanded to integrate the knowledge and values of those most affected by the problem, even when anecdotal in nature – an approach that has been dubbed post-normal science (Ravetz and Functowicz, 1993). Sustainability challenges then became a powerful driver for crystallizing and implementing the post-normal science paradigm.

The multifaceted nature of forest ecosystems, their vital role in sustaining economic systems, and the diverse and conflicting interests of stakeholders, make sustainable forest management an excellent case study for sustainability issues in general. Forest ecosystems provide numerous goods and services crucial for our life and well-being. Most forest ecosystem goods are excludable and rival market goods, and market transactions can provide feedback signals concerning their marginal values, scarcity and so on. In contrast, most ecosystem services (like climate regulation, habitat, scenic beauty) are non-excludable and non-rival; markets fail to measure their value, signal their scarcity, or even provide incentives to provide them (Costanza et al. 1997; Farley, this book, chapter 2). As a result, market economies systematically favor the potentially irreversible conversion of ecosystem structure to readily substitutable economic products over conservation to ensure the continued provision of frequently non-substitutable ecosystem services, regardless of relative values. Sustainable forest management offers serious challenges in a market economy.

But, discovering the nature of systematic market incentives to convert ecosystem structure rather than conserve it is not enough to achieve SFM. Sustainable forest management demands not only the integration of academic and stakeholder knowledge, but also the translation of academic research and stakeholder insights into everyday decision-making, practice, and behavior. A transdisciplinary case study (TCS) model can help us fill the existing gap between ecological economics, forest science, policy-making, and everyday practice, in a straightforward and comprehensive way.

3.2 Transdisciplinary Case Study for Sustainability Learning

Transdisciplinarity can be defined as an integration of values and knowledge from society into the production of scientific knowledge (Scholz et al. 2006), and is distinct from multidisciplinarity and interdisciplinarity. In multidisciplinary research, each researcher conducts separate disciplinary analyses of a given problem with little communication between each other beyond adding up the results. In interdisciplinary research, there is more communication and collaboration, but the basic approach is to divide a problem into separate components to which each disciplinary expert applies their own disciplinary method regardless of the problem. In transdisciplinary research, in addition to integration of stakeholder and expert knowledge and values, the problem determines the appropriate tools and methods, not the discipline. In other words, transdisciplinary work is integrative, multidisciplinary work is additive, and interdisciplinary work is based on the divide and conquer strategy. As we all know, integration is much more difficult than addition and division (Farley in press).

In Europe one of the first transdisciplinary case studies (TCS) was undertaken at the Institute of Human-Environment Systems Natural and Social Sciences Interface at the Swiss Federal Institute of Technology in ETH (Eidgenössische Technische Hochschule) Zurich in 1994 (Posh and Scholz 2006). Currently, transdisciplinary case studies are frequently arranged by European universities. The insights gained from these innovative teaching experiences were discussed at a symposium on "Transdisciplinary Case Study Research for Sustainable Development" (Helsinki, June, 2005), and are highlighted in the International Journal of Sustainability in Higher Education (2006). Applying transdisciplinary case studies as a means of organizing sustainability learning has become an effective and popular form of mutual learning by doing, and has also helped in the practical implementation of research results in real world conditions.

In the United States, the Gund Institute for Ecological Economics (GIEE) has pioneered the scientific atelier, a self-designing, collaborative process for solving real world problems. Ateliers are designed to integrate insights across disciplines and institutions, as well as research, learning, and service. This approach brings students and faculty from several disciplines together with a broad cross-section of stakeholders in problem-focused, adaptive, workshop settings, frequently in countries that are less developed or undergoing transition to a market economy. The ateliers focus on a particular research topic and produce a variety of publications ranging from academic journal articles with practical policy implications that represent a new transdisciplinary synthesis of the problem to grant proposals and policy papers aimed at local decision makers. The approach assumes "peer-to-peer" interactions among the participants, and all participants share the common goal of addressing the chosen research topic from their particular perspective and sharing their own learning about other perspectives. Atelier organizers typically choose the research topic in collaboration with a local partner and assemble a number of component resources that are available for use during the course. These resources may include lectures on specific topics, computer modeling hardware and software, reference data and literature, and training in collaborative problem solving. Research is problem-driven rather than tool-driven, but an effective workshop requires that appropriate tools be available. Some of the Gund Institute's experience with TCS is presented in *Ecological Economics: A Workbook for Problem-Based Learning* (Farley, Erickson and Daly 2005).

The main advantages of ateliers include:

- Building researchers', students' and stakeholders' capacity for real-world problem solving;
- Creating new knowledge with practical applications for both academia and society;
- Stimulating students to generate new knowledge and to prepare for their future professional lives;
- Developing a new educational model integrating conventional lectures with field-based teaching and internet-based education;
- Facilitating dialogue and mutual understanding among academia and community, and among stakeholders within a community; and
- Improving communication, knowledge dissemination, and collaboration between academia and society as a whole.

As our experience suggests, simply implementing an atelier generates a flow of benefits both for academia (papers, monographs, further research) as well as society (new levels of collaboration and knowledge dissemination among stakeholders, as well as an improved understanding of their own connection to and responsibility for sustainability).

According to Scholz et al. (2006), the core patterns of TCS theory are ontology, epistemology, methodology, and project management conceptualization. We use this framework to present the atelier paradigm and show its relationship to TCS using an example of a particular atelier. However, we also have a major complaint with the framework: if a central goal of TCS is to integrate values and knowledge across science and society, then we must be able to communicate in a widely shared language which will almost certainly exclude words such as ontology and epistemology (Farley 2007; Norton 2005).

3.3 Ontology of an Atelier

In basic English, ontology is the study of what exists. In the case of TCS, it entails a description of the system being investigated, its initial state (where are we today), its target state (where do we want to be in the future), and a relevant transition process (how do we get there?). Ontology also concerns the system's dynamics as well as measures and indicators of its quality required to compare different states of the system.

As an illustration of a particular atelier we will use an atelier jointly organized by the GIEE at the University of Vermont and the Institute of Ecological Economics (IEE) at the Ukrainian National Forestry University. The international atelier was entitled Ecological Economics and Sustainable Forest Management in the Ukrainian Carpathians (henceforth EE and SFM in the UC), and took place in Lviv and Transcarpathia in Fall 2007. The goal was to understand and address the challenges to implementing sustainable forest management in a transition economy.

To put this in context, the Ukraine is undergoing transition from a centralized economy to a more market based one, which gives it the flexibility to design property rights regimes tailored to the physical characteristics of goods and services generated by natural capital in general and forests in particular. Ukraine has little forest cover and an overall deficiency of forest resources (UNECE 2003). At the same time forests are distributed over the territory in a very irregular way: forest cover in the steppe zone is 1.32 million ha (5.4 %), and in the Carpathians it is 2.08 million ha (36.7 %). The value of forest resources and forest ecosystem functions is nonetheless very high. For example, the Carpathian forest sustains high levels of endemic biodiversity and provides habitat for numerous endangered species (Millennium Ecosystem Assessment 2005).

Without careful planning, conversion to a market system threatens Ukraine's forests with misuse and degradation. As described earlier and in chapter 2, market forces systematically favor the harvest of marketable forest structure over the provision of non-marketed ecosystem services. In addition, harvest of market products are directly captured by conventional measures of economic welfare, such as gross domestic product (GDP), while less tangible ecosystem services are largely ignored. As a result, both private forest landowners and revenue seeking decision makers may favor destructive and unsustainable natural resource management despite the high dependence of local populations on such ecosystem services as water supply and water regulation. The urgent and vital question is how to balance business and environmental interests in a developing market economy in a way that satisfies basic human needs for the present without sacrificing the potential for doing so in the future.

The atelier brought together scientists and students from the US, Sweden, and Ukraine, forest experts and entrepreneurs, local community representatives and environmental NGOs to: 1) assess the current state of Ukraine's forest resources; 2) develop a vision for a sustainable forest management regime in the future; 3) assess the challenges and obstacles to achieving SFM in a transition economy; and 4) develop strategies for overcoming these obstacles.

As is typical of ateliers, the precise problem remained ill defined. The general question in this case was how the Carpathian region could be transformed to a sustainable one providing a balance of natural, human, social and built capitals that best meet societies needs. In the midst of global ecological and economic changes, it is difficult to describe the initial state of the system. Rational, well-informed people can generate entirely different visions of a future target state, and it is often only possible to reach consensus by keeping the vision vague. The assessment of obstacles to achieving the transformation and the strategies for overcoming them were similarly nebulous. This is typical of the problems addressed by TCS (R. Scholz et al. 2006).

3.4 Epistemology of an Atelier

Epistemology concerns how we acquire knowledge. In the case of TCS, relevant knowledge concerns both the physical nature of the system as well as stakeholder values concerning desirable states of the system. These normative and systemic spheres complement each other in both TCS (Scholz 2006, pp. 234-235) and ateliers.

The guiding question of the atelier was formulated according to the normative concept of sustainable development, and further refined according to stakeholders' perceptions, values and preferences. When there is no one right answer to a problem, stakeholders' values are particularly important. Furthermore, stakeholder involvement facilitates problem solving; the more closely stakeholders are involved with a project, the more likely they are to find research results to be credible and to follow through with action. However, we also had to be aware that the more involved participants had a greater stake in any particular outcome. Information from more objective stakeholders, therefore, carried considerable weight.

The systemic sphere involves such epistemics as understanding (the highest level of hierarchy), conceptualization, and analysis (the lowest level of hierarchy). Scholz and others (2006, pp. 234-235) explain that in TCS these "three systemic epistemics are strongly interrelated along the streams of decomposition (down-stream) and synthesis (up-stream)." Ateliers focus on analysis and synthesis as well (Farley, Erickson, and Daly 2005), but further recognize that when problems are urgent, stakes are high, facts are unavoidably uncertain, and available time and resources are limited, it is frequently necessary to supplement the conventional scientific method with the methods of post-normal science. Anecdotal information provided by informal interviews with community members and local atelier partners may carry more weight than the results of scientific research on similar systems elsewhere. In particularly urgent situations, for example when a forest is being actively cleared as research is being conducted, ateliers strive to obtain only the minimum information needed to assess the situation and propose a course of action. When stakes are high, questionable quality of any single source of information can be addressed by triangulation – when three or more separate sources or disciplinary perspectives agree, the information should carry more weight (Farley, Erickson, and Daly 2005).

Ateliers particularly focus on the need to transfer and synthesize knowledge across disciplines and institutions and hence prioritize effective communication. However, communication across disciplines can be very difficult. A group of students in France has issued a call for a post-autistic economics. The implicit diagnosis is that economics as currently taught in most universities exhibits the symptoms of autism, including an inability to communicate. This problem affects not only economics, but in fact most disciplines, due to the narrow boundaries established around disciplines and the distinct vocabularies they develop (Daly & Farley 2004). The problem is not as severe within the natural sciences where consilience is occurring, which is to say that the sciences do not contradict each other. For example, biologists understand that their discipline depends on the rules of chemistry which, in turn, depends on the laws of physics (Wilson 1998). Unfortunately, the same is not true of the social sciences. Not only do economists, sociologists, and political scientists offer theories that often differ in fundamental ways, but their theories sometimes contradict the laws of physics, chemistry and biology.

Our experience suggests that communication between different disciplines is best achieved by transdisciplinary collaboration on real life problems taking a systems perspective. This approach gives everyone a shared understanding of a general problem. Anyone who has learned a foreign language knows that in the beginning, conversation is greatly facilitated when you are very familiar with the topic being discussed. You might not understand a specific word, but in context the meaning becomes obvious. Exactly the same principle applies to transdisciplinary integration. Our team of scientists from a variety of disciplines was able to communicate much more effectively because we shared basic knowledge about the system we were discussing, and could explain disciplinary jargon to others through examples drawn from that shared knowledge. In the case of this workshop, for example, ecologists could readily explain how ecosystem structure generated function using concrete examples, and economists could explain that those functions of value to humans were ecosystem services, that the 'market value' of those services was in theory determined by marginal changes in service provision, and that the loss of these ecosystem services was an opportunity cost of clearcutting.

Communication problems extend well beyond the walls of academia, particularly when there are serious cultural differences between sectors and nationalities. In general, non-governmental organizations working with communities affected by the research problem can play a vital cross cultural communication link, as they will be familiar with the local community, government and academia. Above all, communication across sectors must be based on mutual respect and the recognition that all sectors have valuable information and skills, but effective solutions are unlikely without collaboration.

3.5 Methodology

The basic principle in ateliers is that the problem being addressed determines appropriate methods, not disciplinary boundaries. While ecological economic ateliers typically define problems at least partially from the perspective of three critical issues – ecologically sustainable scale, socially just distribution, and economically efficient allocation – the specific problem still determines the specific method for addressing each of these issues. Nonetheless, there are a number of general methods such as problem decomposition, analysis, synthesis, brainstorming, communicating, web-based teaching, and backward planning that are broadly applicable in most ateliers (Farley et al. 2005; Scholz et al. 2006).

The problem specific methods are by nature the most interesting and the most difficult to describe generically. Possibilities include deep interviews, focus groups, and questionnaire development; rapid ecological assessment techniques (e.g. of stream ecological integrity); quantitative techniques like statistical analysis and valuation of ecosystem services; policy analysis; and advanced computer based systems modeling. Participants choose the most relevant methods for a specific case study or for the facet of that case study they choose to address.

The EEE and SFM in the UC atelier brought together scientists and students from the US, Sweden, and Ukraine, forest experts and entrepreneurs, local community representatives and environmental NGOs. The expertise of the various academic participants proved highly complementary and was effectively integrated with local knowledge and ability. For example, one group used relevant software to examine services generated by local forest ecosystems, identified stakeholders' preferences regarding these services using conceptual content cognitive mapping techniques, and examined those preferences by means of non-parametric statistic analysis (Zahvoyska, 2007). Changes in landscapes were traced from a historical perspective using previously compiled databases. Atelier results may take many months to be finalized, and EE and SFM in the UC results are still being written up.

3.6 Atelier Management

An atelier per se is an important and multifaceted scientific event that demands appropriate managerial efforts. One particular challenge is coordinating background preparation work for international teams in order to ensure the most effective use of precious field time. Atelier web sites containing relevant coursework, literature, site descriptions, etc. can be very helpful in attracting appropriate participants and coordinating preparation. They also serve to communicate after the fact and post results (see http://www.uvm.edu/giee/? Page=ateliers/index.html&SM=ateliers/ ateliers_menu.html for examples). Main stages of the a EE and SFM in the UC atelier are illustrated by Figure 3.1.

It is worth mentioning that all preparations for the EE and SFM in the UC atelier were done by faculty and students of GIEE and IEE; some was achieved as part of a project in a separate course in ecological economics. This phase of atelier development instigates a lot of academic contacts, both personal and institutional. The shared search for relevant sources in periodicals, monographs, and e-space brought benefits for all sides and resulted in a huge volume of applicable publications. When resources are available, preliminary visits can be quite useful; for example GIEE scientists visiting the IEE delivered a series of lectures on ecological economics, and IEE scientists visiting the GIEE presented a panel on

Bioconservation Trends in Eastern Europe (http://www.uvm.edu/ conservation-lectures/? Page=video_spring07. html). Both visits facilitated crystallization of the atelier topic.

Ateliers are intended to be creative, constructive, and self organizing. Despite effective background preparation, ateliers inevitably evolve on the ground as new issues and ideas emerge. It is essential to include time for brainstorming both at the start of the atelier and midway through the process.

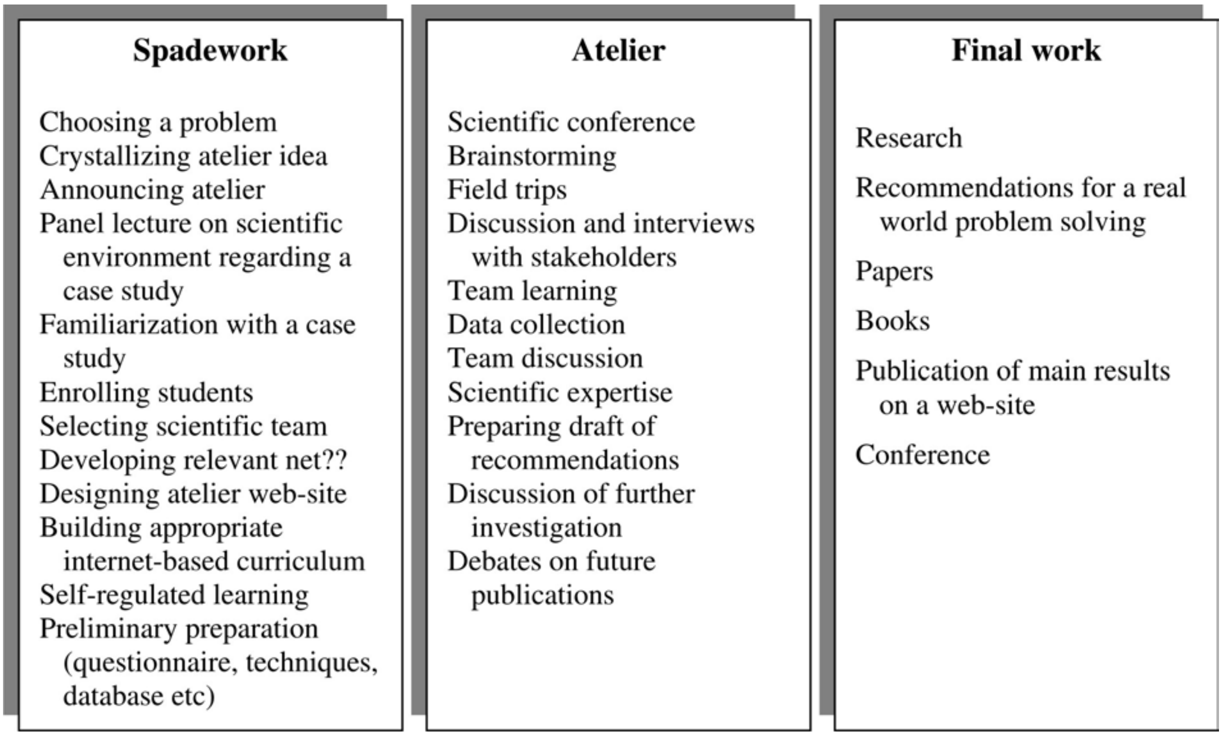

Fig. 3.1 Atelier management scheme

The host country team is generally responsible for managing logistics, which can be difficult and time consuming. Typical tasks include arranging field trips, ensuring adequate time for relevant data collecting, and setting up interviews, meetings and discussions with stakeholders. The importance of these tasks cannot be overstated, as they are essential to efficiently using precious field time. Critical roles in the final stage include accurate documentation, clear definition of tasks for teams and individuals within those teams, and ensuring adequate time for following through on journal articles. Once final products have been generated, they must be disseminated to all participants. Without this step, the atelier is unlikely to bring benefits to the communities involved and is little more than an academic exercise. In the EE and SFM in the UC atelier, results were presented in a closing conference and an academic conference the following spring, published in book format, and organized for journal publication.

3.7 Results

Ateliers as a form of TCS can generate a variety of educational, scientific and social outcomes. Key educational benefits include:

- Pioneering and improvement of innovative forms of teaching sustainability science;
- Stimulating self-learning about sustainability issues and improving one's capacity to self-teach;
- Facilitating the exchange of cross-institutional knowledge;
- Capacity building and enrichment of curriculum and didactics in sustainability science;
- Greater experience in a blend of academic lecturing, problem-based learning and internet-based education;
- Improved design and implementation of interdisciplinary and collaborative teaching models for mutual academia and societal learning; and
- Creation of web-sites that serve a repositories of knowledge on the subject matter and are readily available to other communities and institutions dealing with similar issues.

Scientific benefits and results include:

- New approaches, tools, and techniques resulting from conceptualized case studies of specific phenomena caused by human activity in ecological-economic systems;
- Scientific knowledge complemented by knowledge of a society, community and /or stakeholders; and
- Strengthened relationships between university education and science. It should be mentioned here that in the former USSR, a university education was decoupled from pure scientific research. Hence, the issue of establishing strong links between them deserves special attention from the Ukrainian Ministry of Education and Science.

Lastly, social benefits, the third pillar of sustainable development, include:

- An important surge of knowledge, ideas, and scientifically-grounded recommendations towards implementing eco-innovations in business, government, and personal environments for communities involved in the ateliers;
- The establishment of stronger links between communities and academia;
- The initiation of creative and advantageous polylogue between stakeholders;
- Student familiarization with real-world problems and community capacity-building tools they can apply throughout their future careers; and
- Improved cross-cultural relations between institutions and communities.

3.8 Discussion of Atelier's Findings

The capacity-building (both to students and to society/community) approach of ateliers creates new demands and roles for teachers and students. Ateliers tend to blur the distinction between teachers and students, just as they blur the distinction between research and education. Teachers in an atelier setting have more of a role as 'guide by the side' then 'sage on a stage'. They become coaches and supervisors of the problem-solving process. They help students activate and reveal their latent knowledge and capacity, to uncover approaches, techniques, and methods they can study themselves, and to communicate their results to other participants. Ateliers are also important in developing group and team learning skills for both. Faculty and students alike are more effective in their roles when they have experience in TCS methods, which, in turn, increases the success of the atelier or TCS. Unfortunately, most universities still focus on conventional, top-down disciplinary approaches to education even though it makes little sense to use a traditional sender-receiver model to teach students how to engage in problem based mutual learning. Ateliers frequently require that TCS methods be learned on the job, by faculty and students simultaneously. Building on ideas from Stauffacher et al. (2006), Figure 3.2 presents some features of a problem based mutual learning model.

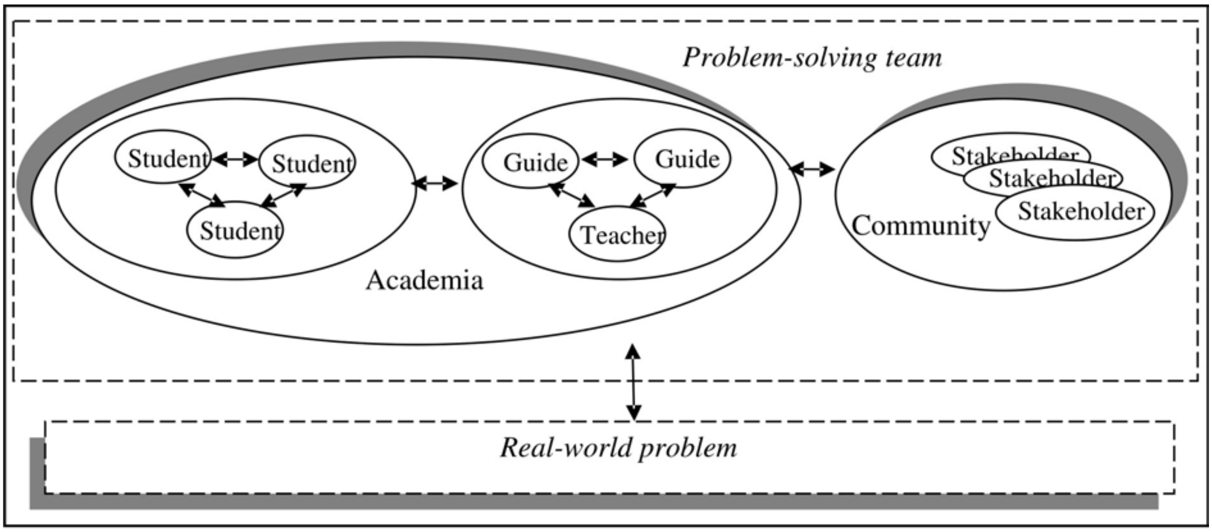

Fig. 3.2 Model of interactive problem-based mutual learning

The experience of learning about a specific problem as well as the benefits of mutual learning prove very useful for students. In addition to in depth knowledge about a specific topic, they acquire real-world problem solving skills within a sustainable development framework. Teamwork facilitates the process while simultaneously teaching group skills. Such abilities are crucial for tackling environmental challenges in cross-cultural multi-institutional and interdisciplinary environments.

Ateliers are also useful to society as whole. As our experience shows, bringing together stakeholders in conditions that facilitate open discussions also results in mutual learning and understanding results that can catalyze change.

3.9 Conclusion

The evolving paradigm of post normal science has emerged to address problems in which facts are uncertain, stakes are high, decisions are urgent, and values matter (Funtowicz & Ravetz 1993). Environmental problems specifically and sustainability science in general exhibit all of these characteristics. To understand and resolve such problems requires the synthesis of insights from the natural sciences, social sciences, and ethics, as well as the integration of different institutional perspectives and values. Conventional science based on objective, value neutral decisions must be supplemented by the subjective values of people affected by a specific problem. Given the urgency posed by looming threats to sustainability, investigation, learning, and action must be integrated. Dialogue and co-operative learning are essential. Current conditions demand new styles of investigation, decision-making, and teaching. The atelier method makes a concrete contribution to developing effective TCS approaches to real-world problem solving. As such it helps society as whole and specific communities tackle sustainability challenges.

The EE and SFM in the UC atelier combined international conferences, panel lectures and discussions, with field research and group work to: 1) clarify insights into a real-world problem; 2) improve an existing model of problem-based interactive learning and enrich it through concrete examples of community capacity-building activity; 3) instigate additional collaborative research; and 4) generate papers and other interdisciplinary, transdisciplinary, and cross-cultural exchanges. It also helped local stakeholders truly understand existing problems, possible scenarios and development trends, and instruments and arrangements for dealing with such problems according to sustainable development strategy.

Ateliers and other forms of TCS are an essential part of an effective education in sustainable development as a whole and for approaching SFM in particular. Weak links between practice and forest research are a recognized limitation of the dissemination of new knowledge (Peyron 1999), that ateliers help to overcome. The thoughtful practice of mutual learning, research, and problem solving can help catalyze transformations towards sustainable development in the forest sector.

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Трансдисциплінарні шляхи до сталості: нові підходи для інтегрування досліджень, освіти і політики

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Для більшості нагальних проблем, які постали перед людством, скажімо, проблеми управління лісами відповідно до вимог сталого розвитку, факти є непевними, відповідальність – високою, рішення – невідкладними, а вартості – надзвичайно важливими. Традиційні наукові методи стали непридатними для вирішення цих проблем. Натомість потрібні трансдисциплінарні підходи, які спонукають до пошуку спільних рішень науковців, підприємців, урядові структури і громадянське суспільство (громади). І хоча ці підходи ще тільки формуються, актуальність проблем така, що ми повинні водночас покращувати їх і застосовувати для навчання нового покоління осіб, які прийматимуть виважені рішення. У цьому розділі описано один із таких підходів – науковий ательєр (наукові студії, від франц. *Atelier* – ательє, майстерня). Ми розглядаємо парадигму цього підходу, його онтологію, епістемологію і методологію, а також практику менеджменту, наводячи конкретний приклад ательєру "Екологічна економіка і сталий менеджмент лісового господарства в Українських Карпатах", організованого науковцями університету Вермонту і НЛТУ України восени 2007 року.

Chapter 4

Methodological Approaches to Ecological Economic System Efficiency Evaluation

Yuriy Tunytsya[1]

Abstract Ecological economics assumes the organic unity of the ecological economic system both at macroeconomic and microeconomic levels. It reveals the main tensions between economic requirements and ecological imperatives and finds the ways of overcoming these tensions both at the sector and territorial levels. Natural resources and ecosystem services should be considered within the framework of the unified ecological economic system. The human use of the environment should be understood as a threefold process of sustainable use, protection, and regeneration of the ecological economic system. The goals of preventing the loss of ecological potential and achieving sustainable development may be reached by two ways: the first is to bring the production technology into correspondence with ecological imperatives; the second is goal-oriented environmental protection activity. The ecological-economic effect is based on the net economic effect of the production-economic activity minus ecological costs and losses. The notion of "ecological economic cost-effectiveness" equally corresponds to the development laws of society and nature and therefore satisfies the principle of sustainable development. Forest presents a very good model for the eco-economic system. The problem of ecological economic cost-effectiveness in forestry is so complex that the approach used to solve it can illustrate the possible ways of ecological economic problems solving in general.

4.1 Introduction

Economy and ecology do not just possess the same linguistic root. Interconnections exist between these two systems also. In the second half of the 20th century these interconnections have became so obvious that nowadays it is widely accepted

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that it is reasonable to consider economic and ecological systems as a unified ecological economic system. Such a postulate is easiest to understand at a macroeconomic level. In the long term any society has to pay for the negative ecological consequences, caused by the production-economic activity of enterprises and firms of different branches of the economy. The costs of environmental protection, the treatment of air and water, as well as soils and other components of the biosphere are currently covered mainly from the state budgets in Ukraine and in other transitional countries. At present, firms and enterprises do not bear direct responsibility for the environmental degradation and other negative ecological consequences of their activity. This results in environmental protection being the concern of the state, society and taxpayers, not for the environmental polluter.

The unity of the ecological-economic system is more difficult to understand at a microeconomic level. Microeconomics, which -studies the activity of small economic structures – households, firms and governmental agencies – does not accept such a unity. Ecological costs and losses are treated as external to the activity of households and firms. Moreover, household, firms are not willing to include these expenditures in the cost of their production, as this therefore increases the price of products and decreases competitiveness and income.

Ecological economics assumes the organic unity of the ecological economic system both at macroeconomic and microeconomic levels. It reveals the main tensions between economic requirements and ecological imperatives and finds the ways of overcoming these tensions both at the sectoral and territorial levels. Also, it could be argued that the economic system is more dependent on the ecological one than vise versa (Tunytsya 2006).

The problem has been stated in the following terms: "Any system is developing at the expense of the environment. In any environment, as in a supersystem, the compensatory reactions, able to sustain its destroyed homeostasis, are generated. Until the intensity of the destruction is less or equals the environment's capacity to withstand them, the development continues "conflict-free". However, when the destruction exceeds constructive processes, the crisis of the relations between the system and its environment occurs. And, as in the "system-environment" the first component always depends on the second, the destruction of the environment inevitably turns into a catastrophe for the system. Hence, the nature – the environment of life for mankind – is of highest value. The loss of the environment of life would mean the death for all the people, and it would happen "before the nature would die" (Reymers, 1980).

The cause-consequence relations interconnect economic and ecological subsystems of the general system. Development, stabilization and degradation of each one of these subsystems, influences the other. Moreover, degradation of the ecological subsystem always implies degradation of the economic subsystem. The degradation of both subsystems may happen either simultaneously or the economic subsystem may survive the ecological one for some time. Those who don't realize the importance of the cause-consequence relations between economic and ecological subsystems, will, however, eventually suffer the consequences. Continuing production despite the degradation of ecological subsystem will inevitably lead to the collapse of the economic subsystem.

4.2 Environment and Natural Resources in the Unified Ecological Economic System

The environment includes all five main components of the biosphere: land, water, fossils, plant and the animal kingdoms, and air space. The environment includes man himself, who is a part of living nature.

The environment can be divided into life support services and natural resources which represent the potential raw material base for material production. Life support services of life and natural resources form the unified natural material basis for both the economic and ecological systems. However, a traditional economic system is interested only in natural resources, which represents the present or potential raw material base for the different branches of economy. As for the non-resource components of environment (such as solar radiation, air, water, and other components of the biosphere that are not used directly in the production process, they are considered to external to the economic system).

However, the environment, including life support services, natural resources and a mankind, makes up a unified ecological system at all scales- global, regional, and local.

Disregarding the life support services component results in a non-rational use and depletion of the natural resources component and causes a decrease in the long-run ecological potential, of the whole ecological system. Thus, the economic system should include not only the resource part of the biosphere but the life support services as well.

Sometimes it is practically impossible to distinguish between life support services and natural resources since the same components of the biosphere (e.g. land in agriculture and in forestry) act simultaneously in both. But the division into two components is important from a methodological point of view.

It is important to underline the fact that life support services are connected with the economic system not only by cause-consequence relations. The life support system also acts as a supersystem in relationship to the economic system (Reymers, 1980). That is life support system, as ecological systems, should become a priority from the point of view of ensuring sustainable development.

Natural resources and life support services should be considered within the framework of the unified ecological-economic system. These components are integral parts of the economic process of material goods production as well as important factors in forming GNP and the national wealth.

Life support services suffer considerable damage due to the productive activities of man, both through pollution and through extraction of raw materials.

The human use of the environment should be understood as a threefold process (Fig 4.1) of sustainable use, protection, and regeneration of the components of production – life support services and natural resources (the ecological economic system).

In ecological economic system economic system always depends from ecological system (Fig. 4.2). Each subsystem goes through the development, stabilization and degradation finally. The degradation of ecological subsystem (as result of human activity or under influence of natural factors) leads finally to the degradation of economic system. Therefore it is important to avoid the degradation of ecological subsystem of ecological economic system. It's a condition for sustainable development of any territory.

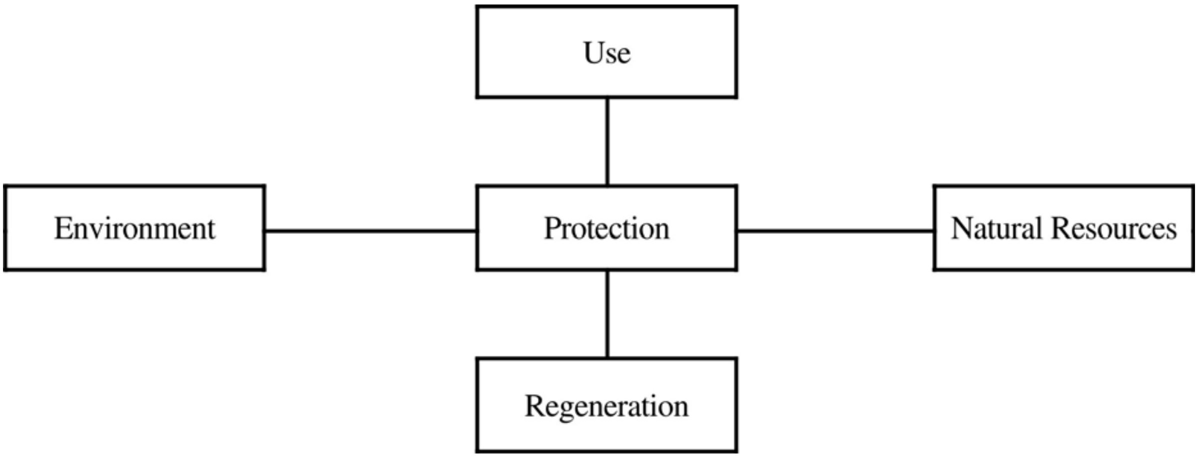

Fig. 4.1 Environment and nature resource use system

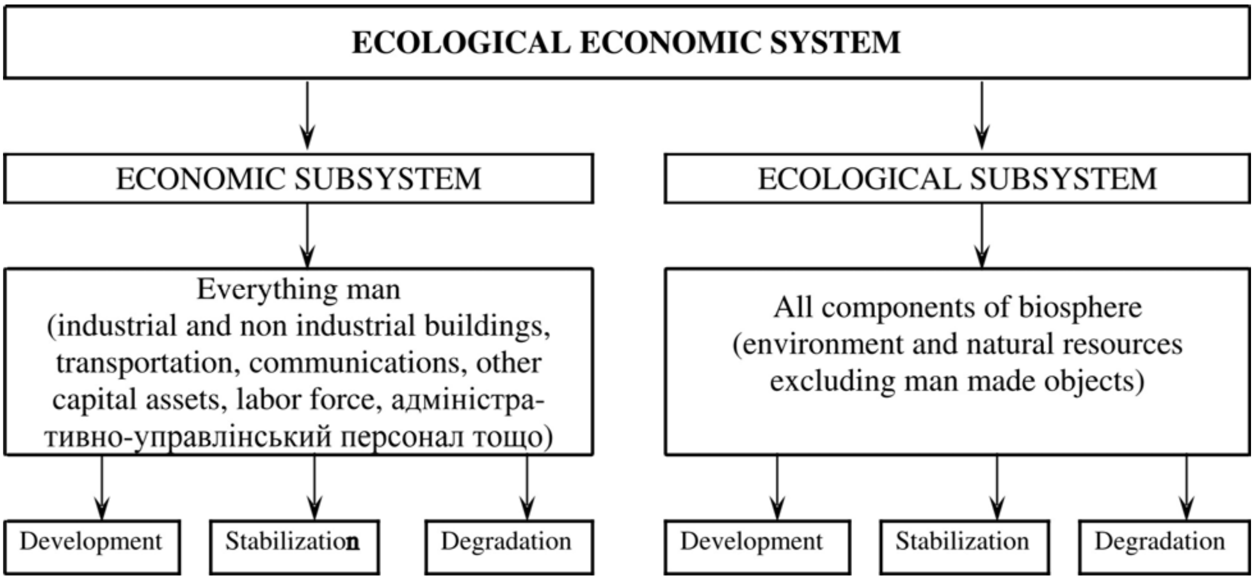

Fig. 4.2 Structure of ecological economic system

For our opinion, new models of the economy development should be developed and implemented on the basis of theory of ecological economics about a unity of ecological and economic system. There are unity, contradictions, interrelations, and interdependences among economic system and ecological system which calls greening of economic theory and economic rethinking of ecology and other natural sciences.

4.3 Effects of the Interaction of Economic and Ecological Systems and Their Classification

The interaction of the two life-ensuring systems – economic and ecological – in the production of goods and services is accompanied not only by a desirable *economic* result but also by an attendant *ecological* one.

Ecological effects mean any changes in quality of the environment of life as well as in the quantity and quality of natural resources, in space and time. Such changes may be either positive or negative in character – improvement or worsening of the natural conditions of life, increase or decrease of the natural resources quantity and quality. Ecological effects influence or can have future influence on the economic results of material production and on the non-production sphere.

Ecological effects are characterized by, at least, eight indicators:

1. origin (natural or technological);
2. form of manifestation (obvious or concealed);
3. possibility of quantitative measurement (measurable or non-measurable);
4. character of interdependence with a traditional economic effect;
5. possibility of forecast (forecasted or non-forecasted);
6. possibility of the return to status quo (reversible or irreversible);
7. time lag;
8. duration

The most dangerous effects are concealed as non-forecasted ones which can arise unexpectedly, inflicting great losses to an economic system and even causing victims.

The classification given in table 4.1 has a practical significance. It allows us to define the character of ecological effects and to undertake necessary measures to prevent undesirable ecological effects.

Table 4.1 Classification of ecological effects

Defining principle for the pair of effects	***Type of effects***	
	First (+)/(-)	Second (+)/(-)
1. Origin	natural (happening for natural reasons)	artificial (caused by human activity)
2. Forms of manifestation	obvious (visible or outwardly perceptible)	hidden (concealed, not perceptible or seen outwardly)
3. Capacity of quantitative evaluation	measurable (the one which could be measured quantitatively)	non-measurable (cannot be measured quantitatively)
4. Character of interdependence with economic effect	spontaneously turning into economic effect (directly transformed)	indirectly connected with achieving economic effect (indirectly transformed)
5. Time lag	coinciding in time with the achievement of economic effect	not coinciding in time with the achievement of economic effect
6. Capacity to reverse	reversible	non-reversible (only negative)
7. Durability	short-term	long-term
8. Possibility to foresee	can be forecasted	can not be forecasted
9. Scale	Local and regional	global
10. Motivation	Deliberate	unintentional

There are ten pairs of effects in figure 4.3. Taking into consideration the fact that they can be either negative or positive total number is forty. All of them are dynamic and can transform into each other. Effects of natural origin could be produced by human labour (artificially). Hidden ecological effects become evident with time and visa versa – the evident one can become hidden. An ecological effect, which is at present only indirectly connected with the achievement of economic results in production, tomorrow can have direct influence on the economic results of this production.

4.4 Economic "Law" for Ecological Costs

Ecological costs are the total combination of expenses and losses in the sphere of environmental use and environmental protection. This is one of the fundamental notions of ecological economics.

Ecological costs of material production and non-production sphere include:

- direct costs of environmental protection, treatment of air and water lands, and other components of the environment of life;
- costs of timely quality regeneration of the environment of life degraded by destructive changes;
- losses connected with irreversible negative effects on the environment, quantity and quality of natural resources;
- losses connected with the necessity of reserving, for environmental protective purposes, objects of nature, which could be exploited and yield real economic effects;
- additional costs in connection with the development of natural resources under worsening conditions and resources remote from the centers of direct consumption;
- relatively high costs of processing secondary and low grade raw materials into commodity products in order to save the good quality raw materials;
- costs of extended regeneration of renewable natural resources, as well as for research and the creation of substitutes for non-renewable resources;
- general costs of fundamental and applied scientific-research and design works in the sphere of the environment of life and natural resources, formal and non-formal ecological education of the population.

Due to the worsening of global and regional ecological situations, ecological "costs" have tended to increase both on the national and global scale. One may assert that there exists an economic "law" of the increase of ecological costs to society. The "law" states that there is an inevitable increase in space and time of the costs of material production, the non-production sphere on the protection, use, and regeneration of natural resources and quality of the environment of life conditions.

The economic "law" on the increase of the ecological costs to the society reflects objective cause-consequence relations existing between the level of intensity of natural resource use, the level of environmental pollution and other forms of ecological system degradation on the one hand, and the necessity of adequate compensatory expenditures for the regeneration of life support services and natural resources, on the other hand.

The effect of this "law" is preconditioned by the fact that no activity can function without utilizing the natural resources of the planet and without having some environmental impact. Therefore, in the process of mankind's development, there arises the necessity for an increasing expenditure of money for ecological purposes.

Ignoring the influence of this "law" on the economic system results in the degradation of the quality of life support services, in the depletion of the natural resources and finally in the need for new ecological expenditures to combat the increased probability of ecological losses. Thus, socioeconomic impoverishment follows. Application of this law in social practice at the global, national, regional, and local levels is a prerequisite for balance between ecological and economic systems, and for sustainable development to occur.

The law would appeared to be confirmed by empirical evidence, which demonstrates the relationship between intensity of the use of natural resources, the quality of life support services, and quality of human life itself. This law will be in effect until the reasons for its existence, such as non-compensatory use of natural resources and non-compensatory destructive changes in the environment of life, take place. It is possible to decrease its effect by optimizing the interaction between the society and nature. This requires agreed actions at regional and global scales. In order for such actions to become a reality, it is necessary to replace the traditional economic criterion of the evaluation of efficiency in production by a unified ecological-economic one.

In accordance with this law "ecological costs" should be included into the list of production expenditures. "Ecological costs" in the structure of the cost of production and services can perform a double function. First of all, it can forestall anti-ecological economic activity and stimulate rational use, protection, and regeneration of natural resources. Secondly, it can become a source of the replenishment of the funds, directed at the financing of the environmental protection and development of new ecologically safe technologies.

4.5 Principles for the Ecological Economic Evaluation of Environment and Natural Resources

The depletion of natural resources, implies loss of ecological potential, which it will be necessary to renew in the future. It is also implies the degradation of the life support services, which would have to be improved at the expense of future investments.

The goals of preventing the loss of ecological potential and achieving sustainable development may be reached by two ways. The first is to bring the production technology into correspondence with ecological imperatives, to provide it with ecological orientation, and, to structurally entwine ecological factors in the fabric of the corresponding technologies. The second is goal-oriented environmental protection activity. These often overlap. In particular this overlap takes place in extractive branches of industry, in agriculture, forestry, water management, as well as other spheres of production activity connected with the use and regeneration of natural resources. Complete unification of these two ways will, in the future, become a new stage in the development of human civilization. In order to achieve this, we should be guided by principles for the ecological economic evaluation of life support services and natural resources – along the following times:

- The principle of complexity: the registration and evaluation of all interdependencies between life support services and natural resources in different territories and in their relationship.
- The principle of scarcity: weighting the relative scarcity of individual components and conditions of life support services and natural resources.
- In accordance with the requirements of these principles a comparatively higher weight is given to the irreplaceable, non-transportable life support services and resources, as well as conditions and resources, which are in shorter supply in comparison with others.
- The principle of the regional differentiation: this which envisages the different levels of evaluation of the qualitatively identical conditions of the environment of life and natural resources (space evaluation).
- The principle of evolution: evaluations and forecasts, should take into account possible changes in ecological and economic conditions in future. This can affect the relative scarcity of individual ecological services and natural resources.
- The principle of feedbacks: taking into account boomerang effects (negative ecological effects).
- This implies consideration in economic calculations of the mutual influence of economic activities on life support services and natural resources and vice versa.

4.6 Criteria for the Ecological Economic Cost Effectiveness in the Natural Resource Use

Production of goods and services toward to satisfying individual and social needs on the one hand, and the desire to maintain ecological conditions on the other hand, implies a new economic category – ecological economic cost-effectiveness or "ecoeconomic cost-effectiveness". Illustratively, the relationship between economic effects, reflects economic activity, and ecological effects is shown on figure 4.3 on the coordinate axis are economic effects. On the abscissa axis – are ecological effects. This illustrates the notion "ecoeconomic cost-effectiveness".

Integral ecological-economic effect of environment of life, natural resources as well as of other production-economic activity is an algebraic sum of two different in nature effects – traditional economic and ecological ones. These effects are achieved, as a rule, with a different lag and, only in some cases, simultaneously. Traditional economic effect is, as a rule, positive while ecological one could be both positive and negative. The negative effect is the most urgent one.

The ecological effect reflects changes, in space and time, of life support services and natural resources under the influence of different factors. These changes may have both positive and negative character – improvement or degradation of man's life conditions, increase or decrease of the quantity and quality of natural resources.

The ecological-economic effect is based on the net economic effect of the production-economic activity minus ecological costs and losses. The notion of "ecological economic cost-effectiveness" equally corresponds to the development laws of society and nature and therefore satisfies the principle of sustainable development.

A rough measure of ecological economic cost-effectiveness is the ratio of the value of the integral ecological-economic effect of the production-economic activity to the sum of traditional economic and ecological expenditures.

The integral ecological-economic effect, achieved at minimum social costing, is an important factor in sustainable development.

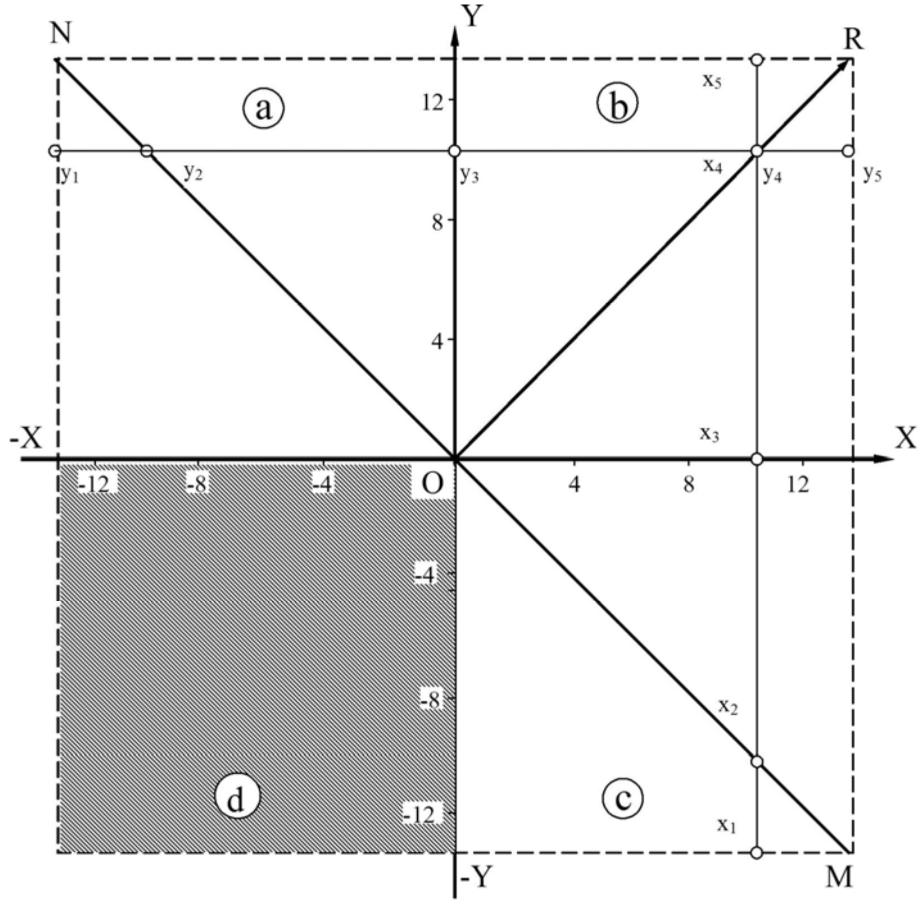

Fig. 4.3. The criterion of ecological economic "cost effectiveness" in production
X scale – size of the ecological effect; Y scale – size of the economic effect; NOM – discriminate of the positive and negative ecological economic (E-E) effect; OR – vector of the optimal E-E effect; XI, X2, X3, X4, X5 / Yl, Y2, Y3, Y4, Y5 – types of the hypothetical monetary value of the annual ecological economic effect in industrial activity.

The criterion for the efficiency of an economic system, (that will also satisfy the requirements for sustainable development), is the maximization of the integral ecological-economic effect.

A sample numerical example follows. Hypothetical evaluation of the ecological economic efficiency is carried out by means of the five-point scale in table 4.2.

The mathematical formulas for the evaluation of different types of production activity given in the table 4.2 are presented in the simplified form in the table 4.3.

Supposedly, there are five hypothetical types of technologies for the production of some product. In the real life the number of these types could be numerous. If we calculate the results of industrial activity of the firm according to the traditional criterion of economic efficiency, then the annual economic effect of in all five types of activity, given in figure 6, will be equal in value – 1 million dollars.

Table 4.2 Ecological-economic evaluation of economic production activity

No. of variant	***VARIANT chosen***	**ANALYTICAL EVALUATION OF CONDITIONS**		
		GENERAL	Natural Use	Nature Conserving Use
1	INEXPEDIENT	$\sum_1^T Exy < 0$	$Ey - Ex < 0$	- Ey > Ex
2	PERMISSIBLE	$\sum_1^T Exy = 0$	Ey – Ex = 0	- Ey = Ex
3	SATISFACTORY	$\sum_1^T Exy > 0$	Ey – Ex > 0	- Ey = 0
4	OPTIMAL	$\sum_1^T Exy$ = Ex+Ey	Ex = Ey	Ey = Ex
5	MONOEFFECTIVE	$\sum_1^T Exy$ > Ex+Ey	Ex > Ey	Ey > Ex

Table 4.3 Hypothetical monetary value of the annual ecological economic effect in industrial activity

Type of the technologies	***Hypothetical value of the ecological economic effect***		
	Natural use	Environmental conservation	General
1	Exl= -1400.0 Eyl=1000.0 ΣExy=-400.0	Exl=1000.0 Eyl=-1400.0 ΣExy=-400.0	ΣExy=-800.0
2	Ex2=-1000.0 Ey2= 1000.0 ΣExy=0	Ex2=1000.0 Ey2=-1000.0 ΣExy=0	ΣExy=0
3	Ex3=0 Ey3=1000.0 ΣExy= 1000,.0	Ex3= 1000.0 Ey3=0 ΣExy= 1000.0	ΣExy= 2000.0
4	Ex4= 1000.0 Ey4=1000.0 ΣExy= 2000.0	Ex4= 1000.0 Ey4= 1000.0 ΣExy= 2000.0	ΣExy= 4000.0
5	Ex5= 1400.0 Ey5=1000.0 ΣExy= 2400.0	Ex5= 1000.0 Ey5= 1400.0 ΣExy= 2400.0	ΣExy= 4800.0

In the traditional input-output formula of calculating profits (benefits) the specific type of technology producing 1 million dollars does not matter for the firm.

It does not matter for the firm which type of technology to use:

- The technology polluting environment, worsening the quality of ecosystems or even damaging it (type 1).
- The technology having less negative influence on the environment and producing benefits equal to ecological losses (type 2).
- The technology having no visible negative influence on the environment and producing net benefits without ecological losses (type 3).
- The technology doubling the unified ecological economic effect due to improving the quality of environment in the course of production (type 4).
- The ecological technology causing larger positive ecological effect than the traditional economic one (type 5).

As I have mentioned before, in the traditional criterion, it makes no difference for the firm which type of technology will produce 1 million dollars. But, if we use the new ecological economic criterion, which is the key concept of the ecological economics, then it will turn out that public efficiency (net efficiency) of these 5 types of technologies will be far from equal.

In the first type of production $1 million of benefits for the firm will turn out into $ 400,000 losses for the society (see figure 6). This happens because to compensate for ecological losses, caused by this type of technology, the society will have to spend $ 1,400.000. The benefits of the firm are $1 million, but the losses to the society are $1,400, 000. The difference according to ecological economic criterion is 1,400.000 -1,000.000 = -400.

In the second technological type $1 million of benefits will turn out into zero benefits for the society. All the benefits should have been spending to compensate for ecological losses, caused by the industrial activity of the firm. So the future ecological costs to the society will be equal to the benefits of the firm.

The difference according to ecological economic criterion is 1,000.000 – 1,000.000 = 0.

In the third technological type the benefits of the firm will be real, as its activity have not caused ecological losses. The benefits of the firm will not cause any losses to the society, as there will be no ecological losses. The difference according to ecological economic criterion is 1,000. 000 – 0 = 1,000.000.

The fourth type is even better, it could be called the 'optimal' one, as it satisfies both ecological and economic requirements. However, it is extremely difficult to achieve this type of technology in the real life. In this type the benefits cause the equal positive ecological effect. The difference according to ecological economic criterion is 1,000. 000 + 1,000.000 = 2,000.000.

This fourth type satisfies the sustainable development principle announced by Rio-92. This type of technologies should be a final goal for the individual subjects of national economics (firms), international firms as well as for the countries as it provides for long term sustainable social economic development.

And, finally, the fifth type is possible. In it the positive ecological effect exceeds the traditional economic one. The difference according to ecological economic criterion is 1,000. 000 + 1,400.000 = 2,400.000.

4.7 Ecological Economic Criterion for the Evaluation of Natural Resource Use: Forestry as a Case

Forests can be considered a biologically renewable natural resource, i.e. they have capacity to regenerate themselves. At the same time, forest and forest resources present a very good model for the eco-economic system.

The problem of ecological-economic cost-effectiveness of expenses in forestry is so complex that the approach used to solve it can illustrate the possible ways of solving ecological economic problems in general.

The summary effect of investments into forestry can be divided into a traditional economic effect of timber sales, ecological effects of oxygen production and water regulation, and other useful functions of the forest. Thus, current forestry should be considered, on the one hand, as an organizationally formed, independent branch of material production and, on the other hand, as an integral part of the material goods production process. Understanding of these two aspects of forestry is important to any of the ecological-economics analysis.

Economists have argued that the "timber age" has not come to an end yet, but that wooden raw material, probably, will become one of the scarcest biological resources in the future. However, we should keep in mind that the forest is not only a source of obtaining timber. First of all it is one of the most important components of the biosphere. Scientific research has verified that forests synthesize more than 50 % of atmospheric oxygen produced by the vegetation of the entire planet. If we add to this other functions of the forest such as its influence on the water regime and climate and its protection of soils from erosions one should acknowledge that forests from a young age till their maturity have a real economic value for a society.

As an independent structural component of the biosphere and an object of the economy, forests benefits for society which are connected among themselves as well as with the external environment. They may be divided into four main groups presented on fig. 4.4. Considering forest as the DMFR system, we try to embrace all the aggregate of its multilateral components – carriers of consumption value – and to take into account ecological factors while evaluating their use.

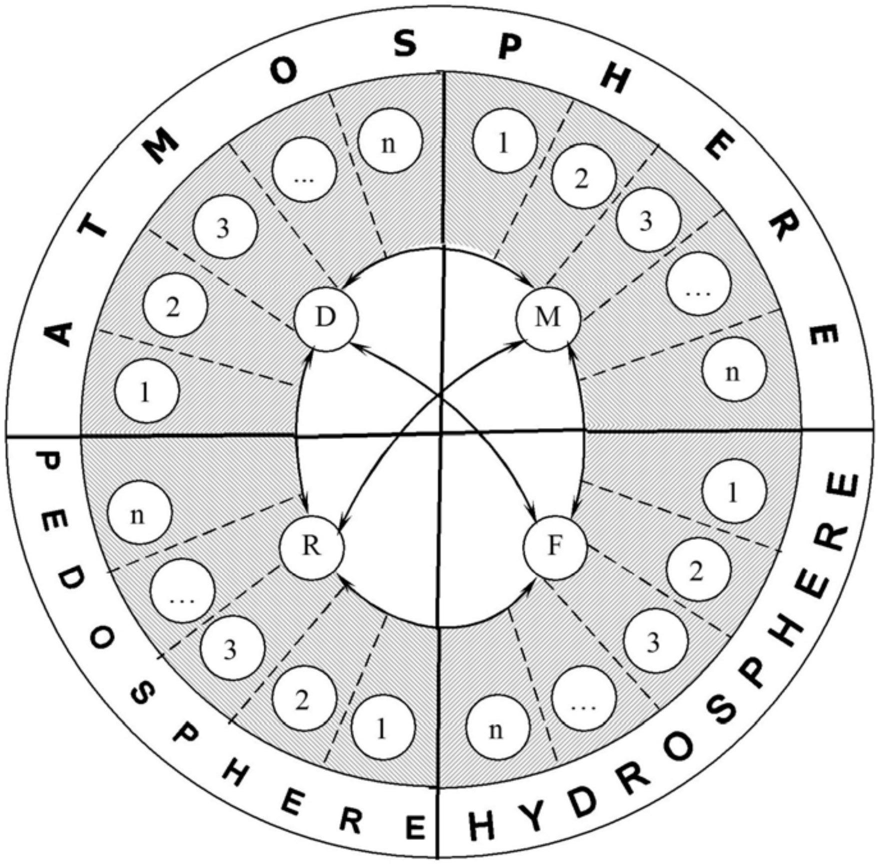

Fig. 4.4 The forest ecological economic system: the interrelationship of potential products and services, where D – raw material resources of wooden origin; M – resources of non-wooden vegetable origin; F – resources of animal origin; R – multiple useful functions (services) of the forest, its influence on the environment.

Besides, one should keep in mind that DMFR system is closely connected with the external environment, first of all with pedosphere, hydrosphere, and atmosphere. That is why, the forest ecosystem should be considered as PHDMFRA system. All relations in this system are fulfilled through pedosphere, ground waters, and atmosphere. As we can see, forest, as a DMFR system is quite an obvious model for the unification of the economic and ecological systems into a unified eco- economic system. The process of the forest use is a mere reflection of the real process of the use, protection, and regeneration of biologically renewable natural resources.

In the table 4.4 the approach to evaluation of the different types of forest management development according to E-E criteria is illustrated.

Table 4.4 Evaluation of forest management development according to E-E criteria

Types of development	***Analytical demands on the evaluation according to E-E criteria***			***Evaluation of the development possibilities of forest management***
	Use of forest resources	Reproduction and conservation	General	
1	Ey + Ex < 0	Ex + Ey < 0	$\sum_1^T EExy < 0$	Inevitable degredation
2	Ey + Ex = 0	Ex + Ey = 0	$\sum_1^T EExy = 0$	Lack of development
3	Ey + Ex > 0	Ex + Ey > 0	$\sum_1^T EExy > 0$	Satisfactory development
4	Ey = Ex	Ex = Ey	$\sum_1^T EExy = Ex+Ey$	Good development
5	Ey > Ex	Ex > Ey	$\sum_1^T EExy > Ex+Ey$	Very Good development

4.8 Conclusion

Considerable worsening of the environmental situation at global, regional, and local levels has provoked a new way of ecological-economic thinking. It is quite clear that nowadays it is unacceptable to act in accordance with traditional views of human influence on the environment, and traditional methods for evaluating economic activity. It is necessary to develop new methods for the evaluation of economic activity which are sensitive to the growing influence of the economy on its environment.

By applying the methods of natural and social sciences, engineering ecological economics attempts to find the interconnection between these sciences and the human intellectual ability to ensure sustainable development. In the future sustainable development may be achieved by stimulating preventive protection of the environment by ecological redesigning of all the spheres of production as well as meeting ecological requirements in all other fields of human activity. In order to achieve sustainable development, ecological effects should be included in the economic choices assessment.

Ecological economics points out the ways in which an economic incentives system may prevent environmental damage. It can also suggest levels of compensation for the inevitable ecological damages, which occur without the violation of environmental protection legislation. These damages should be compensated by the responsible industrial and commercial structures. Thus, ecological economics theory provides the ways for achieving the goals *of sustainable development.*

Environmental problems should be solved not only by specially empowered bodies, and relevant institutions but by society as a whole.

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Методологічний підхід до оцінки ефективності еколого-економічної системи

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Між економічною та екологічною підсистемами єдиної еколого-економічної системи існує причинно-наслідкова залежність. Розвиток, стабілізація та деградація однієї з них неминуче позначаються на іншій.

Традиційна ринкова економіка засадничо суперечить екологічним вимогам, тому нагальним завданням сучасної економічної науки має стати формування нової – екологічної економіки. Принципи екологічної економіки мають запанувати у всьому світі, адже планета Земля – цілісна взаємопов'язана глобальна еколого-економічна система. Оновлену економічну політику держав потрібно грунтувати на трьох основних складниках: екологічній моралі (виховання нової ментальності); екологічній економіці; екологізованому праві. Ці компоненти мусять бути визначальними для державних інституцій і політичних сил. Завдання економістів-екологів – обґрунтувати органічну єдність еколого-економічної системи як у макро-, так і мікроекономічному вимірах, виявляти основні суперечності між економічними та екологічними вимогами, запропонувати шляхи подолання їх на галузевому й територіальному рівнях.

Домогтися сталого розвитку неможливо без економічно та екологічно ефективного виробництва у поєднанні зі зміною структури споживання. У багатьох випадках це потребуватиме переорієнтації існуючих систем виробництва та споживання (які склалися у промислово розвинених країнах і стали прикладом для наслідування у всьому світі) на універсальний еколого-економічний критерій.

Екологічний ефект – це будь-які зміни якості умов природного життєвого довкілля у просторі та часі, а також зміни кількості та якості природних ресурсів. Вони можуть бути як позитивні, так і негативні. Від екологічного ефекту узалежнені економічні результати матеріального виробництва і невиробничої сфери. Для екологічних ефектів властиві такі ознаки: походження; форма прояву; можливості кількісного виміру; характер взаємозв'язку з традиційним економічним ефектом; синхронність; можливість повернення до статусу-кво; тривалість дії; прогнозованість; масштаби дії; мотивація.

Негативний ефект може виявитися у вигляді прямих ресурсних втрат для національної економіки або у вигляді непрямих збитків, спричинених зниженням якості (пошкодженням) інших видів природних ресурсів, погіршенням умов природного довкілля (забрудненням, повенями, ерозією ґрунту тощо), шкідливим впливом на людське здоров'я .

Інтегральний еколого-економічний ефект природокористування чи будь-якої іншої господарської діяльності є алгебраїчною сумою двох різних за формами прояву ефектів. Інтегральний еколого-економічний ефект, якого досягнуто за мінімальних витрат суспільної праці і природного (екологічного) потенціалу, є важливим чинником орієнтації будь-якої економічної системи на забезпечення принципу сталого розвитку. Критерієм ефективності функціонування економічної системи, зорієнтованої на забезпечення вимог сталого розвитку, є максимізація тривалого інтегрального еколого-економічного ефекту.

Chapter 5

Transdisciplinary Approach to Sustainability: New Models and Possibilities

Lidiya Hryniv[1]

Abstract Theoretical and methodological problems of the ecological economics and the estimation of functions of ecosystem services have been investigated. The content of basic categories of spatial economic analysis of sustainable use of natural resources has been determined. Theoretical aspects of noospheric model of ecologically sustainable development and its functions in economy have been considered.

5.1 Introduction

It has been sixteen years since the UN adopted the concept of sustainable development of the Earth. However, we still have not got an integrated mechanism for this concept realization since some theoretical problems havent have been solved yet. Modern economy in the process of natural resource utilization goes on ignoring the requirements (demands) for preserving the natural capital of the planet, and recognizing the only model of productive function of the economy as the basic one. At the same time, it can observed a situation when a further economic expansion becomes irrelevant as it exhausts the existing potencial of natural resources and destroys the biosphere. Obviously, it is the fact that the economy of the 21st century is not capable of being developed according to the old models since it entered the epoch when the natural capital and its biological productivity become the main limiting factor of its further development. This epoch can be characterized by greater losses of biological diversity causing the decrease in overall production of the photosystesis on the Earth which is the major food production sourse of the planet. In case if the economy continues neglecting this limiting factor in the near

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future it may completely destroy the biosphere resource for a further existence of humanity.

The natural ecosystems changes that have enveloped the modern world continue to remain one of the most important global problems of the humankind existence. In a short-term period these natural changes lead to economic fluctuations conditioned by the necessary compensational losses whereas in a long-term period the decrease in stableness of exchange process in the biosphere causes violation of stability in market equilibrium in economy and conditions inflation processes. Under such circumstances there is a need to talk about the modem system definitions of the natural changes as an endogenous factor for the related economical changes. However, these economic changes have not been adequately reflected in macroeconomic analysis so far, which does not provide a possibility to give an advanced notice to their development.

5.2 Classic Economic Theories Failures and Sustainable Development Challenges

Sustainable development can be presented as an optimal trajectory of the humankind movement with its possibilities and restrictions. In this context, the attention has to be paid to the theoretical and practical matters of this development.

Firstly, the functioning of economy within the boundaries of the global ecological economic system characterized by the limited possibilities of pure water production and production of the photosynthesis on surface requires the review of the structure of the macroeconomic models that should be based upon the spatial laws of the natural process. For that purpose the ecological proposal (supply) of the natural capital should be defined on the basis of the modeling its biophysical function.

Secondly, the theory of the macroeconomic balance does not provide the self-organization of the ecologically sustainable economics. For that reason the market mechanisms in the use of nature resources have to be supplemented by the mechanisms of provision for the sustainable functioning position for the ecological-economical systems that are the non-balancing systems. The preservation of the biological productivity of the natural capital based on the law of the biological mass preservation should be the major criterion.

Thirdly, the theoretical economics cannot be just limited to the modeling of merely production function. The necessity arises to model the sustainable natural use (utilization) function, which can be named as the noosphere function. We propose the model of the noosphere function as a qualitatively new one of the sustainable development, and it consists of the following three functions: negentropy function; biophysical function of the ecological-economical systems; the function of the natural capital consumption. This enables us to have a different approach to a definition of the sustainable development indicators. The realization of the sustainable development of the world conception has to be adequate to its diversity. There is an apparent inequality between the rich and poor countries regarding the use of the natural capital of the planet and production of wastes. Under conditions of the ever-increasing deficit in mineral and energy resources and the threats of the global ecological disaster, the mechanisms of investment projects financing directed at the international sustainable development need to be changed.

The wider development of the swapping transactions can be considered as prospective in this direction for the post-socialist countries, as mutually beneficial transactions of the exterior debts accounting in exchange for the nature protection measures.

A very negative phenomenon that does not favor to the realization of the sustainable development of the world is the practices of the poor countries in rent seeking in the field of natural resources use. In the countries that have a developed market economy the rent searching favors the stimulation of the innovations in production and in nature protection fields of activities whreas in the existing transition economies in the course of rent searching process nothing primarily has been improved neither in production area, nor in that of the use of nature but only the redistribution of costs occurs. This has been accompanied by the further transformation of the price formation mechanism that does not reflect the level of the limit scarcity of the natural capital resources, but also leads to the ever more ineffective use of nature with the purpose of increase in shadow export transactions. Such practices worsen the global ecological situation.

Hence, the modern stage of the sustainable development has to draw the world economy to the needs of the harmonious coexistence of the nature and society as close as possible through the formation of the new geological cover of the planet, which is noosphere. In its turn, this requires the development of the new methodological approaches and new technologies for its implementation on practice.

Nowdays ecological and economic crisis is explainedby inability of economic science to meet the new challenges connected with determination of the cost of services of natural capital for the natural environment and economy. Underestimation of the reserves and resource flows of nature leads to the negative results both in economic and socio-ecological development.

5.3 Economic Evaluation of Natural Capital and Ecosystem Services

Economic evaluation of natural capital has to consider the cost of its elements and services both for the economy (business) and for preservation of processes that allow to keep ecosystems stability and that are taking place between terrestrial ecosystems and external natural environment (biosphere). This causes the need for a more detailed methodological study of the peculiarities of nature capital reproduction. More attention should be paid to transdisciplinary issues which are related to to the peculiarities of functioning of terrestrial ecosystems.

Thus, how do the terrestrial ecosystems function? What does restrict services of the ecosystems? What is the end result of the functioning of terrestrial ecosystems?

The processes on the Earth are taking place in the thermal shell of the atmosphere that has the ability to retain a certain temperature level in certain territory.

For this reason it is possible to state that isothermal processes do occur on the Earth's surface and, thus, in the terrestrial ecosystems. As the solar energy that appears to be the main driving force of all conditions and processes on the Earth, is delivered in cycles, these conditions and processes have also a cyclic character. Each process has its definite designation, that is, performs a certain work. Therefore isothermal processes can be interpreted as the processes connected with a free exchange of energy and entropy between the system and external environment. Free energy serves as the principal source of work in "isothermal process" and consists of internal energy E and energy characteristic of entropy in the system with "-"sign, that is, negentropy T. Thus, negentropy + is the measure of orderliness of each physical system, and T – temperature of the system that corresponds to -273°C or = 0° Kelvin. The minimal order is an even distribution, absence of any temperature gradients and other fields of force. There is no source of the processes in a condition with the minimal negentropy.

Global climate changes are not only the result of the increased emissions of carbon dioxide and other gases into the atmosphere, but first of all a result of excessive pressure on the terrestrial ecoystems. This results in the depletion of their resources which disturbs the mechanism of exchange processes and, therefore, stability of biosphere. The losses of biodiversity become irreversible and this means that tendency of deterioration of stability of the existence of terrestrial ecosystems has a progressive character.

In order to prevent further destruction of terrestrial ecological systems the need has appeared for theoretical modeling of their functions and determining the norms of conservation and consumption of natural capital which are spatial-economic norms and depend on biophysical parameters of nature stability.

The components of natural capital play a decisive role in the economy of every country. Being variable in the production function of economy they are also an essential factor of production as well. However, the elements of natural capital participate in exchange mechanisms with their energy and material playing a clearly defined function in local biogeocenoses along with essential performance of the production function of the economy. Thus, one may say, that nature capital not only forms a foundation for economic processes implementation, but also for the demand of "biophysical" consumer, that is, for every local biogeocenosis.

Economic productivity of natural capital depends on the level of conservation of biomass in terrestrial ecosystems. For this reason the most up-to-date ecological economic theory must rely on the theory of V. Vernadskiy. Today there are all reasons to think that the initial paradigm of sustainable development was developed in the publications of V. Vernadskiy, in which he presented analysis of ecosystems conservation (Vernadskiy 1944).

Ecosystem approach to evaluation of the elements of natural capital will take into consideration both their economic opportunities, and biophysical limits of their consumption in accordance with entropy law as well. Consumption of natural capital must be made taking into account peculiarities of not only economic behavior of consumer, but also that of "ecological behavior" of every biogeocenosis. In this sense it is necessary to proceed from biophysical regularities of its stability when analyzing factors of the function of consumption of nature capital.

The principal purpose of each ecosystem is conservation of solar energy. That is, the inflow of solar energy is balanced by the loss of energy in the form of infrared radiation to the rest of the Universe. This testifies to the fact that the established negentropy (orderliness) in each natural subsystem of the ecosociosystem is stable initially and depends of its temperature characteristics which are the boundary of its stable homeostasis. This negentropy as natural orderliness which according to the law of biomass conservation by V. Vernadskiy ensures homeostasis in biosphere, an can be regarded in our opinion as the spatial capital of biosphere, as it is the main factor of conservation of energy and matter flows in the planetary EESS (ecological-economic-sociosystems).

This negentropy can be accumulated or dissipated in the process of the nature use. For this reason investigation of ecological sustainability of the resources of nature capital must be made from mesolevel to macrolevel. Each territory has its temperature and other peculiarities on which the speed of heat exchange with the natural environment and the capacity volume for functioning of ecosociosystem depend. Thus, natural capital of each EESS we interpret as both, reserve (action) of free energy F, which depends on the volume of accumulated orderliness (σ). and disorderliness (S_n) forming the potential of its capacity for work. In this context we can speak of ecological proposal EESS Q as of the function of energy equivalent of its nature capital:

$$Q(F) = Q(E + \sigma - S_n), \tag{1}$$

where: Q – EESS ecological proposal;
F – EESS free energy;
E – internal energy in EESS;
σ – negentropy in EESS;
S_n – entropy in EESS determined by the performance of biophysical and economic work.

This universal function pertains to all elements of nature capital and proves the fact that in spatial coordinates the entire nature capital is critical, as it supports the planet live environment which is biosphere.

That is why conservation of this global ecosystem and its spatial components must consider the laws of their energy reproduction. Spatial non-uniformity of biosphere, according to V. Vernadskiy theory regulates the natural level of orderliness (negentropy), which is the determining factor of conservation of biomass in each ecosystem. Thus, the model of ecologically sustainable development of economy must also reflect the factors of energy besides only of economic reproduction of the stability of natural capital.

Ecologically sustainable condition of an eco-socio-system can be considered as condition to which it returns with its own internal regularities, continuously reproducing parameters of its natural subsystem and ensure stable stationary conditions of its functioning. Special attention should be drawn when defining the meaning of the formation of stable conditions in ecosociosystems that this stability combines the two fundamental characteristics as the produce of economic product and the product of nature (biomass). These conditions do not converge with the equilibrium of economic processes at all. They must also find an adequate reflection in macroeconomic identities through the functional dependence of the volume of the use of nature on the volume of energy equivalent of local nature capital. On the macroeconomic level this means, that the volume of gross domestic product created in the sphere of the use of nature is determined not only by exclusively economic components Y = C + I + G + NX, but also by biophysical components of aggregate ecological proposal (Y_1):

$$Y_1 = C_1 + I_1 - A_1; \tag{2}$$

The general regulator for an EESS from the standpoint of cybernetics is a special form of organization of feedback preserving the unity of quantity and quality of the system, i.e. its measure or boundary. Such measure for each EESS is conservation of natural stability of biological productivity of its natural capital (Hryniv 2001).

Every natural EESS subsystem has a boundary of orderliness which cost is P_{gp}. Dissipation of this orderliness in the result of inadequate use of nature explains the reasons of ecological disbalance of EESS, for the change of the value of their stationary temperature regime testifies to the change of not only quantitative, but also qualitative boundaries of their natural self-organization. This means that for each biogeocenosis as an ecosystem and a component of the biosphere there is a natural boundary of percentage of forest land, a boundary of atmosphere transparence, a threshold of saturation with living matter, a threshold of humidity, etc. All these threshold values must be known by humans so that they would be able to prevent destruction of the environment. Thus, to ensure ecologically sustainable use of nature it is necessary to consider not only the demands of economy, but also biophysical demands of EESS for conservation of this orderliness and, therefore, of biomass of nature capital. The reserve of free energy as the energy equivalent of the working capacity of nature capital (K_n) can be changed in the following directions:

1) receipts of "investments" of negentropy leads to the growth of aggregate reserves F;
2) increase of aggregate entropy S_n leads to the reduction of reserves F and, therefore, reduces bioproductivity K_n in the long-term period.

Thus, in order to achieve a stable bioproductivity of nature capital K_n it is primarily required, that the following condition is observed:

$$\delta - S_n = P_{gp} > 0, \tag{3}$$

where P_{gp} – cost of biophysical orderliness K_n.

Thus, let us determine a natural threshold tendency of ecosystem to conservation of biomass Kn. According to the law of conservation of biomass the norm of conservation Kn in EESS is equivalent to Pgp. If internal energy of terresrial ecosystem is a constant, then

$$Q = Q\,(P_{gp}). \tag{4}$$

Our task is similar to Solow model, however it investigates a biophysical function of a nature capital with the purpose of its evaluation.

$$\Delta P_{gp} = \delta - S_n \tag{5}$$

$$S_n = h \cdot P_{gp} \tag{6}$$

$$Q = c + \delta = (1 - S)\, Q + \delta \tag{7}$$

where, S – norm of conservation; h – depreciation coefficient.

Wherefrom we receive:

$$\delta = S\, Q. \tag{8}$$

In order to achieve stability of an ecosystem it is necessary that it acquire a stationary condition, that is:

$$\Delta P_{gp} = \delta - h \cdot P_{gp} = 0 \tag{9}$$

$$P*_{gr} \frac{\delta}{H}. \tag{10}$$

Thus, at this cost of biophysical orderliness P*gp the ecosystem is in stationary condition.

Let us find the level of the "golden rule" characteristic of Solow model. Threshold productivity Kn will be equal to:

$$MPK = Q\,(P_{gp} + 1) - Q(P_{gp}), \tag{11}$$

where MPK – threshold productivity of nature capital.

Under the "golden rule" the net threshold product of nature capital is equal to the norm of its depreciation.

$$MPK - h = 0 \text{ or } MPK = h. \tag{12}$$

Thus, ecologically sustainable use of a nature in TEESS is such use of nature, in which maximal conservation of natural orderliness of the ecosystem is achieved. With the reserve of natural orderliness (negentropy) of TEESS which conforms to the "golden rule" of accumulation conservation of nature capital achieves it maximum and the norm of its economic consumption must be equal to the norm of its depreciation. Such a metrological approach to determination of the norm of an ecologically expedient economic activity within the limits of a local space provides new opportunities for introduction of protection mechanisms in the sphere of the use of nature. The cost of biophysical orderliness formed on the basis of an ecological demand for conservation of stability of each land ecosystem is the road sign which combines interests of nature and interests of spatial economy. Nature-economic norm setting for maximal conservation of the stability of bioproductivity of nature capital provides additional chances for conservation of biodiversity of the planet.

Thus, the following consequences can be summarized:

1. Absence of an effective mechanism of realization of the concept of sustainable development is explained mainly by inadequate interpretation by neo-classical theoretical economics of the "natural capital" category and its spatial-biophysical functions in the environment.

2. Determination of the system that estimates biophysical orderliness for the norm setting of of ecosystem's stability conservation creates new prerequisites for application of preventive (but not compensating) economic mechanisms in the field of the use of nature resources.

3. Implementation of economic activity ecologically expedient norms for consumption of nature capital within the boundaries of a local space will provide an opportunity of maximal conservation of biodiversity for future generations.

5.4 Ecologically Sustainable Economy and Spatial Modeling

The concept of the formation of ecologically sustainable economy (ESE) – which is opposite to the existing concepts – considers economy as a system functioning in isothermal regime within the boundaries of the global ecosystem of the planet – biosphere and is determined not only by the factors of production function, but also by the spatial-ecological factors of preservation of its durability. The model of life-preserving economy is outlined in the context of this concept which in its essence is a noosphere model based on the new system of parameterization of the restrictions related the use of nature resources. This new approach gave the opportunity to combine the subject of macroeconomic research with spatial economic modeling of the functions of nature capital consumption which will facilitate biodiversity conservation.

Also we propose an estimate of correlation of natural processes of energy and matter exchange, as well as that of socio-economic processes in terrestrial ecological-economical-sociosystem (EESS) as the object of realization of the concept of sustainable development. The project has proved that self-organization of the EESS takes place on the basis of reproduction of stable stationary conditions of its natural subsystem. The project pioneers determination of EESS energy reproduction and evaluation of their relationship with economic reproduction. It also proves, that their production function is a derivative of thermodynamic functions of free energy forming the ecological proposal depending on the two forces – "investment" of negentropy and the volume of entropy. It presents the theoretically modeled TEESS behavior in the processes of the use of nature resources which has permitted to determine spatial-economic factors of preserving its effectiveness and initiate the new methodological approach to ensuring a balanced EESS development as the foundation of effective policy of conservation of biodiversity.

The terms "spatial coordinate of the function of nature capital energy" and "EES ecological proposal" as categories are linking biophysical and spatial-economic criteria of conservation of stability of nature capital. Introduction of these terms and models into the theory ecological economic evaluation of the use of nature resources opens up new methodological opportunities for further research of the problems of ecological balance of the use of nature from the standpoint of its spatial-economic structure. This provides an opportunity of modeling qualitatively new spatial functions of reproduction of nature capital as land ecological systems which, unlike the functions of sustainable development adopted in modern macroeconomic analysis, aim at prevention of destruction of the environment through conservation of biodiversity in spatial-temporal coordinates.

The new in principle methodological proposals reveal the essence of the system of ecologically balanced use of nature, which implies observance of correspondence of the extent of the use of nature capital to biophysical limits of its reproduction through the function of negentropy. It has been proved, that the function of negentropy of economy of the use of nature counteracts dissipation of natural orderliness of every local biogeocenosis in the process of economic activity and, therefore, ensures ecologically balanced use of nature and conservation of biodiversity. This studies substantiates the determining role of this function in the development of ecologically balanced economy for it is the function of o the new bio-social cycle formation which at the same time creates the new orderliness in the environment and economy.

This research proves that as far as every natural EES subsystem has a limit of orderliness which is a necessary prerequisite for preservation of its biophysical effectiveness in the future to ensure ecologically balanced use of nature it is necessary to take into account not only the demand of economy for natural resources, but also biophysical demand of EES for preservation of this orderliness and, thus, biomass of nature capital. Prevalence of the level of orderliness (negentropy) over the level of disorderliness (entropy) is the dynamic indicator determining biophysical effectiveness of EES and the source of conservation of organic life on the planet. The potential of orderliness of each ES can be interpreted as its spatial capital, as it creates new flows of energy, matter and information. Substantiation of this category permitted formulation of principal spatial-economic identities of EES balanced development as supplements to the identities of macroeconomic equilibrium.

5.5 Conclusion

The chapter defines the place of spatial-economic analysis in macroeconomic research of ecologically balanced use of nature. It proves, that the volume of gross product produced in the sphere of the use of nature is determined not only by such economic components as consumption, investments, public purchases and export-import flows, but also by biophysical components of cumulative ES ecological proposal which are the functions of their stable stationary conditions. The studies of interdependencies between the components of cumulative proposal of ecological benefits and cumulative proposal of economic benefits calculated on the basis of aggregation of relevant indices of mesolevel EES allowed to identify the new functions and norms of ecologically balanced use of nature. New spatial-economic factors of balanced development of EES which are not considered in the fluctuations of market prices and were not taken into account previously have been implemented into macroeconomic analysis.

Modeling of the function of ecological proposal of EES has been made. New criteria of ecologically balanced use of nature are proposed which consider the factors of conservation of biological productivity of nature capital in the long-term period of time.

Methods of determination of the indicator of ecological balance of economy that as opposed to the pure economic effeciency methods are based on taking into consideration of the EES orderliness potential have been suggested.

Index of normative scope of biomass conservation of EES nature capital as a qualitatively new parameter of the economy of the use of nature determining conservation of biodiversity has been defined.

The function of ecologically balanced use of nature capital has been modeled. This allowed to suggest new methodological approach to determination of the norms of the use of nature which contrary to the pure economic efficiency calculation methods can prefent harmfull influences on the environment.

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Трансдисциплінарний підхід до сталості: нові моделі та можливості

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У цьому розділі досліджено теоретико-методологічні проблеми екологічної економіки і зокрема, оцінки екосистемних послуг. Запропоновано трансдисциплінарні підходи до моделювання складних еколого-економічних взаємозв'язків на рівні наземних екосистем. Розкрито зміст категорій просторово-економічного аналізу природокористування. Запропоновано заповнити "білі плями" теоретичної економіки, пов'язані з визначенням екологічно доцільного масштабу господарювання в межах просторових природно-господарських систем, тобто екосоціосистем. Врахування регламентуючих чинників, які визначають регенеративну здатність наземних екологічних систем як природного капіталу планети, дасть змогу запобігти їх подальшому перевантаженню. Особливо актуальним питанням є визначення екологічно доцільних норм обсягу видобутку ресурсів природного капіталу в межах локального простору.

Запропоновано нові моделі функцій споживання та збереження природного капіталу. Розглянуто теоретичні аспекти ноосферної моделі розвитку екологічно збалансованої економіки. Зроблено висновки, що відсутність ефективного механізму реалізації Концепції збалансованого (сталого) розвитку зумовлена насамперед невідповідним трактуванням теоретичною економікою категорії "природний капітал" та його просторово-біофізичних функцій у довкіллі; визначення системи оцінок біофізичної впорядкованості для нормування збереження стійкості екосистем створює нові передумови для застосування превентивних, а не компенсаційних економічних механізмів у сфері природокористування; запровадження у практику господарської діяльності екологічно доцільних норм споживання природного капіталу у межах локального простору дасть змогу максимально зберегти біорозмаїття для прийдешніх поколінь.

Chapter 6

Peculiarities and Perspectives for Greening of International Economy Development

Ion Dubovych[1]

Abstract The global environmental crisis requires humankind to think about finding ways for the "greening" of all possible human activities. This paper analyzes the international perspective in the field of environment and economics. The importance of environmental and economic conditions in transboundary territories is stressed. A new field of study, termed "transboundary economic greening," is proposed as a sub-discipline of ecological economics for the objective assessment of bordering territories. Given the interrelated and interdependent global ecological-economic system, there is a necessity for this the new field of research. To better understand transboundary economic greening and environmentally sustainable international economics, this paper discussed the ideas and main concepts supporting the proposed field of investigation. In particular, the meanings of such concepts as "ecological economic system" and "international environmental and economic relations" are discussed.

Анотація Глобальна екологічна криза спонукає людство до екологізації усіх сфер діяльності. У руслі цієї тенденції описано міжнародну еколого-економічну співпрацю України. На основі україноцентричного підходу до типологізування держав світу проаналізовано важливість вивчення еколого-економічного стану прикордонних територій. Для оптимального і водночас об'єктивного еколого-економічного дослідження прилеглих до кордону регіонів сусідніх держав запропоновано увести в еколого-економічний комплекс наук такий напрям досліджень, як "транскордонна екологізація економіки".

Зважаючи на те, що планета Земля є цілісною глобальною еколого-економічною системою, розглянуто потребу започаткувати науково-дослід-

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ний напрям "міжнародна екологізація економіки". Для того, щоби реальніше окреслити суть "транскордонної екологізації економіки", та "міжнародної екологізації економіки", проаналізовано деякі концепції та поняття цієї сфери. Зокрема, йдеться про "еколого-економічну систему", "національну екологічну та економічну політику", "міжнародні екологічні та економічні відносини" тощо.

Особливості та перспективи розвитку міжнародної екологізації економіки

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6.1 Вступ

Із розвитком цивілізації, бурхливим зростанням чисельності населення на Землі (6,8 млрд у 2008 р.), обсягів виробництва та його відходів, проблеми взаємин суспільства і природи дедалі актуалізуються.

До найнагальніших питань загроженості життєвого середовища людства належать невпинна деградація природного довкілля, виснаження природних ресурсів та екологічна небезпечність. Ці аспекти набули особливого значення наприкінці XX і початку XXI ст. У багатьох країнах деградація біосфери призвела до нечуваних природних катаклізмів, погіршення якості життя та здоров'я громадян. З огляду на це виникає потреба розроблення теоретико-методичних засад регіональної та глобальної екологізації економіки і ефективного механізму її практичної реалізації.

Проблеми екологізації економіки висвітлено в наукових працях українських (Ю.Ю. Туниці, Б.В. Буркинського, І.М. Синякевича, Л.Г. Мельника, Л.С. Гринів та ін.) та зарубіжних (Роберта Костанзи, Германа Дейлі, Джошуа Фарлея та ін.) вчених. Проте досі немає усталеного засадничого підходу до міжнародної екологізації економіки, вироблення механізму адекватної протидії новочасним екологічним викликам.

Метою дослідження є аналіз глобальних екологічних проблем та обґрунтування потреби розроблення теоретико-методичних засад регіональної та глобальної екологізації економіки і ефективного механізму її практичної реалізації.

6.2 Передумови та перспективи екологізації економіки на міжнародному рівні

Дані екологічного моніторингу переконують, що негативні тенденції до забруднення довкілля дедалі посилюються. Щороку близько 6 млн га сільськогосподарських угідь перетворюються на пустелі. Збіднюється біорізноманіття рослинного і тваринного світу, а це послаблює тривкість екосистем. За даними Всесвітнього фонду охорони живої природи, на Землі щогодини зникає один вид тварин.

Щодоби планета біднішає на 40 тис. га лісу (Дубовіч 2005), тобто упродовж року – це близько 14,6 млн. га, тобто набагато більше, ніж загальна площа лісів України – 10,8 млн га (Олійник та ін.2008, с. 67).

Відрадно, що в розвинених країнах світу (США, Німеччині, Швеції та ін.) еколого-політичні принципи у сфері використання, відтворення та охорони лісів відповідають сучасним викликам. Але водночас користувачі лісових ресурсів цих держав, охороняючи свої національні багатства, експлуатують ліси економічно слабко розвинених країн у Латинській Америці, Африці та ін. Така еколого-економічна політика недопустима.

Оскільки половину усього атмосферного кисню продукують ліси, а також, зважаючи на їх кліматорегулювальну здатність, вже сьогодні неодмінно потрібно приймати кардинальні рішення щодо припинення нераціонального лісокористування та процесів знеліснення.

Непередбачувані наслідки для світової спільноти має аварія, яка сталася 26 квітня 1986 р. на Чорнобильській АЕС. Її цілком обґрунтовано називають катастрофою: близько 50 тис. км^2 території України, де проживало понад 3,5 млн. осіб, зазнало впливу радіоактивного забруднення. Приблизно такі ж площі – на території Росії та Білорусі. За масштабами викидів радіоактивних речовин у довкілля немає аналогів у світі. Внаслідок ядерної катастрофи значно побільшало онкологічних захворювань, хвороб ендокринної системи, органів дихання тощо.

Усвідомлюючи вагомість з глобальних екологічних проблем, науковці (більш, ніж 1500 з 68 країн) виступили з Декларацією-попередженням людству, в якій наголошено, що залишилось не більше одного або декількох десятиліть до того, коли змогу запобігти загрозам, які постають перед людством, буде втрачено і воно опиниться на межі виживання (Паламарчук, Коренюк 2003, с. 3-17).

Отже, з цих та інших прикладів можна дійти висновку, що екологічні проблеми мають глобальний характер і становлять загрозу подальшому існуванню життя на Землі.

Хижацьке ставлення людини до природи та її багатств здатне спустошити нашу планету. Потреба вирішення глобальних екологічних проблем зумовила прийняття відповідних міжнародних правових актів, укладання договорів, угод тощо, які сукупно створили міжнародну екологічну політику та міжнародне екологічне право. Ця політика і право існують поряд із національними політичними та правовими екологічними системами. Загальновизнані принципи і норми міжнародної екологічної політики та екологічного права спонукають окремі держави до ухвалення відповідних правових актів національного екологічного законодавства та розвитку міжнародної співпраці у цій царині.

Вирішення нагальних екологічних проблем можливе тільки за умови широкої й активної міжнародної еколого-економічної, еколого-політичної та еколого-правової співпраці усіх держав.

Взаємозалежність екологічних та економічних чинників – це нагальні питання про системну еколого-економічну ефективність використання природних ресурсів, охорону довкілля та екологічну безпеку людства. Як відомо, їм належить чільне місце в концепції сталого розвитку. Забезпечення сталості й дотримання екологічної безпеки в будь-якій державі чи регіоні неможливе без екологізації економіки, тобто без її спрямування на подолання інтегрального екодеструктивного впливу процесів виробництва та споживання товарів і послуг.

Тому віднедавна чинник екологізації економіки дедалі актуалізується і починає превалювати у міжнародних відносинах.

Проблеми міжнародної екологізації економіки вперше було висвітлено на Конференції ООН з охорони природи, яка відбулася 1972 р. у Стокгольмі (Швеція).

Поступово екологізації економіки сприяла Міжнародна конференція з екологічних питань у Ріо-де-Жанейро (Бразилія, 1992). Завдяки цій конференції окреслено нові шляхи міжнародної співпраці щодо захисту цілісної глобальної системи довкілля й розвитку. Особливу увагу було зосереджено на потребі зміцнення зв'язків науки з урядовими структурами, промисловістю та громадськістю (Дубовіч 2005, с. 169-174).

Отже, оскільки екологізація економіки є глобальною проблемою, вжити заходів, які б сукупно сприяли створенню передумов для ефективного її вирішення.

Україна також не залишається осторонь, керуючись для екологізації національної економіки основними напрямами державної еколого-економічної політики, а також міжнародними конвенціями, договорами та угодами.

За відсутності ефективної системи управління в екологічній сфері і в контексті повільніших, ніж очікувалося, структурних реформ та модернізації технологічних процесів, зростання економіки призводить до високих рівнів забруднення та підтримки старих неефективних підходів до використання енергетичних та природних ресурсів, що потребує суттєвого підвищення дієвості та ефективності державної екологічної політики й екологічного законодавства.

На сьогодні чинним документом, що визначає рівень екологізації економіки, еколого-економічну та еколого-політичну стратегію в Україні, є Постанова Верховної Ради України "Про основні напрямки державної політики в галузі охорони навколишнього природного середовища, використання природних ресурсів та забезпечення екологічної безпеки" (від 5 березня 1998 р.). Багато положень цього документа уже не відповідає сучасним вимогам. Тому виникла потреба розроблення нового стратегічного законодавчого акта на довгострокову перспективу, який би враховував процеси глобалізації економіки, розвиток у країні ринкових відносин та рішення Київської конференції міністрів навколишнього природного середовища "Довкілля для Європи" (2003 р.), Всесвітнього самміту зі сталого розвитку в Йоганнесбурзі (2002 р.), положення низки міжнародних зобов'язань України у сфері охорони довкілля.

Варто зазначити, що Кабінет Міністрів України ухвалив (17 жовтня 2007 р.) Концепцію стратегії національної екологічної політики України на період до 2020 року. Ця Концепція спрямована на екологізацію економіки, поліпшення екологічної ситуації, раціональне використання та відтворення природних ресурсів, екологічне убезпечення, послідовне зниження екологічних ризиків для здоров'я людини, введення системи екологічного маркування товарів і продуктів харчування, приведення якості питної води у відповідність із європейськими стандартами, підвищення якості повітря, запобігання змінам клімату шляхом технічного переоснащення виробничого комплексу та введення енергоефективних і ресурсоощадних технологій тощо. Але у зв'язку з політичною нестабільністю в державі цей документ досі не затвердила Верховна Рада України.

Україна, як незалежна держава та правонаступниця міжнародно-правових зобов'язань колишнього СРСР, є учасницею декількох десятків (близько 50) міжнародних еколого-економічних конвенцій та двосторонніх угод: *Договір про заборону випробування ядерної зброї в атмосфері, космічному просторі й під водою* (Москва, 1963); *Конвенція про заборону розроблення, виробництва та нагромадження запасів біологічної і токсичної зброї, їх знищення* (Лондон, Москва, Вашингтон, 1972; ратифіковано 1975 р.); *Конвенція про запобігання забрудненню моря скидами відходів та інших матеріалів* (Лондон, 1972; ратифіковано 1975 р.); *Конвенція про охорону світової культурної та природної спадщини* (Париж, 1972; ратифіковано 1988 р.); *Конвенція про заборону військового та іншого ворожого використання засобів впливу на навколишнє середовище* (Женева), 1976; ратифіковано 1978 р.); *Конвенція про транскордонне забруднення повітря на великі відстані* (Женева, 1979; ратифіковано 1980 р.); *Конвенція про контроль транскордонних перевезень токсичних відходів та їх видалення* (Базель (Швейцарія), 1989); *Конвенція про транскордонний вплив промислових аварій* (Гельсінкі, 1992); *Конвенція про охорону та використання транскордонних водотоків і міжнародних озер* (Гельсінкі, 1992) та багато інших.

Головними здобутками міжнародної співпраці України у сфері екологізації економіки є:

- відображення національних інтересів та позиції держави в директивних документах та рішеннях форумів міжнародних міжурядових організацій;
- розширення сфери міжнародної співпраці завдяки укладенню нових угод, договорів та програм;
- утвердження міжнародно-політичного авторитету України та вдосконалення національно-правової бази;
- підвищення екологічної кваліфікації (правової, технологічної та методології управління), спрямованої на покращення екологічної ситуації в Україні;
- отримання від міжнародного співтовариства допомоги у царині охорони довкілля тощо.

Відповідно до міжнародного екологічного права та принципів, проголошених на Міжнародній конференції 1992 р. у Ріо-де-Жанейро, кожна держава має суверенне право на здійснення власної еколого-економічної та природоохоронної політики і зобов'язана гарантувати у межах своєї юрисдикції або контролю, що її дії не шкодять довкіллю інших держав чи районів, які перебувають за межами дії їхніх національних законів (Малишко 2001).

Ці та інші принципи міжнародної еколого-економічної співпраці свідчать про те, що ефективне вирішення проблем, пов'язаних з глобальною екологічною кризою, може здійснюватися, насамперед, завдяки суворому дотриманню екологічного законодавства як на національному, так і на міжнародному рівнях.

Беручи до уваги україноцентричний підхід до типологізування держав світу (Шаблій, 2006), Україна повинна приділяти більше уваги вивченню досвіду екологізації економіки сусідніх держав та їхніх регіонів, зокрема прикордонних. Вивчення міждержавних еколого-економічних зв'язків прилеглих до кордону територій має не лише наукову, а й практичну мету.

Вважаємо, що, міжнародну екологізацію економіки треба починати не з макро-, а з мікрорівня. Особливе місце тут належить прилеглим до кордону територіям держав-сусідів. Відповідно до цього підходу, вагоме значення має транскордонна еколого-економічна співпраця суміжних держав.

Об'єктом дослідження є прилеглі до кордону регіони. Вони становлять певну географічну територію, яка охоплює ділянку державного кордону та суміжні прикордонні території двох або більше держав і характеризується певною одноманітністю в одному або декількох аспектах.

Однією з організаційних форм транскордонних відносин є єврорегіон – транскордонний регіональний утвір (що охоплює території по обидва боки від державного кордону). У межах єврорегіонів, за згодою центральних державних органів, місцеві органи влади прикордонних областей мають змогу розробляти і застосовувати на практиці спеціальні комплексні економічні, екологічні, культурні та інші програми.

В Україні на її прикордонних територіях діє шість єврорегіонів (Карпатський, Верхній Прут, Нижній Дунай, Дніпро, Буг і Слобожанщина).

Прикордонні території суміжних держав мають багато спільних рис не лише у природно-географічному, а й у еколого-економічному, геополітичному та інших аспектах.

Добросусідські взаємини держав багато у чому залежать від ефективної транскордонної співпраці в еколого-економічній сфері, яка своєю чергою залежить від рівня економічного розвитку, екологічного виховання населення, культури та освіти. Дисбаланс в екологічному вихованні, невідповідність рівнів економічного та соціально-політичного розвитку між суміжними державами часто призводять до міжнародних непорозумінь.

Транскордонні еколого-економічні відносини мають низку особливостей, зумовлених наявністю кордону та потребою його облаштування, потребою міждержавного регіонально-прикордонного еколого-економічного та еколого-інформаційного співробітництва, міжнародної екологічної безпеки, використання природних ресурсів тощо.

Проблеми міжнародної екологізації економіки, а також потреби співпраці між сусідніми державами (на різних рівнях – районних, обласних чи загальнодержавних) свідчать про те, що значну увагу слід приділяти вивченню еколого-економічного стану саме прикордонних територій.

Тому, щоб дослідити екологічну ситуацію прикордонних територій, треба ввести в еколого-економічний цикл наук такий науковий напрям досліджень як **транскордонна екологізація економіки**, або **еколого-економічні транскордонні відносини**. На її базі можна досліджувати екологізацію економіки *прилеглих до кордону територій* (Дубовіч 2005).

Вивчення еколого-економічної ситуації прикордонних регіонів суміжних держав потребує здійснення аналізу за такими показниками: географічне розташування, природні умови і ресурси, історико-географічні особливості розвитку, екологічний стан, еколого-політичні та еколого-правові аспекти, рівень економічного і соціального розвитку, структура господарства, розвиток зовнішньоекономічних зв'язків, демографічна ситуація, екологічне виховання громадян, соціально-психологічний клімат тощо. Таким чином, екологізація транскордонних відносин вимагає глибокої і детальної обізнаності у всіх сферах людської діяльності прикордонних регіонів.

Важливим моментом екологізації транскордонної співпраці є об'єднання зусиль науково-дослідних, еколого-економічних, еколого-політичних, еколого-правових, еколого-інформаційних та управлінських структур суміжних прикордонних територій з метою залучення всього наявного потенціалу.

Для оптимальної і водночас об'єктивної еколого-економічної транскордонної співпраці дослідження прилеглих до кордону територій мають здійснювати одночасно спеціалісти двох сусідніх держав, за потреби залучаючи і третю сторону (представників-фахівців інших держав). Незалежно від тих чи тих непорозумінь у міжнародних відносинах, що склалися історично, нині потрібно шукати цивілізовані шляхи вирішення багатьох міждержавних проблем, особливо екологічних.

З огляду на те, що планета Земля є єдиною взаємопов'язаною глобальною еколого-економічною системою, принципи екологізації економіки повинні запанувати у цілому світі. На міжнародному рівні (з участю всіх держав) повинні здійснюватись практичні заходи щодо формування спільних еколого-економічної політики та права. Тому для вивчення глобального екологічного стану і прийняття відповідних заходів варто ввести в еколого-економічний цикл наук такий науково-дослідний напрям як **міжнародна екологізація економіки**, або **міжнародні еколого-економічні відносини**. Адже тільки на її базі можна досліджувати екологізацію економіки країн світу та міжнародні еколого-економічні відносини.

Для того, щоби краще зрозуміти суть наведених вище напрямів досліджень, варто проаналізувати деякі базові для цієї сфери концепції та поняття. Зокрема, йдеться про *еколого-економічну систему, національну екологічну та економічну політику, міжнародні екологічні та економічні відносини* тощо.

Ідея комплексного вивчення процесів *еколого-економічного* розвитку зародилась у другій половині 60-х років XX ст. і пов'язана з іменем американського географа-економіста В. Айзарда, який запропонував використовувати принципи інтеграції екологічного та економічного аналізу у регіональних передпланових дослідженнях. Згодом у межах регіональної економіки В. Айзард спробував викоритати еколого-економічний аналіз в моделях управління регіональними системами. Пізніше (з початку 70-х рр. XX ст.) проблеми комплексних еколого-економічних досліджень почали активно вивчати й інші держави, зокрема і Україна (у Львові, Сумах, Києві, Одесі та інших містах) (Туниця 2006, с. 10-12).

На думку академіка НАН України Юрія Юрійовича Туниці, нові моделі розвитку економіки не можуть бути розроблені та впроваджені без поглибленого опрацювання постулатів екологічної економіки, або еколого-економічного вчення про єдність екологічної та економічної систем.

Аналізуючи *національну екологічну та економічну політику* будь-якої держави світу, можна побачити, що кожна з них має свою специфіку розвитку. Це зумовлено історико-географічними особливостями, рівнем економічного розвитку, рівнем екологічної культури, екологічної свідомості, екологічної відповідальності громадян та багатьма іншими чинниками (заміна характеру виробничої діяльності з погляду екологічних наслідків, запровадження маловідходних та безвідходних екологічних технологій, виробництво екологічно чистих продуктів харчування; контроль з боку органів держави та інших уповноважених представників щодо охорони довкілля, раціонального використання та відтворення природних ресурсів; доступність екологічної інформації для всіх громадян держави; участь у міжнародній еколого-економічній співпраці тощо).

Екологічна та економічна політика окремих держав втілюється у формі національних програм, у яких основний акцент спрямований на збереження якісного стану природного життєвого середовища і раціонального використання та відтворення природних ресурсів.

В Україні загальні основи і мета екологічної та економічної політики викладені здебільшого у законодавчих актах: "Про охорону навколишнього природного середовища" (від 25 червня 1991 р.) та "Про концепцію державної регіональної політики" (від 8 липня 1998 р.), відповідно до яких узгоджуються всі інші законодавчі акти у сфері охорони довкілля, природокористування та соціально-економічного розвитку.

На сучасному етапі соціально-економічного розвитку головною метою державної економічної політики є збільшення національного багатства завдяки ефективному використанню природно-ресурсного, трудового та науково-технічного потенціалу країни.

Відповідно до наукових джерел міжнародного права, *міжнародні економічні та екологічні* відносини регулює система міжнародно-правових норм.

Міжнародне економічне право – це система міжнародно-правових принципів і норм, які регулюють економічні відносини основних суб'єктів міжнародного права: держав, міжнародних міжурядових організацій тощо (Міжнародне право 2005, с. 235).

Міжнародне екологічне право – це сукупність міжнародно-правових принципів та норм, якими регулюються на загальноприйнятих принципах та нормах міжнародні права, міждержавні суспільні відносини щодо охорони довкілля, збереження, раціонального використання та відтворення природних ресурсів з метою забезпечення сприятливих для життя людини властивостей екосистеми (Дубовіч 2007, с. 135-136).

З метою забезпечення рівних екологічних прав та обов'язків для громадян всіх держав світу в галузі охорони навколишнього середовища, екологічного убезпечення й раціонального використання та відтворення природних ресурсів академік НАН України, ректор Національного лісотехнічного університету України Юрій Юрійович Туниця запропонував для розроблення і відповідного застосування на практиці концепцію **"Екологічна Конституція Землі"**. На наш погляд, на часі – розроблення механізму її практичної реалізації.

Беручи за основу наведені вище концепції та поняття, міжнародне екологізування економіки потребує:

- міжнародної екологічної експертизи всіх проектів природокористування;
- відповідальності держав за знищення екосистем, яке відбуваєсья навіть у межах власних територій;
- створення міжнародного механізму стимулювання, поширення і запровадження технологій, спрямованих на дотримання еколого-економічних норм тощо.

6.3. Висновки

Екологічні проблеми виникли давно. Але науково доведено, що лише на початку третього тисячоліття постала глобальна екологічна криза. Реальну загрозу екологічної катастрофи дедалі більше визнають на державних та міжнародному рівнях.

В умовах всебічного й активного вивчення і відповідного практичного застосування *транскордонної екологізації економіки* та *міжнародної екологізації економіки* є реальні можливості вирішити чимало існуючих еколого-економічних, еколого-політичних та еколого-правових міждержавних проблем. Це допоможе:

- зробити міждержавні кордони якомога прозорішими (зокрема, у сфері екологізації економіки);
- створити атмосферу взаємної довіри і поваги, розбудови дружніх і взаємовигідних партнерських відносин між державами;
- активізувати еколого-економічну, еколого-політичну та еколого-правову міжнародну співпрацю на різних геопросторових рівнях (мікро-, мезо-, макро-);
- активніше впливати на екологічне виховання громадян.

Зважаючи на екологічні функції лісу (водоохоронні, захисні, кліматорегулювальні, санітарно-гігієнічні, оздоровчі, рекреаційні та ін.) та потенційні загрози прилеглим до кордону територіям сусідніх країн унаслідок вирубування лісів, виникає потреба увести такий науково-дослідний напрям, як "транскордонна екологізація лісового господарства". На його базі спільними зусиллями науковці суміжних держав зможуть виконувати комплексні дослідження щодо використання, відтворення та охорони лісових ресурсів на прикордонних територіях.

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PART II

INTEGRATING SUSTAINABLE FOREST MANAGEMENT AND ECOLOGICAL ECONOMICS: PROBLEMS AND OPPORTUNITIES

ЧАСТИНА II

ІНТЕГРУВАННЯ МЕНЕДЖМЕНТУ СТАЛОГО ЛІСОВОГО ГОСПОДАРСТВА ТА ЕКОЛОГІЧНОЇ ЕКОНОМІКИ: ПРОБЛЕМИ ТА МОЖЛИВОСТІ

Chapter 7

Sustainable Forest Management Alternatives for the Carpathian Mountain Region: Providing a Broad Array of Ecosystem Services

William S. Keeton and Sarah M. Crow[1]

Abstract International criteria for sustainable forest management (SFM) in temperate and boreal forests share a number of themes in common, as evidenced by similarities among the Montreal and Helsinki Processes. But translating these into meaningful implementation practices that differ from past approaches has been challenging in the Carpathian Mountain region of Eastern Europe. In this paper we explore contemporary science, emerging models, and innovative practices that offer guidance on implementing SFM criteria, with a focus on three criteria: 1) conservation of biological diversity, 2) maintenance of water resources, and 3) contribution to global carbon cycles. Particular reference is made to SFM options for the Carpathian Mountain region of Ukraine. The contribution of SFM to biodiversity conservation depends first on the establishment of fully representative reserve systems. On managed forestlands surrounding reserves, shifting stand age class distributions closer to the historic range of variability and recently developed silvicultural practices, such as disturbance based forestry, will help maintain ecological connectivity, landscape heterogeneity, and stand structural complexity. Strategically placed restoration of native species composition in areas dominated by spruce plantations will both enhance forest health and play an important role in biodiversity conservation. Conservation of aquatic resources is also significant concern in the Carpathian Mountain region. Broader use of contemporary watershed management approaches is recommended, including delineation of riparian buffers, riparian forest restoration, and ecologically informed forest road management. Expanding forest sector participation in carbon markets offers new opportunities and challenges for SFM in the Carpathians. Ukrainian afforestation/reforestation goals have the potential to sequester large quantities of carbon. This may have significant economic

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value as international carbon markets develop. The relatively long rotations currently required under Ukrainian forest code offer significant carbon storage benefits. Other innovative silvicultural options may provide future economic incentives for SFM in the Carpathians. On-going research suggests that structurally complex temperate forests, such as old-growth Carpathian beech and mixed conifer-hardwood forests, store very large amounts of carbon. Conservation of these systems can contribute to climate change mitigation efforts. Active silvicultural management for structurally complex, high biomass forests offers additional benefits.

7.1 Introduction

Over recent decades common principles of sustainable forest management (SFM) have emerged internationally, as evidenced by similarities among the Montreal Process criteria and indicators (non-European temperate and boreal nations) and the Helsinki Initiative (European nations). Each agreement presents a set of criteria (general principles) and indicators (measureable or clearly identifiable objectives and requirements) intended to guide SFM policy development and planning in signatory nations. Both processes include ecological as well as socio-economic criterion (Table 7.1).

Recent initiatives, such as the U.S. Forest Service's Local Unit Indicator and Development program, have scaled the global or continental scale indicators to regional and sub-regional scales. This helps increase applicability to specific forest systems and locales. Concurrently, scientific advances and creative SFM projects have explored a variety of innovative forest management approaches (see reviews in Keeton 2007). These help transform general principles and theory into practical guidance for multi-functional forestry that is applicable and feasible under real field conditions. This paper explores contemporary science, emerging models, and innovative practices that offer guidance on implementing SFM criteria in the Carpathians with a focus on Ukraine.

In the Carpathian Mountain region of Eastern Europe, translating internationally recognized SFM principles into meaningful change and management strategies has been more challenging in the context of a post-Soviet transitional economy. In Ukraine, for example, there is a long history of well trained, professional forest management within the State Forestry Enterprises (Nordberg 2007). However, forest management remains highly regimented, with most policy emanating from centralized planning at the ministerial level (Soloviy and Cubbage 2007). This contrasts with other Eastern European countries, where forest administration has decentralized but involved sweeping forestland privatization (Sikor 2003). While the relatively low rate of privatization in Ukraine has prevented some of the environmental problems and landuse conflicts occurring elsewhere (Sikor 2003), centralized forest governance and overall declines in forest sector investment since the collapse of the Soviet Union have limited innovation and policy reform at local, district, and regional administrative scales (Nordberg 2007). Illegal logging continues to stymie forest management efforts, and remaining prevalent both within

Table 7.1 SFM criteria under the Montreal Process (non-European temperate and boreal forested nations) and Helsinki Initiative (European temperate and boreal forested nations). Check marks indicate principles shared by both agreements. Note that while the Helsinki Process does not explicitly address legal systems at the criterion level, the importance of legal frameworks for SFM is manifest in a number of specific indicators.

Criteria	Montreal Process (1994)	Helsinki Process (1994)
Conservation of biological diversity	√	√
Maintenance of soil and water resources	√	√
Contribution to global carbon cycles	√	√
Maintenance of ecosystem health	√	√
Maintenance of ecosystem productivity (wood and non-wood)	√	√
Provision of multiple, long-term socio-economic benefits	√	√
Legislative, institutional, and economic frameworks	√	

and outside of protected areas in Ukraine (Kuemmerle et al. 2007, Kuemmerle et al. In Review). While net forest cover increased slightly in the Ukrainian Carpathians between 1988-2007, the area affected by illegal logging during this period was roughly equal in size to the total area of government sanctioned logging (Kuemmerle et al. in Review). Bureaucratic inefficiency, lack of public involvement mechanisms, and limited participation by non-governmental organizations have also impeded broader adoption of SFM principles in forest planning and governance (Soloviy and Cubbage 2007). These factors inhibit the ability of forest managers to respond effectively to new demands and opportunities, such as global carbon markets.

There are also positive signs. Accords established by the Carpathian Convention (2003), expanding enrollment in sustainable forest certification, and non-governmental organization initiatives are bringing new attention to this region. There may be opportunities for application of new SFM implementation approaches, but this will require access and openness to new information as well as experimentation and demonstration. In this paper we review a selection of SFM approaches that have high potential and applicability in the Carpathian Mountain region. These are tiered to three (of several) international SFM principles: 1) conservation of biological diversity, 2) maintenance of water resources, and 3) contribution to global carbon cycles. The goal is build on the experience, innovation, and expertise already available within Eastern Europe through multilateral information sharing. This was the objective of our Atelier on Ecological Economics and Sustainable Forestry, held in Ukraine during September 2007 and reported in these proceedings.

7.2 Creating a 21st Century Forestry in the Carpathian Mountain Region

In thinking about progressive models for forest management in the Carpathian region a certain philosophical view of SFM seems especially relevant. In hard times and challenging economic circumstances sustainable development initiatives that build the social capital necessary for environmental protection become as important as the technical and scientific basis for forest management decisions. In the late 1990s a prestigious panel of scientists and economists in the U.S. described this philosophy as follows:

"Sustainability ...has three aspects: ecological, economic, and social...the sustainability of ecological systems is a necessary prerequisite for strong productive economies, enduring human communities, and the values people seek from wildlands. We compromise human welfare if we fail to sustain vital, functioning ecological systems. It is also true that strong economies and communities are often a prerequisite to societies possessing the will and patience needed to sustain ecological systems (Committee of Scientists 1999)."

According to the committee's report forest management must start with an understanding of the capacity of an ecosystem to produce a full range goods and services, including biodiversity. Only then, and within these constraints, should targets for extractive or harvestable resources, such as timber and minerals, be established. This differs from some traditional forest management approaches focused primarily on timber production and commodity output targets. At the same time, however, the committee recognized that commitment to ecosystem protection was a choice not likely to be made by impoverished peoples and communities striving to meet the basic necessities of life. The committee's words ring especially true in the Carpathian Region, which is struggling economically (Sikor 2003, Palang 2006) and yet subject to increasing development pressures including growing tourism interest (Turnock 1999). Recent severe flooding triggered, in part, by montane forest clearing (Shulyarenko 2002), such as catastrophic flooding in summer 2008, have rekindled public awareness of the connection between SFM and economic/social well being. Some remote areas of the Carpathians retain remnants of traditional, locally-based forest management approaches that help maintain community interest in SFM (Elbakidze and Angelstam 2007). These cultural traditions were mostly superseded by government controlled forest management on the State Forest Enterprises established by the Soviets, and political upheavals have disconnected communities from a shared, cultural connection to the landscape in some regions (Palang et al. 2006). However, more recently innovative community based project, such as the Swiss-Ukrainian Forest Development Project in Transcarpathia, are helping reestablish mechanisms for public participation in SFM decision making.

Carpathian forests bear the legacy of a long history of intensive management dating to the Austro-Hungarian period (19th Century) and more recent forest management systems introduced under the Soviet regime. Much of the native beech (*Fagus sylvatica*) and mixed species forests were converted to Norway spruce (*Picea abies*), native to the region but planted ubiquitously on non-endemic sites and using non-local genetic varieties (e.g. Austrian genomes). This, together with even-aged, plantation style forest management practices, resulted in homogenized and simplified forest structure and composition at both stand and landscape scales (Stoyko 1998). This situation is not unique globally, bearing a striking resemblance to landscape scale changes occurring in the U.S. Pacific Northwest during the 20th century for instance (Swanson and Franklin 1992). Now with conversion of some areas back to uneven-aged stand structures and mixed species composition underway in the Carpathians (Chernyavskyy 2000), SFM principles stressing management for and restoration of ecological complexity seem particularly germane. Kohm and Franklin (1997), in their edited volume "Creating a Forestry for the 21st Century," offered insight on this question. They wrote "if 20th century forestry was about managing individual forest stands, simplifying stand structure, and providing timber, 21st century forestry will be defined by understanding and managing complexity, providing a wide range of ecological goods and services, and managing across broad landscapes." A more applicable definition of SFM for the Carpathian Region would be hard to find.

That 21st century forestry should focus more holistically on a full range of ecosystem goods and services dovetails nicely with the theory and practice of ecological economics. Like contemporary views of forestry, ecological economics is concerned with the valuation and provision of ecosystem services defined very broadly. Thus we see distinct commonality between these disciplines in the context of SFM. A multi-disciplinary emphasis on deriving economic, social, and ecological benefits from the provision of ecosystem services is thus the order of the day for SFM in the Carpathians and globally.

7.3 Conserving Biodiversity through "Matrix Management"

The Carpathian Mountain region is the focus of considerable international attention due to its unique biological and cultural resources, now recognized as of global significance by UNESCO and other international bodies. The Carpathians harbor a full compliment of large European mammal species, such as the lynx (*Lynx lynx*), wildcat (*Felis silvestris*), river otter (*Lutra lutra*), gray wolf (*Canis lupus*), woodland bison (*Bison bonasus*),, wild boar (*Sus scrofa Attila*), moose (*Alces alces*), red deer (*Cervus elaphus*), and brown bear (*Ursus arctos*). Over 200 species of plants are endemic to this region, and the largest remaining stands of old-growth European beech forest are found only here, such as within the Uholka World Heritage Site. Old-growth beech forests historically covered two thirds of Europe, yet remain in stands greater than 10,000 ha only in the Carpathians (UNEP and WCMC 2007). Current conservation efforts in the Carpathians fit into two main groups: those focusing on establishment and better management of protected areas, and those interested in sustainable management practices outside of core protected areas. The region's bi-lateral and multi-lateral biosphere reserves, including the East Carpathian and Carpathian Biosphere Reserves, incorporate elements of both approaches (Fall 1999), but suffer from lack of formalized transboundary cooperation mechanisms and insufficient institutional resources (Bihun et al. 2008).

How to best allocate land to a mix of protected areas and actively managed areas has been a fierce topic of debate for many years. However, it is now generally recognized that reserves and SFM areas are, in fact, complementary, and that both are required to achieve biodiversity conservation across large landscapes (Keeton 2007). Most conservation biologists agree that the first step is to design a comprehensive reserve system containing the most complete and spatially redundant ecological representation possible (Noss and Scott 1997). Once this system is in place, it offers an insurance policy for experimentation and innovation on the actively managed landscape. Protected areas create more flexibility for foresters, not less, because they minimize risk associated with over reliance on any one approach. Thus protected areas and SFM are mutually advantageous and self-reinforcing.

Sustainable management of forestland surrounding reserves will be essential to meet conservation objectives. An emerging approach to landscape scale planning, called "matrix management," focuses on maintaining connectivity among reserves, watershed functionality, and habitat representation on actively managed timberland (Keeton 2007). The Carpathian landscape, consisting of a mix of forestlands assigned to different levels of protection, intermingled human settlements, and agricultural lands, is in many ways highly amenable to matrix management. The need to maintain corridors and ecological connectivity is particularly important given the migratory patterns and foraging behavior of the region's increasingly rare and geographically isolated large mammal populations, such as bison. According to Lindenmayer and Franklin (2002) matrix management has five principles; these are:

1. maintenance of stand structural complexity,
2. maintenance of connectivity,
3. maintenance of landscape heterogeneity,
4. maintenance of aquatic ecosystem integrity, and
5. risk spreading, or the application of multiple conservation strategies."

The Ukrainian state-owned forest system (99 % of forestland in the country) already provides the administrative foundation needed to design a comprehensive and complementary system of protected areas and SFM areas. The majority of state forests are allocated to two main groups: "group one" (56 %) managed under a multiple use doctrine and limited timber harvesting; and "group two" (44 %) having a stronger timber production mandate. A significant portion of group one forests are protected to varying degrees under a range of designations, including strictly protected scientific preserves (zapovidniks), nature parks, "regional landscape parks" (IUCN category IV protected landscapes), and state forestry enterprises (comparable to the U.S. national forest system). Since independence the area of protected forest has more than doubled nationwide (Nordberg 2007). Because of the relatively high degree of protection offered to group one forests, Nordberg (2007) called Ukraine's forests "among the most protected in Europe." However, as noted above remote sensing data have shown the extent of illegal logging and perhaps also "sanitation cutting" (salvage of defoliated spruce) to be much greater than portrayed by official statistics (Kuemmerle et al. in review). Nevertheless, these land allocations provide the building blocks necessary for matrix management, particularly if illegal logging can be curbed.

In the Carpathians as in many regions of the world, there are important questions regarding how to design the most fully representative system with the greatest likelihood of maintaining viable populations. Currently approximately 17.6 % of forests in the Ukrainian Carpathians are protected within core reserves (IUCN categories I-III, Budyakova et al. 2005), significantly higher than the 5 % average for European countries. An on-going effort conducted by the World Wide Fund for Nature and other organizations is mapping the distribution of biodiversity and "High Conservation Value" forests throughout the Carpathian Range (Bogdan Prots, WWF, personal communication). This will allow more robust prioritization of areas for reserve status or special management consideration.

7.4 Silviculural Alternatives for the Carpathians: Providing a Broader Mix of Ecosystem Goods and Services

Complementing a foundational protected areas system, matrix management requires specific implementation approaches (e.g. planning and silvicultural approaches) that will sustain production of a broad range of ecosystem goods and services across the actively managed landscape. These must be adapted to the cultural preferences and forest dynamics of specific regions (Keeton 2007). An emerging approach in SFM internationally, termed "disturbance-based forestry," may be particularly relevant to the Carpathians. The fundamental concepts are similar to European "natural dynamics forestry" and "close to nature silviculture." A paramount objective of disturbance based forestry is to better conserve biological diversity by emulating the landscape dynamics and disturbance regimes to which organisms are adapted (North and Keeton 2008). These include patch mosaics or habitat pattern, abundance, and distribution that shift over time and space in response to natural disturbances, successional processes, and climate variability (Aplet and Keeton 1997). The Carpathians have a natural disturbance regime dominated by wind events, ranging from frequent low intensity wind throw (e.g. gap creating disturbances) to moderate intensity (Fig. 7.1) and stand-replacing windstorms (Lavnyy and Lassig 2003, Nagel et al. 2006). Thus, innovative silvicultural systems emulating both gap dynamics and intermediate disturbances are directly applicable to this region. Examples include the "expanding gap" system

(Fig. 7.2) first developed in Germany and now utilized in the northeastern U.S. (Seymour et al. 2005); the "structural complexity enhancement" system first tested in Vermont, U.S.A. (Keeton 2006); multi-cohort management systems that emulate the multi-aged stand structure associated with intermediate intensity wind regimes (Hanson and Lorimer 2007); and variable retention harvest systems (Franklin et al. 1997). Each of these helps achieve matrix management objectives by maintaining landscape heterogeneity and connectivity across managed forestlands.

However, more than 90 % of Ukraine's forests are plantations or regulated even-aged stands (Budyakova et al. 2005). Stand structure tends to be significantly less diverse than in multi-aged and natural forests, a comparison that holds true for the Norway spruce (*Picea abies*) plantations as well as younger beech and mixed species stands typical of the Carpathians. In comparison to uneven-aged primary forests (Fig. 7.3), even-aged plantations typically have less vertical differentiation of the canopy (i.e. they are single layered), less horizontal complexity (e.g. gap structure), and lower densities of other important habitat characteristics, such as large trees and downed logs (Parpan et al. 2005, Chernyavskyy 2005). Thus, disturbance-based silviculture promoting redevelopment of complex stand structures, provides a broader representation of habitat characteristics in managed stands (Franklin et al. 2002). If planned as an element of matrix management, together with reserves and careful scheduling and placement of harvest units, disturbance based forestry represents a "win-win" scenario. It accommodates both timber harvesting as well as sustained ecosystem functioning.

Mono-cultured plantations in the Carpathians have been susceptible to mortality agents, such as root rots and spruce bark beetle (*Ips typographus*), and have been stressed by airborne pollution, including acid deposition and heavy metals. Collectively these have contributed to spruce dieback (Badea et al. 2004, Grodzkia et al. 2004, Shparyk and Parpan 2004). Although dieback has been less severe in Ukraine compared to other Carpathian countries, region wide about 40 to 50 % of both spruce and fir (*Abies alba*) has been damaged by heavy defoliation (Badea et al. 2004). Hence, there is a pressing need for broader adoption of restorative silvicultural practices, such as even to uneven-aged conversion systems. These include sequential partial cutting approaches (e.g. two and three stage shelterwoods) that promote development of multi-cohort, mixed species stands over time. There is experience with phased conversion systems in Western Europe and North America, but there seems to be little awareness of them in the Carpathian region. Ukrainian foresters have developed a rapid restoration system involving clearcutting of dead and dying spruce ("sanitation cutting") followed by replanting with site-endemic native species (Fig.7.4).

However, recent evidence suggests this is frequently used for commercial rather than strictly restorative objectives, exploiting an exemption from limitations on cutting unit size in the Forest Code (Kuemmerle et al. 2007, Kuemmerle et al. in review). Moreover, it is important for restoration treatments to be planned strategically, rather than opportunistically, so as to restore high priority sites while minimizing fragmentation and watershed impacts.

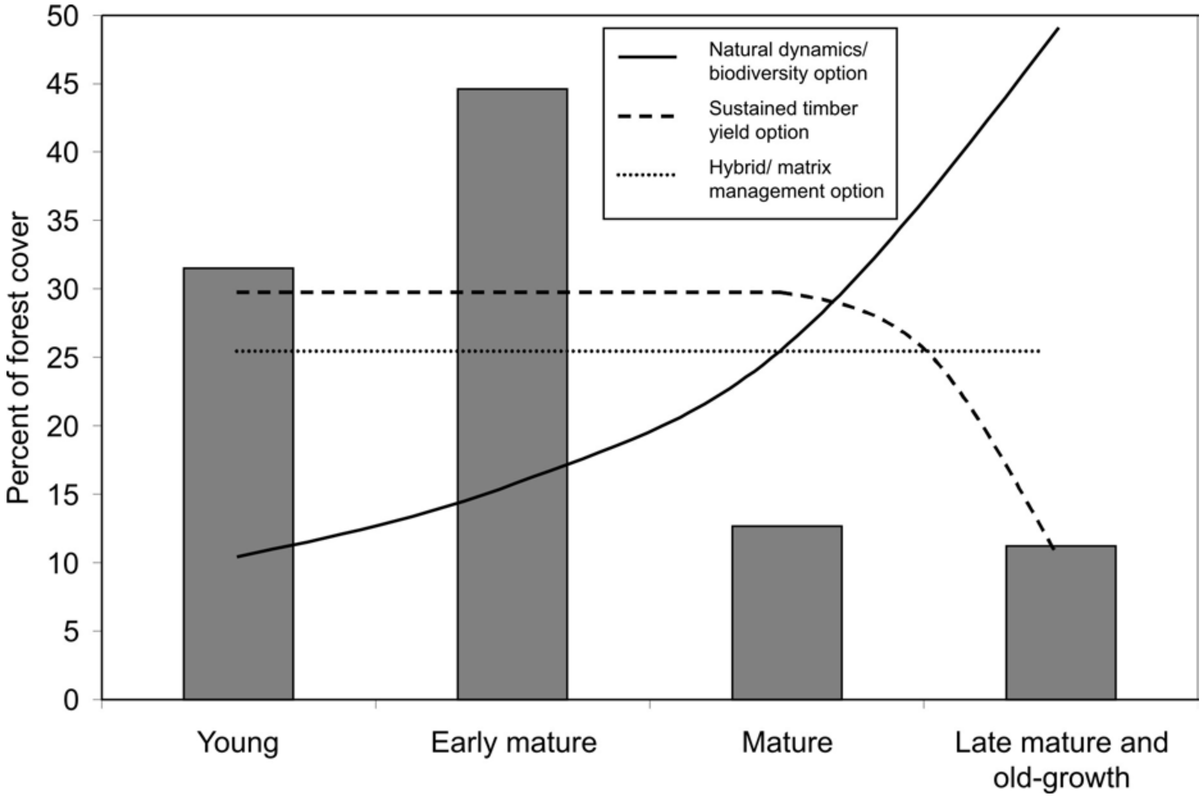

Fig. 7.5 The bars show Ukraine's current forest age class distribution based on data from Strochinskii et al. (2001). Three other distributions (lines) are added to illustrate alternatives that Ukraine might consider. The solid line represents the age class distribution that would develop over time in the absence of human disturbances, and provides a benchmark for understanding the associated changes in forest biodiversity. The dashed line represents a distribution that would favor sustained timber yield, but would not necessarily provide sufficient representation of late-successional forests. A matrix management alternative (small dots), combining sustained timber production and biodiversity objectives, might be a hybrid of the two, such as a completely balanced distribution with equal proportions in each age class.

Another concern pertains to the current age class distribution of Ukrainian forests (Fig. 7.5), which is skewed heavily towards young and early mature plantations. Early to mid successional stands comprise 88.8 % of Ukraine's forests, whereas only 11.2 % are in a late-successional condition (mature and old-growth) according to inventory data (Strochinskii et al. 2001). Fully 76.1 % of stands are entirely sub-merchantable (Strochinskii et al. 2001). This reflects a history of overcutting under the Soviets, especially during the 1950s (Nijnik 2004), resulting in conversion of landscapes from old forest dominated to young forest dominated. Some have argued that the current forest age distribution will result in future timber supply limitations if harvest levels are not increased during the near term (Nijnik and van Kooten 2000, Irland et al. this volume). In our view, however, this minimizes the current deficit of harvestable stands relative to sub-merchantable stands. Rather, the solution is to allow the merchantable growing stock to build up both passively and through stand improvement and intermediate treatments, such as precommerical and commercial thinning. Others have drawn similar conclusions, arguing that "harvest potential will increase in the future" and pointing out that the area of mature stands almost doubled from the late 1980s to late 1990s

(Polyakova and Sydor 2006). Ukraine currently harvests less than 30 % of the gross annual growth in its forests, signaling that timber stocks are increasing, not decreasing. Far from limiting future timber availability, the current distribution provides an abundant source from which merchantable timber will recruit over the next several decades.

Once sufficient merchantable stocking is achieved, careful stewardship to maintain a desired distribution (either balanced across age classes or tilted toward mature and late-successional forests) will sustain timber yields while maintaining a broader mix of ecosystem services (Fig. 7.5). Polyakova and Sydor (2006) argue that active management will be vital because so much of the forested landscape is in plantations or has developed from afforestation. Over ninety percent (or 2.1 million ha) of the total forest cover in the four Ukrainian Carpathian oblasts (or provinces) is in plantations (Budyakova et al. 2005). Moreover, moving the age class distribution closer to the historic range of variability (Aplet and Keeton 1999) may be more likely to perpetuate a wider range of biodiversity. For instance, the current age distribution may contribute to an under-representation of late-successional species (Keeton 2006), though this connection has not been empirically established in the Carpathians. However, given the strong association between biodiversity and forest developmental stages (Stoyko 1998), shifting the landscape towards a better balance of stand ages would provide both a stable timber supply and ensure more comprehensive representation of forest age related habitat conditions. In addition, maintaining some margin of unharvested net growth provides numerous ecosystem services, such as development of stand structural complexity, riparian functionality, and carbon storage. There is unlikely to be a deficit of early successional forest habitat in the future due to forest regrowth on abandoned agricultural lands, which has increased markedly during the post-Socialist period (Kuemmerle et al. 2006, Kuemmerle et al. 2008).

7.5 Conserving Freshwater Ecosystems and Watershed Functioning

The need to develop new approaches for forest watershed management and conservation of aquatic resources has been recognized internationally as a key element of SFM. The Carpathians have experienced several severe flooding events over the last decade, including particularly destructive floods in the summer of 2008. While extreme precipitation is considered the primary cause, the magnitude of flooding has also been attributed to logging and land cover change in some cases. For example, Dezso et al. (2005) concluded that recent floods in eastern catchments (Ukraine) of the Tisza river were not caused solely by heavy precipitation, but were related also to the 10-20 % forest cover loss that occurred from 1993 to 2001. Thus, an important issue for SFM in the Carpathians is application of watershed management approaches designed to reduce flooding hazards, such as cumulative effects analysis and spatial planning (Naiman et al. 1997).

Emerging science describing forest ecosystem regulation of hydrologic and watershed functions is directly relevant to the Carpathian region. Scientists have documented important ecological interactions between riparian forests and aquatic ecosystems (Ward et al. 2002, Naiman et al. 2005, Keeton et al. 2007). For instance, studies in the U.S. Pacific Northwest showed that clearcut logging and logging road construction can reduce the ability of forests to regulate peak stream flows during moderate intensity storm events, maintain late-summer stream flows, and control erosion (Naiman et al. 2005). Modeling work has also demonstrated linkages between forest cover and runoff during moderate rain-on-snow events, but runoff can be insensitive to land cover when the sheer volume of precipitation overwhelms other factors (Storck et al. 1998). Some studies (Jones and Grant 1996; Jones 2000) have found that peak (flood) flows are higher on and downstream of areas with extensive clear-cutting and road construction, while others (e.g. Bowling et al. 2000) have not been able to confirm these statistical associations. In-stream water quality, the physical integrity of stream channels, and other aquatic habitat characteristics, such as recruitment of in-stream coarse woody debris, are also impacted by logging, particularly when large trees are removed from riparian areas (Naiman et al. 2005).

In some parts of the world improved scientific understanding has led to regulations and changes in management practices designed to better protect freshwater ecosystems. For instance, delineation of riparian buffers and riparian forest restoration are now frequently employed as central elements of SFM (Gregory et al. 1997, Stuart and Edwards 2006). Riparian buffers take different forms. Some are entirely off limits to logging or road construction, while others allow limited entry if deemed appropriate (Lee et al. 2004). Many regions employ zonations with varying intensity of permissible management, often including a strictly protected zone immediately adjacent to the stream channel. Broader adoption and enforcement of similar approaches would help safeguard aquatic resources in the Carpathian Mountains. Reforestation and improved riparian protection is needed especially on cutover and degraded main floodplains, which are ubiquitous throughout the Ukrainian Carpathians

Recently calls have been made throughout the Ukrainian forest sector for increased construction of logging roads (personal communication with State Forestry Enterprise officials). This reflects the general disrepair and lack of investment in the existing forest infrastructure and limited forest access, particularly away from valley bottoms. Decommissioning deteriorating, poorly designed roads close to streams and rivers is an imperative, and the desire for greater access for forest management and recreation are also understandable. In our view, however, forest managers in the Carpathians should be warned to proceed carefully with plans for new road construction. This is vital to minimize road system extent and landscape fragmentation, design well engineered roads with minimal erosive and hydrologic impacts, make use of temporary logging roads whenever possible, and avoid negative impacts to aquatic ecosystems, for instance by minimizing the number of stream crossings. Forest managers in this region are urged not repeat the painful lessons learned from rampant logging road construction elsewhere in the world.

7.6 Forest Carbon Management: Opportunities and Incentives for SFM in the Carpathians

Market-based mechanisms providing payments for ecosystem services, such as clean water, non-timber forest products, and ecotourism, demonstrate the potential for incentivizing SFM through the application of ecological economics principles. Rapidly expanding carbon markets have great potential in this respect (Ruddell et. al. 2007). Under the Kyoto protocol's clean development mechanism, participating countries can purchase credits from developing nations, including former Soviet republics, to offset greenhouse gas emissions elsewhere. Initially afforestation and reforestation were the primary forest sector opportunities for earning credits. More recently, carbon markets have introduced credits for "avoided deforestation" and even "improved forest management (IMF)." The latter requires participants to substantiate that additional carbon will be stored with some degree of "permanence" over a baseline or "business as usual" scenario, and thus IMF has been difficult to quantify and validate. And there are the added difficulties of accounting for carbon stored in wood products, "leakage" in the form of emissions from materials substituted for wood products, and carbon fluxes (e.g. energy inputs) associated with a full suite of forest management activities (Ray et al. 2009). On-going work around the world is working to resolve these technical issues and opportunities are growing for forest sector participation in carbon markets.

Afforestation is one activity where Ukraine and other Carpathian nations are positioned to immediately benefit from carbon markets. In 2002 Ukraine launched a program called "Forests of Ukraine," with the objective of increasing forest cover from 15.6 % (10.9 million ha) to 16.1 % (11.3 million ha) of its total land area by 2015 (Soloviy and Cubbage 2007). According to Nijnik (2001) there are 2.3 million ha of additional land available for afforestation in Ukraine alone based on an analysis of current land use, terrain, and soils. This number declines to 1.7 million ha when areas requiring unacceptably high afforestation costs are excluded. Currently Ukrainian forests sequester about 180 million tons of Co_2 annually through growth in existing forests (Soloviy and Yaremchuk 2001). Areas available for afforestation have the potential to store (i.e. in new forest biomass) an additional 200 million Mg of carbon after 40 years, and would be cost effective for earning carbon credits based either on in-situ carbon storage or emissions offset by biomass fuel production (Nijnik 2001).

Ukraine has been signatory to the Kyoto Protocol since 2004. Because of depressed economic growth since independence, Ukraine is predicted to emit less greenhouse gas than permitted (by so called "Assigned Amount Units" or AAUs) under most scenarios of economic growth and energy efficiency (Victor et al. 2001). This is expected to yield a surplus 1.5 to 1.6 billion tons of $C0_2$ equivalent over the first commitment period, allowing it to sell up to US$ 21.6 billion of AAUs (Victor et al. 2001). Consequently, forest sector participation in carbon markets would only supplement the already substantial market opportunity Ukraine enjoys. Ukraine is eligible to participate in Joint Implementation sequestration projects under the Kyoto Protocol, and is working with the World Bank on a trial carbon management project involving afforestation on 15,000 ha of abandoned agricultural land near Chernobyl (World Bank 2006). According to the World Bank (2006), "it is likely that the overall cost of the project will be about US$ 11 million over ten years, and carbon trade could offset these costs by about US$ 2-4 million." This pilot project is expected to lay the ground work to help Ukraine pursue broader carbon market participation through both afforestation and forest management.

There may be opportunities for earning carbon credits through avoided deforestation in areas of the Carpathians experiencing land use pressures or threatened with forest conversion risks, such as recently privatized forests facing subdivision and development in Poland and Romania. On-going research suggests that structurally complex temperate forests, such as old-growth Carpathian beech and mixed conifer-hardwood forests, store very large amounts of carbon (Keeton and Chernyavskyy, unpublished data; Szwagrzyk and Gazda 2007), comparable to the maximum achieved in temperate forest ecosystems globally (Luyssaert et al. 2008). Thus, conservation of the remaining unprotected old-growth and primary forests would carry significant carbon benefits. Carbon credits could be used to help augment funds used for conservation activities, providing an example of the covarying environmental benefits associated with carbon management, such as biodiversity protection.

While still in its infancy, IMF may add further potential for carbon market participation in the Carpathians. Innovative silvicultural options, including extended rotations and retention forestry, have been developed to enhance carbon storage in managed forests (Ray et al. 2009). These may provide economic incentives for SFM in the future. The relatively long rotations (e.g. 80 to 140 years depending on forest type and "group") currently required under Ukrainian forest code (Strochinskii et al. 2001) already offer significant carbon storage benefits, but limit opportunities to create additionality (enhanced storage) over baseline levels. Alternative silvicultural systems specifically intended to promote development of structurally complex, high biomass forests offer additional opportunities, while also providing sustainable timber harvests (Keeton 2006).

7.8 Conclusion

There is a long history of professional forest management in Carpathian nations, but new opportunities and challenges confront the region. International criteria provide a basic framework for SFM, but implementation approaches need to be adapted to the Carpathian context. Efforts to integrate principles of ecological economics and sustainable forest management carry great potential in this respect. Concepts such as matrix management and disturbance-based forestry are readily adaptable to the Carpathian landscape. They would help provide a broader array of ecosystem goods and services, including biodiversity conservation and timber revenue, if employed in conjunction with careful, landscape scale reserve design and establishment. An adaptive approach to SFM will be essential due to the anticipated effects of climate change on Carpathian flora and fauna. Recent scientific advances in the fields of watershed management, riparian forest conservation, and logging road system design will help inform improved protections for aquatic ecosystems in the Carpathians. Market based incentives for sustainable forestry, such as green certification and carbon markets, provide significant opportunities for the Carpathian region.

The challenge facing Ukraine and other nations in the region is to merge these ideas into a holistic, ecosystem management approach that can be implemented within existing or reformed administrative frameworks. If this can be achieved, there will be great prospects for sustainable forest management in the Carpathians long into the future.

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Менеджмент сталого лісового господарства для регіону Карпат: забезпечення широкого спектра послуг екосистем

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Міжнародні критерії менеджменту сталого лісового господарства (СЛГ) для лісів помірної та бореальної зон мають багато спільного, у цьому переконує порівняльна характеристика Монреальського та Гельсінкського процесів. Проте адаптувати їх до практично значущих методів господарювання, кардинально відмінних від тих, що застосовувались у минулому, є непростим завданням в умовах Карпатського регіону Східної Європи. У розділі зосереджено увагу на сучасній науковій теорії, новітніх моделях та інноваційній практиці, які слугують методологічною основою запровадження критеріїв менеджменту сталого лісового господарства, наголошено на вагомості трьох критеріїв: 1) збереженні біологічного різноманіття, 2) збереженні водних ресурсів, 3) внеску до глобального циклу вуглецю. Особливу увагу зосереджено на створенні передумов для СЛГ у регіоні Українських Карпат. Внесок СЛГ у вирішення проблеми збереження біорізноманіття залежить насамперед від повноти репрезентативності системи заповідних обєктів. В експлуатаційних лісах, які межують із цими заповідними об'єктами, наближення структури розподілу класів віку до історично характерної варіабельності та урахування

вання сучасних лісівничих методів (таких як лісівництво, базоване на парадигмі природних зрушень), сприятиме збереженню екологічних зв'язків, ландшафтної гетерогенності та структурної комплексності насаджень. Стратегічно обгрунтовано доцільність відтворення природного видового складу у чистих смерекових насадженнях, – це сприятиме покращанню фітосанітарного стану лісів та збереженню їхнього біорізноманіття. Важливою проблемою для регіону Карпат є збереження водних ресурсів. Доцільно практикувати сучасні підходи менеджменту водних басейнів, зокрема виділення водоохоронних зон, відновлення лісів у цих зонах та екологічно обгрунтований менеджмент лісових доріг. Якомога ширше залучення лісового сектора у ринки вуглецю розкриває нові можливості та, водночас, ставить нові виклики перед СЛГ в Українських Карпатах. Стратегічний курс України у сфері лісорозведення та лісовідновлення свідчить про значний потенціал щодо зв'язування вуглецю у великих обсягах. Цей потенціал може мати високу економічну вартість, оскільки міжнародні ринки вуглецю динамічно розвиваються. Відносно високий вік рубань і тривалий період ротації, відповідно до вимог чинного українського лісового законодавства, може мати позитивний вплив на нагромадження вуглецю в лісах. Сприяти запровадженню нових методів ведення лісового господарства в Карпатах може також економічне стимулювання СЛГ. Сучасні дослідження свідчать, що ліси помірної зони із комплексною структурою, такі як Карпатські стиглі букові та змішані ліси, нагромаджують багато вуглецю. Збереження цих екосистем здатне послабити негативний вплив кліматичних змін. Активні лісівничі заходи, спрямовані на формування лісів із комплексною структурою та високою біомасою, можуть дати додаткові вигоди.

Chapter 8

Forest Sector of Ukraine in the 21st Century: State of Art, Scenarios, and Policy for Sustainable Development

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Abstract Forest policy should show the adequate and efficient reaction on globalization processes, international policy tendencies and transformational processes in economy of country. Current Ukrainian forest policy does not fully correspond to these demands. The analysis of the legislative, environmental, and economic preconditions for its development has been done in the chapter. The scenarios based on critical evaluation of the experiences of other countries and principles of reforms in the forest sector are considered. Expert evaluations have been used to make analysis of forestry sector development scenarios. The experts were represented by forest policy scientists and forest policy decision makers. The main scenarios are not the blue print from the existing models, but adaptations of the main ideas in the field of economic mechanism (taxation and financing systems) and institutional transformation of the governance system) to the specific circumstances of the Ukrainian institutional environment and forest management traditions. Institutional transformations in Ukraine's forestry have started, but the rules of the game and the arrangements have not changed substantially so far, democratization with open privatization nor administrative and financial decentralization has been achieved neither. Democratization, market oriented reformation, and decentralization should be considered as main blocks of policy measures to stimulate institutional transformation of forestry sector. The evolution of forest policy as a science and as a process analysed from different perspectives. It is concluded the principles of ecological economics should be considered as theoretical foundation for creation of effective international, national and regional forest policies. The conditions

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defined according which forest policy would correspond to the national interests of Ukraine and its international responsibilities towards SFM.

8.1 Introduction

The countries of Central and Eastern Europe (CEE) are known as transitional states or countries in transition (CITs) because of transition from communist ideology and centrally planed economy system to market economy and democracy during the last two decades.

Democratization of natural resource decision making and good governance doesn't go simultaneously with liberalization of economies. Combined influences of the globalization and transitional processes create specific challenges for forest policy in countries of this region: adaptation of forestry sector and wood industry to world markets and market economy, controlled changes in forest ownership, restructuring of state forest services, and conservation of forests using economic instruments in a new conditions.

The intersections between SFM and CITs have been notably frequent. To optimize both the global and local values of forests in CITs it has been noted that effective synergies have to be developed between sustainable forest management and sustainable economic and human development in transitional states (Pachova et al. 2004).

Generally, former forest policies in the region we can describe as non-participatory, non-democratic, and centralized – with total public ownership and distribution. Since the early 1990s the countries of CEE have been undergoing significant reforms in their forest sectors.There are cross-country differences in scope and outcome of the sectoral reforms because each country adopted a different transition strategy.

Ukraine is the biggest country in the region, (excluding Russia) and has long historical traditions, experiences and capacity in forest management. Country did pass a new forest code in 2006 in response to the calls for reform and movement toward market processes, more private forest ownership, more democratic decision-making, and better efficiency of state government. The changes in the law are still incremental in nature, but provide a step toward better forest policy to meet the preceding goals.

With introduction of the new Forest Code of Ukraine (2006) and decree of Cabinet of Ministers from April, 18, 2006 "About approval of Conception of reformation and development of forestry" (Conception 2006) the government program of reformation of forestry of Ukraine was outlined. Taking into account the content of these document and steps of governmental organs in relation to its practical implementation it is possible to do a prognosis in relation to that, as far as development of forestry of Ukraine will be successful in the first part of the 21st century, and also as far as it will fulfill conception's purpose of the sustainable ecologically balanced development and will support the efforts towards overcoming of global environmental threats. The authors try to give an answer for these questions on the basis of analysis of the modern state of the forests and forestry of Ukraine and credible scenarios of its development.

8.2 Threats to Forests Sustainability and Communities Well-being

8.2.1 Forests Sustainability Main Challenges

The highest level of agriculture and heavy industries during the times when Ukraine was the part of Soviet Union was placing great pressure on environment. This caused severe environmental problems of air pollution, water pollution, soil productivity decrease, degradation of resources, energy losses, simplification of the landscape mosaics, ecosystems unsustainability in many areas, nuclear contamination (Chernobyl disaster). About 3.5 million ha (or 1/3 of the forests) are contaminated after Chernobyl disaster.

The role of Ukrainian forests is very important for ecosystem services delivering, in particular soil protection, water regimes regulation, creating more favorable microclimate conditions for agriculture (especially in the south region), recreation, and cultural heritage conservation.

The current ecological state of forests is conditioned by the level and intensity of anthropogenic influence as well as by the growing urban and industrial pollution load, which impair the natural stability and environment formative functions of forest ecosystems. In some regions the anthropogenic pressure on forests has caused significant ecosystem instability. During the last few decades the number of fires and burned area increased. Defoliation in Ukraine increased from 2.7 % in 1990 to 69.6 % in 2000 for broadleaved trees, and from 3.0 % in 1990 to 47.3 % in 2000 for coniferous trees – higher than in any other European country (ICP, 2002).). There is minimal monitoring and enforcement by the local authorities to ensure that forestry enterprises comply with environmental regulations (Ukraine: Common Country Assessment, 2002). In addition, illegal harvests made by local population in all the forested regions are a serious threat to the productivity and conservation of forest resources.

According to the former Forest Code (1994), the primary role of Ukrainian forests is to perform environmental functions. In new Forest Code (2006) such statement deleted, but definition of forest and its functional classification are more environmentally then production oriented. It's a reason that in almost 50 % of forests, clear cutting is not allowed, and more than 12 % of forests belong to natural reserves (Kolisnychenko 2003). The nature protected area is growing, and those some state forestry enterprises reduced. At the same time the recent study of Kuemmerle et al. (2007) in the Carpathian border region of Poland, Slovakia, and Ukraine suggested that protected areas generally exhibited less forest harvesting, but protection was far from complete, and the effectiveness of protected areas differed among countries. In Ukraine, harvesting rates inside protected areas were practically equal to those outside, and harvests were widespread immediately before the designation of protected areas.

Consequently, significant human, technical, and organizational experience has been gained in the area of artificial afforestation. In 2002 the government of Ukraine adopted the program "Forests of Ukraine". It is a long-term document that sets out forestry development for 2002–2015. At the same time, in the current transitional economic conditions difficulties in afforestation programs (Soloviy 2000, Soloviy and Yaremchuk, 2001) will continue under the pressure of global financial crisis and its national consequences. The positive influence on its implementation can be expected only because of increasing interest of the Ukrainian government to the bioenergy development.

8.2.2 Threats to Carpathian Sustainability

The forested area of Ukraine is unevenly distributed between four distinct temperate forest regions: the Carpathian mountain forests, the northern forests (Polissiya), the forest steppe and the steppe. The dry mountain forests of the Crimea proceed towards Mediterranean climatic conditions and are often classified as a separate forest region. Furthermore, when you analyze the regional picture, the percentage of forest area in western Ukraine is considerably higher, up to 40 % and higher in the Carpathian Mountains approaching the desired norm of one-third of the landscape.

The Carpathians, covering only 4 % of the country's territory, produce a third of the forest resources of Ukraine and occupy 53.5 % of this region. The location of the Carpathian mountain forests has global environmental significance for the densely populated and highly urbanized landscapes. The biodiversity of the Carpathians is unique, rich, and threatened.

Intensive human influence on forest ecosystems in the Carpathians during the 18-20th centuries, has led to deforestation and forest degradation, creating the challenges to the landscape stability. In 1956-1960 the annual volume of timber harvest exceeded the average increment by almost double (Gensiruk 2002). This resulted in the decrease of water-protective functions of the Carpathian forests, intensified erosion processes, decreased endurance of spruce stands and contributed to the occurrence of floods and windfalls in the mountains (Nijnik 2002). In the 19th century there were 6 floods in the Carpathians, in the 20th century –17, and one flood has already caused serious damage in the 21st century. In the last decades, direct annual loses from floods comprised nearly € 2.23 Mln, with € 73 Mln in 1998, and € 43.8 Mln in 2001 (Lycur 2003). The devastating floods that occurred in the mentioned years and recently in 2008 caused severe damages, and the social and economic problems in a remote mountainous region of Ukraine- Transcarpathia.

Today the tendency is to decrease logging in the Carpathians. However, the forests are still threatened by poor logging practices, over-harvesting in the past, overgrazing, chemical contamination and atmospheric deposition resulting in the decline in forest health and vitality, in soil erosion, destruction of native vegetation, degradation of wildlife habitat and the subsequent loss of biodiversity. Although recent forest policy has aimed at restoring forest resources potential, the emphasis has been given to the creation of forest plantations which are less stable ecologically. Consequently, the decreasing increment of monoculture spruce plantations is particularly observed in matured and over matured stands. Moreover, intermediate and selective timber cuttings often do not respond to the principles of sustainable forest management (SFM) (Nijnik and Oscam 2004), and the use of manual logging or mechanized extraction with obsolete equipment often results in systematic damage of natural regeneration and in soil compaction (Bihun 2005). Some of the threats facing Carpathian forests today include escalating income-generating pressures that create un-sustainable practices. According to the official data, in 2004, more than 1500 m^3 were harvested illegally, i.e. 25 % more than in 2003 (National Report 2004). Forest use in recent years has been strongly driven by short-term financial considerations, whereas overall economic considerations to sustain and enlarge forest resources and ecosystem services have not always been taken into account (Nijnik et al. 2007). Environmental requirements and the needs of local people urgently call for new forest management practices that will put emphasis on sustainable and multipurpose use of forests, and on their proper integration with other land uses into an overall landscape context.

The need to not only protect but also ensure the economic and social well-being of mountain communities is increasing being recognized internationally. However, this awareness is not progressing at a significantly rapid pace to prevent the degradation of mountainous territories around the world. Sustainable rural development in mountain regions is often directly related to unsustainable forest practices and exploitation of forest resources. Widespread in Ukraine's Carpathian Mountains, the challenges to the sustainable development of these regions include low incomes, unemployment and job loss, limited educational possibilities, depopulation of rural areas, inadequate funds for sustainable forest management (SFM) and illegal logging (Bihun 2005). These factors consequently decrease forest productivity, which, in turn, compromises watershed functions and the stability of fragile ecosystems. Other important problems include pollution, unsanctioned land acquisition and unregulated development of recreational areas by outside business concerns which ignore local cultural traditions, including traditional landscape planning and land use systems.

Nonetheless, several countries have enacted legal instruments focusing specifically on the protection and sustainable development of mountainous areas. In the Alps, the Alpine Convention, which includes the governments of France, Georgia, Italy, and Switzerland, is an example of this trend. One of the most important recent developments in the protection of the Carpathian ecological region has been the creation and signing of the Carpathian Convention. The chapter 26 of this book is devoted to the comparative analysis of these conventions.

8.3 Ownership Status of Forest Landscape

Among the most fundamental forest policy issues is defining forest tenure which allocates rights of use, ownership and responsibilities among individual owners, groups and governments (Floyd 2007). In the Ukraine the state forest ownership still prevails, but forests are managed by different state organizations – State Committee of Forestry (SFC), Ministry of Agricultural Policy, Ministry of Defense, Ministry of Emergencies, Ministry of Environment Protection, Ministry of

Transportation, and others. According to the new Land Code (2001) and Forest Code (2006) Ukrainian forests may be state owned (now nearly 95 %), communal (now nearly 4 %) and private (now less then 1 %). Only small parts of forest (up to 5 ha) may be permanently used by private owners.

The best managed forests are owned by enterprises of the State Committee of Forestry 7.4 million ha (66.1 %). There are 318 state forestry enterprises, 4 national parks, 7 nature reserves, two research institutes, two design and survey institutes and other specialized units. The SFC is responsible on forest protection, reforestation and afforestation, and commercially efficient management of forests. The SFC offers jobs for 78 000 people, including 21 000 people in management area. Annually 13 million cubic meters are harvested in the forests under SFC (16 million cubic meters totally in Ukraine) while the wood increment is 24 million cubic meter (35 million cubic meters in Ukraine). In 2007 it was planted 63.7 thousand ha, including 24.5 thousand of new forests (afforestation of marginal lands). At the same time the share of nature protected areas of different types (nature reserves – 6, national parks – 4, sanctuaries – 1239, nature monuments – 1117, regional landscape parks – 33, protected tracks – 543, deontological parks -13, park and garden architecture objects -45) in forest of SFC is 14.1 %, while at average in Europe -12 **%** (The State Forest Committee 2008**).**

So called agrarian forests – (24 % of forest area, 1, 845 million ha of forest lands and 177 thousand ha of shelterbelts) – belongs to the Ministry of the Agricultural Policy. These farm forests are mostly small-scale tracts which are situated among the agricultural areas, near villages, rivers or lakes. Forests belonging to former collective farms are generally far less productive, and have the worse control of forest management. Among permanent forest users, there are many agricultural enterprises, many of which liquidated in the course of the land reform. At the same time this forests are important for climate regulation, creating favorable microclimatic conditions for crops, (especially in steppe zone where one hectare of shelterbelts protects 35-40 hectares of open field), conserving agribiodiversity, and protection from wind and water erosion.

There are 206 specialized forestry enterprises under control of Ministry of Agrarian Policy with 12 000 employees. No centralized decision has been made on the further ownership of these forests. In Vinnytsya, Ivano-Frankivsk, Zhytomyr, Sumy, Lviv, Suny, Chmelnytsk, Cherkassy, and Chernihiv oblasts (provinces) local authorities created communal property specialized forestry enterprices; in Zakarpattya, Kyiv, Poltava, Rivne, Charkiv, and Chernivtsi oblasts such enterprises were transferred to the state (national level) properties. In Volyn oblast such enterprises are still on a stage of decision making about the reforms.

The forestry enterprises subordinated to the Ministry of Agrarian Policy are financed on a lower level from state budget than SFC enterprises: 9.5 UAH per ha of forest area (in 2007) in comparison with 40 UAH per ha for SFC's forests. Agro-Forest Enterprises (AFEs) are funded from the sale of forest products and state subsidy (15-17 %).

A World Bank review of experience of the reform and development of forestry institutions in transition countries emphasises that there is very little empirical evidence to suggest that organizational structures, by themselves, are the key element to a successful forestry sector reform process. To the contrary, evidence suggests that the structural form of a forest organization simply does not matter. Very different models can succeed, and very different models can fail. What matters more is that forest organizations operate in a way which is geared toward service delivery, whether those services are provided for the public good (e.g., biodiversity conservation, recreational purposes, watershed management, insect and fire control, etc.) or for benefits to the forest industry, to private forest owners in need of forest management advice, or to people who need forest products such as timber, firewood and other non-timber forest products. For an institutional reform process to succeed, it must be strongly supported both at the political level, and at the organizational level (World Bank 2005).

The private ownership doesn't play a serious role at the current stage. In contradiction to the most CEE countries restitution of forest properties was not one of the main issues in forest policy reforming because of different historical developments of Western and Eastern Ukraine. In Western Region, which was consolidated with the Soviet Union in 1939, restitution was quite possible because of the ability to find information about former owners before Second World War and borders of their forests. Historical developments, such as nationalization of private properties in the other regions of Ukraine, which were part of Soviet Union since 1920s, prevents the process of restitution, as former owners cannot be determined and the experience of private forest management has virtually lost. Another reason preventing restitution was pervasive public fear that forests would be destroyed immediately if privatized. This capacity will not only require additional legislative changes and developments (there are the cases when the farmers who wish to create private forest stands have a troubles because of lack of clear regulations in this field), but also renewing human resource capabilities and adapting forest institutions to changing circumstances.

8.4 Main Legislative Framework Affecting Forestry

Legislative frameworks of forests and forest resources management in Ukraine were formulated initially in the Forest Code of Ukraine (1994) and Law on the Environmental Protection of Ukraine (1991), and other legislative documents and government regulations. Krott et al. (2000) conclude that legal rules have been reformulated, but are too general or contradictory to give clear guidance to institutions, and that the implementation of laws is moving slowly. The Forest Code identifies the soil protection, water conservation, air cleansing and health-giving functions of forests as being more important than commercial timber exploitation. Some scientists agree because of low amount of forest cover in many regions. On the other hand Nijnik (2002) suggests that in the Forest Code is a wish list for the environmental lobby within the Ukrainian bureaucracy and can not realistically be used to guide forest management without greater knowledge about production possibilities and the trade – offs to be permitted among the various uses of the forest.

Others noted that great attention is paid to the improvement of forest management system through development of forest legal instruments, e.g. Forest Code of Ukraine, while there is little improvement of normative, technical and organizational, technological instruments of forest policy, like rules, codes, instructions for forest practice (Popkov et al. 2002, Storoguk 2003, Polyakov & Polyakov 2003).

Several alternative versions of the Forest Code were developed, including prepared by the State Forestry Committee, and by group of scientists in Ukrainian National Forestry University (Synyakevych et al. 2002), but finally in 2006 a new document was adopted based on old version and fairly policies, and only few changes were introduced.

According to the new law not only agricultural land, but also forest now can be in state, private or communal property. Citizens of Ukraine can hold forest in private property but it should be forest plots not bigger than 5 ha in a private property. The area of plots inherited by legal succession is not limited by 5 ha. A forest permit (special permission) is required to make cuts or other uses of resources in forests of all forms of ownership. Holding of publicly owned forest land under lease is more strictly regulated now too. Forest plots bigger than one ha can be leased for temporary use only by special governmental decision.

Under the new law, the State Forest Committee received more rights to influence forest enterprises which belong to other ministries (Ministry of Agriculture, Ministry of Defense, Ministry of Transportation and Connections). State forestry enterprises can control and put forward a proposal about determination of activity of enterprises, and organizations which break the forest laws.

New, more detailed functional classification of forests was introduced in the new law. There were two groups (1) mainly protective forests with limited exploitation, and (2) exploitable forests. Now there are six groups: (1) Forests with protective functions; (2). Recreational and health-improving forests; (3) Nature conservation forests; (4) Forests of historical and cultural values; (5) Forests of special purpose; and (6) Exploitable forests.

The further forest legislation should be redesigned for conditions of market economy, with the aim to ensure the broad public interest in forestry and with the rest of a country legal infrastructure in mind (Soloviy & Cubbage 2007).

8.5 Problem Areas of National Forest Policy

In Ukraine the main authorities that have influence on forest policy are State Forest Committee and the Ministry for Environment Protection. The scientists from research institutes and universities can be involved in policy formulation in two ways: (a) advising to the state forestry authorities and (b) making pressure through the mass media on governmental decisions. The influence of local authorities, users of forest resources and especially of local communities on forest planning decision making process is very limited. Information about forest resources status, usage, and conservation is not transparent. Generally, Ukrainian environmental NGOs have little interest in forestry topics. Timber companies are new and growing player in a forest policy arena, but they are interested first of all in a permanent delivery of wood for as possible cheaper prices. Consequently, there are no effective institutional mechanisms for the involvement of all stakeholders in decision-making process related to implementation of forest policy.

Among the problem areas of national forest policy are:

- Challenges of transition from command to market economy of the whole economy for forest enterprises and simultaneous decreasing of state budget financing for these enterprises,
- Nonconformity of national forest legislation to socio-economics and market transformations,
- The slower rate of economic and institutional reforms has held back the restructuring of forest management systems, in particular separation between forest management and commercial use of forests has not been achieved (Pachova et al. 2004).
- Governance relies on state authority, without properly functioning market incentives (Nijnik 2002).
- Reduced state wood-processing sector as consequence of disintegration of forest sector as a complex unit and grooving number of uncontrolled small sawmills,
- Sharp reduction of consumer demand on internal market of wood and large increase of volume of wood exported, especially of more valuable tree species,
- Discrepancy of forest management information systems to the modern requirements (Buksha 2004),

In most CEE countries the reforms changed more radically the institutional environment. These changes strengthened the role of forest sector, opened new markets, and increased effectiveness of forest management, but forest resources in some countries at the beginnings of transition find themselves in a risk. Also there is no legal basis for a common European forest policy, the new situation accelerated attempts to harmonize existing regulation in this sector on a European level (Weber & Gerhardt 2000).

About Ukrainian forest sector we can suggest that it is very conservative, and reforms go very slowly, so changes are not as radical as, for example, in agricultural sector. The main content of market reforms in forestry is as follows:

- Introducing right of private property to forest land ownership at limited scale;
- Introducing right to forest land use for citizens and foreign organizations and citizens;
- Privatization of assets of complex forest enterprises;
- Entitling rights to logging for private firms;
- Development of entrepreneurship activity in the sphere of logging, wood processing, export of timber and wood products (Vrublevska 2006).

Analyzing the forest laws and rules with respect to market economy principles, we would say that generally, timber is priced according to demand and supply mechanisms, but numerous administrative control institutions have great influence on state forest enterprises. Real timber markets are just beginning to develop. A private market for management in forestry sector does not exist, but one is emerging for logging and transportation. Some state forestry enterprices use the contractual services of private firms, which deal with timber cutting, its primary processing and wood trade. Other state forestry enterprises as before prefer to do all these works by own personal, and using own harvesting equipment and transportation.

The situation in Ukrainian forestry didn't allow to involve fully the sector in market relations, but at the same time, for opinion of most of national experts, it's saved the forests from too intensive harvesting and destruction. Therefore further forest legislation should be redesigned for conditions of market economy, with the aim to ensure the broad public interest in forestry and with the rest of a country legal infrastructure in mind.

The international cooperation made a contribution to discovering of new opportunities of SFM approaches. For example the project of Sweden Agency Scandiaconsult (2000) provided a strategy for restructuring the organization of the State Committee of Forestry (SCF), acknowledging the different state forest functions and aiming at creating a basis for improved economic results of the forestry sector. Proposed organization of SCF consists from State Forest Enterprise, State Forest Service, Forest Department, and State Department for Protected Areas with Chairman and Board at the top level.

The Ukrainian-Swish project FORZA contributed to practical implementation of the mechanisms for community involvement in decision making and forest planning (Chapter 19) introducing close to nature forestry methods as a tool for forest sustainability approaching (Chapter 12).

For the Ukraine and for its forest sector, progressive changes in formal and informal rules are crucial. Institutional transformations in Ukraine's forestry have started, but the rules of the game and the arrangements have not changed substantially so far. Neither democratization with open privatization nor decentralization has been achieved. Democratization, market oriented reformation, and decentralization should be considered as main blocks of policy measures to stimulate institutional transformation of forestry sector.

The further recommendations concerning institutional design of sector should be based on both formal and informal forest sector institutions analysis. The framework of such analysis can suggests certain features, that condition the behavior of the actors (forest owners, users) in the system, including attributes of physical world (forest land, infrastructure, technology etc.), attributes of community (education, skills, politics etc.) and rules in use (formal and informal rules governing the behavior of a actors) (Olsson 2004).

8.6 Scenarios Analysis for Forest Sector Reforms in Ukraine

8.6.1 Methodology

Expert evaluations have been used to make analysis of forestry sector development scenarios. The experts were represented by forest politics (two groups: forest policy scientists and decision makers). The main scenarios (North American, Finish, German, Polish, of the State Forestry Committee, of the Ukrainian National Forestry University) are note the blue print from the existing models, but adaptations of the main ideas in the field of economic mechanism (taxation and financing systems) and institutional transformation of the governance system) to the specific circumstances of the Ukrainian institutional environment and forest management traditions.

An expert conclusion in relation to the scenarios of reformation of forestry of Ukraine was done on the basis of estimation of ten experts' answers and comments on such questions:

1. What is the probability of the legislative providing of separate scenarios of forest sector reformation in Ukraine: optimistic – a 1 point; not enough optimistic – 0,5 point; pessimistic – 0 points.
2. As far as the separate scenarios of reformation of forestry in Ukraine correspond the theory of forest policy and forest management: fully correspond – a 1 point; partly correspond – 0,5 point; does not correspond – 0 points.
3. As far as the separate scenarios of reformation of forestry in Ukraine correspond conception of the sustainable forest management: fully correspond – a 1 point; partly correspond – 0,5 point; does not correspond – 0 points.
4. What your hopes on the improvement of the state of the forests, strengthening of ecological and social functions of the forests after implementation of scenarios of reformation of forestry in Ukraine in practice: optimistic – a 1 point; not enough optimistic – 0,5 point; pessimistic – 0 points.
5. What your hopes on the increase of economic efficiency of forest management after forestry reformation scenarios implementation in practice: optimistic – a 1 point; not enough optimistic – 0,5 point; pessimistic – 0 points.
6. It was necessary to number all scenarios of reformation of forestry of Ukraine after the level of priority (first numbers – the best, last – the worst). Chosen the greatest priority was estimated as 6 points, every following on one point less.

Each of the scenarios was analyzed in terms of political, economic, ecological and social challenges Ukrainian forest sector meet. Every scenario is foreseen by reformation of the system of taxation and financing of forestry (table. 8.1, and table 8.2) and institutional transformations in the field of forest management.

North-American scenario of forestry reforms. This scenario is foreseen by a reducing State Forest Committee of Ukraine functions to formulation of forest policy and general rules for management of the forests. Creation of national forest legislation in relation to a management the state forests depends upon Ukrainian Parliament and in relation to a management the communal and private forests on Parliament of Autonomous Republic Crimea and regional councils. The forestry enterprises of state and communal ownership together with the forests are passed in a lease (first of all to their current employees). The state stimulates creation of private companies and other commercial structures in forestry and harvesting productions. The network of state institutions, upon which the economic evaluation of forest lands, forest resources and development of norms of rent, depends for the forests and forest lands, is created.

Table 8.1 Forest taxation system according the different scenarios of economic reforms

Scenarios of forestry sector reforms	***Type of forest tax***	***Objects of taxation***	***Method of tax sum estimation***	***Comments to method of taxation***
North American scenario	Ad valorem property tax	Land and trees value	The value of the land and the trees form the basis for tax collection	
	Productivity tax	Forest revenue	Annual property tax is imposed on the capitalized value of the gross or net mean annual revenue from a forest	Can be based on gross mean annual review, on net annual revenue, or on agricultural productivity of forest land
	Site value tax	the value of the land	The value of the trees is removed from the tax base and a property tax is then collected annually on only the value of the land	A yield tax at the time of timber harvest often is combined with the site value tax
	Flat property tax	acre of timberland	The same amount of money per acre is collected on any acre of timberland regardless of its value	
	License fee on timber harvesting	The right on harvesting	Fee for received license	Payment during the license issuing procedure
German scenario	Land tax	Forest lands	The share from forest land price	Payment after reporting period termination
Polish scenario	Forest tax	Conventional forest area (in transferable hectares)	Multiplication of conventional forest area on tax rate per hectar	Payment after reporting period termination
Finish scenario	Forest income tax	Forest income	4.1. Percentage from forest income	Payment after reporting period termination
	Property tax	Property	Percentage from property price	Payment after reporting period termination
	Lump-sum (sale tax on standing timber for a fixed amount agreed upon in advance)	Stumpage fees sum	Percentage from stumpage fees sum	Payment after reporting period termination
Ukrainian scenario (official)	Tax on profit	Profit of forest land user	Percentage from taxed profit	Payment after reporting period termination
	Payment for special use of forest resources	Forest resources designated for special use	Taxes are calculated according to special norms	Payment after reporting period termination
Scenario of the UNFU	Forest income tax	Forest income	Percentage from forest income	Payment after reporting period termination

The general political and legislative approaches in relation to management of the national forests and forestry applied in practice in the USA and Canada laid to the foundation of this scenario. Certainly differences in balance of organs of power in two countries have a considerable influence on development of forest sector in each of countries. In spite of these differences, and also yet more wide palette of differences at the level of the states of the USA and Canadian provinces the principle vision of role of forest policy in these two large forest states is alike.

This scenario, in addition, foresees reformation of financing and taxation of forestry directed on minimization of oncoming cash flows (table.8.2 and table 8.3).

German scenario of forestry reforms. After this scenario it is foreseen to entrust State Forest Committee of Ukraine with a task of forest policy development and the management. It is proposed to create a state owned company "The Forests of Ukraine" and made it responsible for state owned forests management, and to develop a network of regional communal companies for the communal forests management. Within the framework of state company "The Forests of Ukraine" and network of regional communal companies there are only operating forest districts a management in which a task for a public forest service.

Also this scenario provides the policy towards development of the private sector of economy in forestry and harvesting.

Table 8.2 Financing of forestry according to different scenarios

Scenarios for reforms	***Main sources of forestry financing in forests of different properties***		
	State owned forests	Communal forests	Private forests
North American	National budget	Local budgets	Private forest owners
German	State forestry enterprices	Communal property enterprices	Private forest owners
	National budget	Local budgets	
Polish	State forestry enterprices	Communal property enterprices	Private forest owners
	National foundation for forest resources, protection and restoration	Local budgets	
Finish	State forestry enterprices	Communal property enterprices	Private forest owners
Ukrainian	National budget	Local budgets	Private forest owners
	State forestry enterprices	Communal property enterprices	
UNFU	State forestry enterprices National Foundation for Forest Resources Protection and Forest Restoration	Communal property enterprices Local budgets	Private forest owners

Creation of national forest legislation depends upon Parliament of Ukraine and regional on of Parliament of Autonomous Republic Crimea and oblast councils. Forest legislation at regional level does not violate the legal norms of the national forest legislation.

This scenario of reformation of forestry is based on the basis of experiences of Germany (and in some aspects of Austria) in relation to forest policy and management. It does not foresee creation of the standing timber markets but it is directed on market of services and products development in forestry. In addition it requires reformation of financing and taxation system in forestry (table.8.1 and table 8.2).

Polish scenario of forestry reforms. After this scenario it is foreseen on State Forest Committee of Ukraine assigned with the functions of management of the forests and of development of forest policy. For organization of effective forest management a state company "The Forests of Ukraine" is created in the state forests". With the purpose to support the support the state forestry enterprises which are not capable to be efficient in economic sense the "State fund of protection and restoration of forest resources" should be formed with the financing from the state budget, payments of highly economic efficient state forestry enterprises and other sources.

With the purpose of improvement of taxation system regarding the state forestry enterprises the per hectare of forest land rates of tax are proposed (table.8.1 and table 8.2). It is proposed to remain the actual state forest enterprises managed by state managers within the framework of state company "The Forests of Ukraine".

The state stimulates development of private sector of economy in the forestry and harvesting as well. At once development of the standing timber markets and lease of state owned forest lands is not foreseen

Finnish scenario of forestry reforms. After this scenario State Forest Committee of Ukraine assigned on a fulfillment of forest management function through the establishment of two independent institutions in the structure of the State Forest Committee of Ukraine: National directorate on forest management, and National directorate on forests. A national forest policy is developed by Ministry of Natural Environment Protection of Ukraine with participation of State Forest Committee of Ukraine, Ministry of Industrial Policy of Ukraine, Department of Commerce of Ukraine and Ministry of Agriculture and Food of Ukraine. In addition reformation of the system of taxation and financing of forestry is foreseen on the basis of experience of Finland.

Ukrainian official scenario of forestry reforms. This scenario is based "Conception of reformation and development of forestry" (Conception 2006). This conception does not foresee institutional changes in the field of forestry and forest management system. It declare sustainable development of forestry, submission of all state forests to the State Forest Committee of Ukraine, optimization of structure and quantitative composition of the state forestry enterprises, maintenance of current system of stumpage fees. It does not foresee the sale of wood in a forest according the stumpage fees and on auctions. As stumpage fees after this scenario execute a fiscal function, they must be set thus as taxes on a natural resource.

According to this scenario is foreseen the establishing of state woodworking enterprises on the basis of woodworking productions dissociated from forestry enterprises.

Scenario of forestry reforms developed by the Ukrainian National Forestry University. This scenario of reformation of forestry is presented in the published drafts of the Forest code of Ukraine (Synayakevych et al. 2002) and Law of Ukraine the "National Forest Policy"(Synayakevych et al. 2003).

8.6.2 Evaluation of Scenarios for Ukrainian Forestry Reformation

The results of experts' evaluation are presented in tables 8.3 and 8.4. The experts of the first groups among scenarios with the greatest priority named the scenario of UNFU, and Finnish scenario (some experts gave the greatest priority to not a single scenario), however the greatest a middle index of priority is at the scenario of UNFU, the Polish and Ukrainian scenarios follow after it. Also the scenario of UNFU characteristic high indexes of accordance to theory of forest management and forest policy and accordance to conception of sustainable forest management. It is analogical situation with the Polish scenario with which one the experts mostly believe will be related the increase of ecological economic efficiency of forest management. The same hopes and also high probability of the legitimizing providing experts link up with the German and Finnish scenarios. The North-American scenario experts consider as such that corresponds with the conception of sustainable forest management partly. But with this scenario they link up high enough hopes in relation to the increase of ecological economic efficiency of forest management, however give to scenario the lowest priority.

Table 8.3 Expert evaluation of the forest sector reformation scenarios by scientists in the field of forest policy

Scenarios	***Sum of points***					
	Probability of legitimization	Conformity with FM and policy theory	Confor-mity with SFM concept	Expectancies on social and ecological func-tions of forests improve-ments	Expectancies on ecological-economic functions of for-ests improvements	Priority of sce-nario
North American	1	2	2,5	2	3	8
German	2,5	2,0	2,5	2	3	13
Finish	3	3	4	3	2	16
Polish	2,5	3,5	4,5	3,5	2,4	21
Ukrainian (official)	3	2,5	3	2	0,5	18
UNFU	2	4	3,5	2	3,5	25

The experts of the second group the greatest priority give to the Polish followed by the Ukrainian official scenario, and scenario of UNFU which also examined as such which have high probability of the legislative providing.

The first two scenarios got equally high index of priority and most optimistic hopes in relation to the improvement of ecological economic efficiency of the forest management. As most relevant to theories of forest management and forest policy is appraised the German and North-American scenarios, however other their indexes as well as at the Finnish scenario low, as well as their priority on the whole.

Table 8.4 Expert evaluation of the forest sector reformation scenarios by decision – makers in the field of forest policy

Scenarios for reforms	*Sum of points*					
	Proba-bility of legitim-ization	Conformity with FM and policy theory	Confor-mity with SFM concept	Expectancies on so-cial and ecological functions of forests rovements	Expectancies on eco-logical-economic functions of forests improvements	Priority of scenario
1. North American	1	2	1	1	1	9
2. German	1	2,5	1	1,5	1,5	11
3. Finish	1	1,5	1,5	1	1	10
4. Polish	4	3,5	2,5	4	4	26
5. Ukrainian (official)	3,5	2,5	2,5	1,5	2,5	24
6. UNFU	2,5	2,5	2,5	2,5	2,5	21

8.7 Principles for Development of Economic Reforms in Forest Sector and SFM Stimulation

The research results have been used to formulate the principles of the Ukrainian forestry sector reformation. On the basis of international experience of forest sector institutional building, analysis of scientific publications in the field of ecological economics, environmental and forest policy such principles of economic reform in forest sector of Ukraine proposed:

- taking into consideration the best world experience of institutional organization of forest sector, forest governance and management;
- taking into consideration Ukrainian traditions of natural resource use, landscape planning and forest history lessons;
- opposition to destructive influences of globalization which are directed on forest degradation and weakening of forest ecosystems functions and services;
- reformation of forestry should be carried out on the basis of scenario which would have a deep ecological economic substantiation, professional expert evaluation which would take into account the political, legal, economic, ecological, social and cultural aspects of forestry development;
- forest sector' reforms should be durable, evolutional, complex, by the system, stage-by-stage and to take into account the numeral ecological economic and regional features of forest management;
- forest sector' reforms should be instrumental in overcoming of global economic threats, strengthening of global environmental security, and providing of the grounds for sustainable forestry.

Forest policy should be oriented in to the strengthening of the sustainable forest management stimulation. It could be reached only on the basics network of rules that we named as principles of the economic stimulation of the sustainable forest management (Synyakevych and Soloviy 2004). Principles of the economic stimulation of the sustainable forest management reflects ideal model of economic relations in the use of forest resources that is not realised completely in any country, but than closer situation to it than better.

Principle of the set of forest policy instruments orientation on reaching of the maximal grade of economic, environmental and social effect from forest resources use means the system of economic stimulation formation, which is oriented on the receiving of the maximal integral effect from the use and restoration of forest resources.

Principle of the transformation of negative external economic, environmental and social effects, that constitute during the process of forest use into the internal effects (environmental costs) which means transformation of the normative environmental damage (forest soils erosion, injure and annihilation of the forest plants, weakening of the useful properties of forest etc.), that is admitted by the environmental standards, into the environmental costs by the introducing of the green taxes for the environmental damage in forest practices.

Principle of the strengthening of the forest policy instruments stimulate functions taking in to the consideration interrelations among the other components of forest resources foresee the incarnation in practice of the forest policy, which excludes economic stimulation of the intensive reproduction and use of same forest resources component making damage for other components and with taking into account many interrelations that have place among the different components of forest resources.

Principle of the regional differentiation of the forest policy instruments stimulate influence require to take in consider ecological and economic conditions of the forest resources use in the separate regions. Thus, forest policy of stimulation of sustainable forest management in Ukraine should be realised taking into account the ecological role of the mountain forests of Carpathians and Crimea, pollution of the forests of Polissya as a result of Chernobyl accident, ecological, economic and social value of the forests of Forest-Steppe zone.

Principle of the flexibility of forest policy *foresees* flexible modification of the forest policy in the cases when environmental and economic conditions have been changed. In Ukraine economic system essentially changed as result of the national economy reformation, but in forestry sector still preserved imperfect mechanism of forest resources use, which becomes hindrance for the sustainable forestry development.

Maine directions of the forest policy principles implementation and the forest policy instruments that we recommend to use in the forest sector of economy of Ukraine are shown in table 1. Set of forest policy instruments is represented by the traditional instruments (that used in Ukraine) and non-traditional instruments (not used yet in Ukraine). Traditional instruments include the following 1.1, 1.3, 1.4, 1.6, 3.5, 4.4, 4.5, 5.1-5.3 (table 8.5). All other instruments included in list we could consider as non-traditional.

Our investigations and international forest policy experiences confirms the expedience to implement *non*-traditional instruments for the reformation of the forestry sector in Ukraine. Also should be strengthened the stimulate functions of the traditional instruments of forest policy on the basics of the concept of the economic mechanisms for protection of environment and mentioned above principles.

Table 8.5 Forest policy instruments set

Main directions of the forest policy implementations	*Types of the forest policy instruments*
1. Forest policy in the field of price formation	1.1. Forest taxes for special use of forest resources of wood origin. 1.2. Forest taxes for special use of forest resources of non-wood origin. 1.3. Licences and cards for hunting. 1.4. Prices on forestry products. 1.5. Rent payment for the use of forests and forest lands. 1.6. Economic evaluation of forests and forest lands. 1.7. Forest auctions.
2. Forest policy in the field of forestry financing	2.1. Norms of the subsidies from state budget for restoration and protection of forests. 2.2. Norms of the compensations for forestry enterprises because of special regime in the forests of first group with domination of conservation and recreational functions (from state and local budgets). 2.3. Favourable credits for restoration and preservation of forests. 2.4. Funds of restoration and conservation of forests.
3. Forest policy on forestry taxation	3.1. Ecological taxes for the air pollution. 3.2. Ecological taxes for the water basins pollution. 3.3. Ecological taxes for the worsening of the state of forests and forest lands 3.4. Taxes on property. 3.5. Taxes on added value. 3.6. Taxes on forest income. 3.7.Taxational privileges on restoration and preservation of forests.
4. Forest policy concerning forest management	4.1.Environmental standards on state of forests and forestlands. 4.2. Environmental standards on technological processes of the forests restoration and forest resources use. 4.3. Forest certification of. 4.4. Economic sanctions for the environmental damage. 4.5. Payments for works.
5. Forest policy concerning planning and accounting of the forest resources restoration and use	5.1. Forest resources cadastre. 5.2. Plans (programs) of forest resources restoration and use. 5.3. Limits of the forest resources use.

Angelstam et al. (2004) identified three phases in the ongoing development of SFM. The first is based on sustained yield of wood products where humans dominate nature. Second, there is at present in Europe a phase based on multiple use sustaining primarily wood production, but also with attempts to accommodate new issues such as biodiversity and recreation. Third, a future phase is envisioned with sustainable social-ecological systems inspired by and maintaining authentic natural or cultural processes where humans and nature coexist. The current starting point for trajectories towards the SFM calls for more sophisticated, innovative non-traditional policy instruments development based on and local studies of public attitudes and preferences towards forests and forestry and their relevance to current policies.

8.8 Forest Policy Evolution: Where Do We Go from Here?

In most European countries a formal policy was not adopted until the late 19th or early 20th century. The reasons for the creation of state forestry programmes are diverse and include, among others, the fear of timber shortage, strategic reasons to stop, the threat of drift sands, reclamation of "wastelands" (Forest Policy in Europe 2001).

The beginnings of forest policy in the United States can be traced to the beginnings of the conservation movement in late 1800s, and creation of Forest Service as federal government response on growing concerns about perceived resources shortages and forest destruction (Cubbage et al. 1996), but formalization of process in form of policies and programs evolved through some periods. A good example of such document is "Policy of Forestry for the Nation" (Graves 1919).

Forest policy can be defined in many ways, depending on perspective: a first is the juridical perspective, which focuses on actual rules and regulations, a second is the "political science" perspective which means that the political process as such are in focus, and a third is the economic perspective which seeks to indentify and measure the magnitude of market imperfections (Brännlund 2004).

The first definition of forest policy we found in literature is by M. Enders. I is surprisingly that it's already reflects the nature of forest policy as a scientific doctrine "Forest policy is a doctrine about societal and economic importance of the forests and forestry for the state and national economy "(Von Enders 1905). Definition of Weber separates sense of a forest policy as a science and narrow sense of forest policy as activity of forest sector "Forest policy as a science should be understandable as scientific substantiation of economic role of forestry in national economy. Forest policy has deal with the social dimension of forest and considers activities related to forest from technical, industrial point of view. Forest policy as an art is a part of socio-economic, especially public economic activity of the forest sector. This activity is some part restrictive, in other parts restorative, conservative, tending … Often forest policy (in a narrow sense) is identifying the tasks of the state concerning forestry sector to satisfy the demands of the common good as much as possible " (Weber 1926).

The shortest definition is that "forest policy is what governments choose to do and not to do about forests within their jurisdiction" (Floyd 2007) combine juridical and political perspective, because the limits of jurisdiction are always politically motivated and established by political process.

The term "forest resource policy" is used as alternative to forest policy, but using of this term allow integrating political and economic perspective. For example Cubbage et al. define it as "…purposive course of action or inaction followed by an individual or group in dealing with a matter of concern regarding the use of forest resources. Forest policies guide how forests will be used usually to achieve some stated or implicit objective " (Cubbage et al. 1993).

The definitions from clearly political perspective based on interests, conflicts, and processes of bargaining. K.R.Volz (1997) defines a forest policy clearly from political sciences perspective (2002) "Forest policy is goal-oriented action with the intention of ordering the relations and conflicting interests between society, the forest and forestry for the common good The structure of relationships between society, the forest and forestry can be presented as the forest political sub-system on the basis of the general political system. Here, too, one can distinguish between the sectors of input, transformation and output (Nonic 2003).

For many years, forest policy was studied by learning the history of government regulation of forests, but beginning in the 20th century, political scientists began to describe public policy as a complex system of actors and institutions. As a consequence today forest policy is often thought of as a process that proceeds from 1) setting a policy agenda to 2) formulating policy alternatives to 3) adoption of policy choices to 4) implementation of programs and finally to 5) policy assessment (Floyd 2007).

In definition by M. Krott the political perspective is based on institutional ground of programs for the forest sector "Forest policy is that social bargaining process which regulates conflicts of interest in utilizing and protecting forests according to the programs of the forest sector"(Krott 2005).

In definition of I. Synyakevych attention is stressed on legal perspective "Forest policy is a set of principles and instruments which are used by national and transnational bodies, political parties and NGOs for the assertion of their interests in the field of the forest resources restoration, protection and use". At the same time this author see it through the pure economic dimension "Forest policy is a chapter of forest resource economics, which consider forest resource use principles, economic, environmental, social and technological instruments which are used for implementation of this principles" (Synyakevych 2005).

Forest policy has long been used to support strategies which have been considered to contribute to economic development, especially since 1960s. Strategies emphatically linked with macroeconomic theory have been employed since the mid 1980s. Toward the late 1980s increasing emphasis was placed on forest protection and maintenance of biological diversity. This was a sign of the increasing interest shown by society in forest management and thus in reconsidering forest policy goals (Rihinen and Järveläinen 2005).

Forest policy as a separate policy sector is becoming more and more difficult and the is a need for multisectoral policy and policy coordination (energy, environment, industry, education) (Nilsson 2006). Today's forest policy of developed countries is closely connected and integrated to the environmental, agricultural, regional policies where each of them makes the contribution to implementation of the idea of sustainability.

In the nearest future forest policy should be developed through the multidimensional integration of:

- Biodiversity conservation policy,
- Climate changes policy,
- Land use planning policy
- Rural development policy,
- Bioenergy policy,
- International trade policy,
- Community building (participatory) policy.

But the principles of ecological economics should be considered as theoretical foundation for creation of effective international, national and regional forest policies.

8.9 Conclusion

Forest policy would correspond to the national interests of Ukraine and its international responsibilities towards SFM when it fulfills the conditions:

- consider that greening of societal development based on ecological economic approach as objective necessity towards mitigation the global environmental threats, first of all global climate change;
- will be governed by perceiving of moral responsibility of present generation for the forest destruction in past and present state of the forests which as a greatest good will be past to future generation;
- will recognize that along with the preventive measures towards environmental protection the greening of all the fields of society activities (economics, technologies, consumption, education) should be implemented. Forests and forestry as an important factor of environment stabilizing should be in the main focus of these processes;
- will be based on understanding the fact that global and national ecological economic problems cannot be solved without overcoming of an impoverishment and cultural wealth degradation;
- will consider that coherent challenges of sustainable development (especially environmentally caused) not always can be solved in the national borders. The efficient environmental policy and forest policy cannot be implemented without considering the interests of global human community
- will consider a special mission of forestry in 21st century in development of economy, broad social needs satisfaction, delivering ecosystem services, and building sustainable communities.

Good governance, participatory policy, transparence, fair rent distribution that support local socioeconomic development, and SFM which takes into account the multifunctional value of forest landscape, natural capital stock, potential of ecosystem services and defines the scale of forestry activities are core tools for forest resource decision making. Participatory forest policy can serve as instrumental mean for conflicts resolution and for transformative purposes, as tool for improving the lives of people, fairness and balance. The challenge is to create effective institutional mechanisms for the involvement of all stakeholders in the planning and decision-making processes related to the implementation of environmentally, economically and socially sound forest policy.

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Лісове господарство України у XXI столітті: нинішній стан, сценарії та політика сталого розвитку

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На основі аналізу сучасного стану лісів і лісового господарства України, спираючись на зміст чинних нормативних документів та дотримання чи недотримання їхніх вимог на практиці, автори спробували спрогнозувати, наскільки успішним буде реформування лісового господарства України у першій чверті двадцять першого століття, а також якою мірою воно узгоджуватиметься з концепцією сталого розвитку та сприятиме подоланню глобальних екологічних загроз і посиленню екологічної захищеності.

Задля вироблення ефективної концепції реформування лісового господарства на основі досвіду окремих країн, який відображає відмінні підходи до лісового сектора, розроблено шість сценаріїв реформ з метою їх аналізу і з'ясування придатності у контексті політичних, економічних, екологічних і соціальних умов, що склалися в Україні. У коженному сценарії запропоновано реформувати систему оподаткування і фінансування лісового господарства та здійснити інституційні трансформації у сфері управління лісами та лісогосподарською діяльністю. Для об'єктивної оцінки окремих сценаріїв сформовано групу експертів з провідних фахівців з економіки лісового господарства, лісового менеджменту та лісової політики. Здійснили аналіз відповідей експертів, розділивши їх на дві групи: науковців-теоретиків, які досліджують процеси формування лісової політики, та практиків, які мають досвід прийняття і запровадження рішень. Експертний висновок щодо сценаріїв реформування лісового господарства України робили на основі відповідей експертів на питання щодо ймовірності законодавчого забезпечення окремих сценаріїв реформування, їх відповідності теорії лісового менеджменту та лісової політики, відповідності концепції сталого розвитку лісового господарства, сподівань на покращання стану лісів, посилення їхніх екологічних і соціальних функцій та підвищення економічної ефективності лісового менеджменту після реформування лісового господарства України.

На основі світового досвіду ведення лісового господарства, аналізу наукових праць з проблем економіки лісокористування, екологічної і лісової політики та екологічної економіки сформульовано принципи економічної реформи лісового господарства України.

Chapter 9

Traditional Knowledge for Sustainable Management of Forest Landscapes in Europe's East and West

Per Angelstam[1] and Marine Elbakidze[2]

Abstract The contribution of Traditional Knowledge (TK) to Sustainable Forest Management (SFM) varies in time and space. Based on interviews with actors at multiple levels of governance, and official statistics, we describe trajectories of SFM development with respect to ecological, economic and socio-cultural dimensions, and discuss the role of the TK for different actors in three European landscapes. The Troitsko-Pechorsk region in Russia has experienced a dramatic boom and bust development cycle since World War 2. When the Soviet Union ceased to exist, long-distance transport became a formidable obstacle for wood export, reducing the annual harvest volumes by 2 orders of magnitude. Today, local populations either emigrate or depend on subsistence land uses. In the Skole region of Ukraine a village system has been maintained for centuries, and included a clear zonation from gardens, fields, and meadows to pastures and grazed forests. The economic crisis after the collapse of the Soviet Union has revived traditional knowledge as an important tool for rural development and the maintenance of biodiversity and cultural landscape values. In Swedish Vilhelmina, which was initially based on a traditional village system, numerous frontiers of natural resource exploitation have occurred during the past 150 years. Continuous cover forestry and Sami reindeer herding are two traditional land uses. Even if the economic gains of forestry are locally limited, still, a national welfare system supports local populations. We conclude that TK can support SFM locally and regionally, but to satisfy actors at national and international levels also other measures are needed. These range from sustained yield forestry to establishment of protected areas that maintain natural and cultural forest structures.

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9.1 Introduction

Sustainable forest management (SFM) is a concept in continuous development, the interpretation of which varies over time, as well as among countries, regions and even local landscapes in Europe. As a consequence, the knowledge required to realise SFM is heterogeneous and dependent on value sets with different spatial and temporal scale dimensions. The development of the Pan-European forest policy process reflects this. Moving into the post-industrial society, ecological dimensions were included in the definition of SFM in the 1990s (Angelstam et al. 2004a, Innes and Hoen 2005). More recently the role of the social and cultural aspects of SFM in the overall goal of sustainable development, including the role of traditional forest-related knowledge, have been highlighted (MCPFE 2003).

Implementing SFM policies requires a combination of practical experience, engineering and science. The relative roles of these dimensions vary with the types of forest and woodland wood and non-wood goods, services and values, and among regions. Forests and woodlands have been shaped by traditional knowledge long before the development of scientific or industrial forestry. A significant proportion of the world's forests and woodlands is still managed by local and indigenous communities (Stevens 1997). The term traditional knowledge (TK) refers to the knowledge, innovations, and practices of indigenous and local communities, gained over long time and adapted to the local culture and environment. TK helps to sustain production of multiple goods and services, providing livelihoods, security, and quality of life, and contributing to characteristic natural and cultural heritage.

Cultural heritage and traditional knowledge have been recognised and promoted at a global level in a number of international agreements, processes, and programmes. At the European level the political commitments on increasing awareness of the role of traditional knowledge and practices in SFM in the protection of landscapes and the protection of biological diversity have been highlighted (MCPFE 2003, Rametsteiner and Mayer 2003). Similarly, the EU Forest Action Plan acknowledged cultural landscapes, traditional practices, and other cultural values of forests, as some of the ways of achieving local and regional sustainable development. Such landscape values are also included in the new Common Agricultural Policy (CAP), and the European Landscape Convention.

However, traditional cultural landscapes are threatened by socio-economic and technological changes in agriculture, forestry, and by some nature conservation strategies (Angelstam 2006). As noted by MCPFE (2003) applied research on the social and cultural aspects of SFM to support the development of solutions to these challenges requires applied interdisciplinary approaches including both human and natural science methods and collaboration with end-users. This is a major challenge both to donors supporting research and development, and for researchers and practitioners (Tress et al. 2006).

We argue that Europe's diverse forest and woodland landscapes are a valuable "landscape laboratory," which can be used to better understand the perceptions of SFM among actors at different levels of governance and role of traditional knowledge for sustainable landscapes. The historical development of forest use within a region usually goes through more or less distinct phases. According to Björklund (1984) and Angelstam et al. (2004a) these include (1) local use, (2) exploitation of naturally dynamic forest ecosystems, (3) development of sustained yield forestry, and (4) efforts to satisfy ecological and socio-cultural dimensions. However, at a given clock time, because different regions are located in different phases in this development, one can "travel in time" and both learn from past and future phases of development. As TK is rapidly disappearing in many parts of the world, along with local cultures and landscapes where this knowledge survives, it is an urgent task to document the role of traditional knowledge for sustainable forest management.

In this paper, we employ a multiple landscape case study approach to describe trajectories of SFM development. We discuss the role of the TK perspectives held by different actors and stakeholders for SFM in three landscapes occupying Europe's economic periphery. Finally, we discuss the challenge of conducting sustainability science in support of the implementation of locally adapted sustainable forest management practices.

9.2 Methods

This study relies on mixed qualitative and quantitative methods. We made expert interviews at multiple levels of governance from local and regional to national and international, and collected quantitative data to describe the status and trends of economic, ecological and socio-cultural dimensions of sustainability (for details, see Elbakidze and Angelstam, this volume). Within our ongoing multiple case study approach, focusing on Europe's East and West (Angelstam et al. 2007), we summarise the situation in three European local administrative units. These represent peripheral regions of economic development (Whyte 1998) in the Russian Federation's Ural Mountains, Ukraine's Carpathian Mountains, and Sweden's Scandinavian Mountains. All three landscapes are forest-dominated and located in the headwaters of large watersheds (Troitsko-Pechorsk in the Pechora river, Skole in the Dnister river, and Vilhelmina in the Ångermanälven river). All being located in mountain ecoregions the three landscapes have similar social-ecological systems even if they located far apart from one another.

The history of local forest use in the Russian Troitsko-Pechorsk region, located in the south-easternmost corner of the Komi Republic, is relatively recent. Logging for export of wood was for a long time confined to high grading of large valuable trees close to rivers (Galashev 1961). Industrial forestry commenced only after WW2. The area hosts Europe's largest strictly protected area, the Pechora-Ilych state reserve located on the western slopes of the Ural Mountains.

The Skole district in Ukraine's Carpathian Mountains has a very long and complex colonisation history (Elbakidze and Angelstam 2007). From the late Medieval period the upland areas were populated by the Boiko people, who depended completely on the maintenance of an ecologically balanced environment, with minimal use of outside resources and energy almost until the 20th century. The agricultural and forestry practices of that time were to a certain extent a prototype of local sustainable use of natural resources.

The Vilhelmina area in northwest Sweden was settled from the mountains towards the lowlands by reindeer herding Sami people several hundred years ago, and starting in the late 18th century by farmers moving from the coast and lowlands towards the mountains. This historical development pattern means that today there are several different indigenous and local communities, all claiming that their traditional knowledge supports SFM.

9.3 Results and Discussion

9.3.1 Trajectories of Development of Sustainable Forest Management

The perception of SFM is related to contemporary societal values and therefore is not static. Before the advent of industrial forestry, use of natural resources was largely a local and regional activity in all three case studies. We use a graphic presentation (Figure 9.1) to illustrate the trajectories of development regarding the relative focus on the three pillars of sustainability, with its ecological, economic and socio-cultural dimensions.

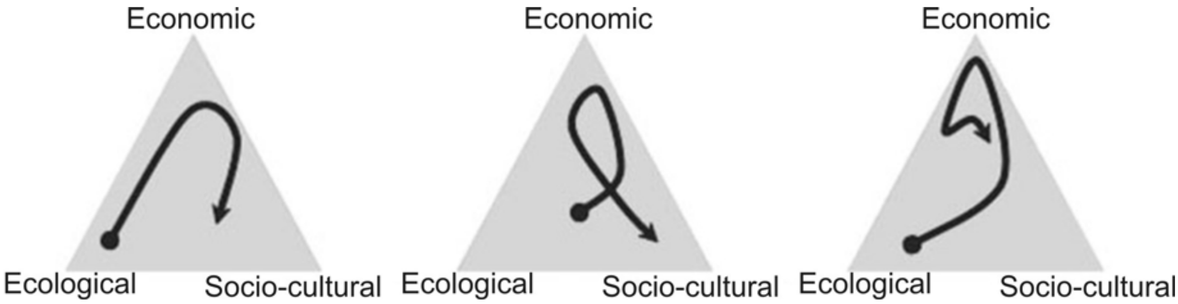

Fig. 9.1 Illustration of the trajectories of development of sustainable forest management during the past 150 years in Russian Troitsko-Pechorsk (left), Ukrainian Skole (centre) and Swedish Vilhelmina (right) in a three-dimensional space representing the three pillars of sustainability.

Still being part of Europe's last ecologically intact forest landscapes (Yaroshenko et al. 2001) the trajectory of development in the Troitsko-Pechorsk area started in the ecological corner (Figure 9.1, left). In Komi the harvested wood volumes increased from 5 millions cubic meters annually before the World War II to more than 25 in 1990. This was followed by a reduction to 6 millions cubic meters today, a 75 % decline, which is deemed sustainable with today's limited road transport infrastructure. In the Troitsko-Pechorsk region the decline was more than 90 %, and in one of the three forest management units in this region forest harvesting for export has virtually ceased. Annual harvest levels have dropped from 1.5 million to only 6,000 cubic meters. As a consequence, emigration rates are high and people who stay in remote areas depend on subsistence gardening and pensions.

In the Ukrainian Skole district, the central landscape element influencing development trajectories is the village, an informal institution and complex land use system supporting local sustainable landscapes (Elbakidze and Angelstam 2006, 2007). During Soviet times land use became more focused on large-scale economic production. Then, as a result of rapid, deep political and economic changes in Ukraine, traditional villages re-appeared as a way for local people to survive (Figure 9.2). Nowadays they are key landscape features protecting cultural diversity and social stability. They provide an example of sustainable co-existence between man and nature and play important ecological, economic, and social roles in local and regional sustainable development. At the same time, there are some negative trends in regional economic development, including conflicts between the needs of local people and limitations on use of forest resources, which are currently owned almost entirely by the state. Other threats include cultural and economic globalisation, and a disrespectful attitude toward old-fashioned way of living from society and governmental organisations.

Fig. 9.2 The traditional villages found in Europe's forest and woodland landscapes is characterised by a centre-periphery zoning, ranging from houses, gardens, fields, mowed and grazed grasslands to forests (i.e. the ancient system with domus, hortus, ager, saltus and silva). This view of the village Volosyanka in the Skole district of Ukraine's west Carpathian Mountains illustrates this gradient of land use. Beginning in the left part of the picture, the church in the very village centre is surrounded by houses that are located in the bottom of the shallow valley. The private gardens have many fruit trees and shrubs. Further to the right there is a fine-grained mixture of grasslands, some individual fields of which has been mowed and have hay-stacks and some not yet, and fields, like the potato field in the foreground. To the right there is forest, which is grazed by cattle moving in and out along specially designed fenced trails from the farm houses in the valley bottom. In addition, above the treeline on the top of the mountains, there are open grazed pasture commons.

In Swedish Vilhelmina numerous stages of natural resource use have occurred during the past 150 years. Sami reindeer herding was the first, together with Swedish small-scale farming based on small-scale agriculture and forestry. Continuous cover forestry methods in mountain forests and reindeer husbandry are two traditional types of land use. When forestry revenues reaching local communities are limited due to effective mechanised industrial forestry, a national welfare system provides additional support. In Vilhelmina several local initiatives have been created to deal with competing landscape uses, and to encourage businesses based on value-added wood products and non-tangible landscape values (see Svensson et al. 2004, Angelstam et al. 2006).

9.3.2 Emerging Clefts Among Actors at Multiple Levels?

The results from interviews at different levels in the three landscape case studies clearly indicate that Sustainable Forest Management appears like beauty – it lies in the eyes of the beholder. The three case studies have distinct profiles of forest use at different levels of governance (Table 9.1).

Table 9.1 Preliminary characterisation of actors' and stakeholders' needs in terms of wood and non-wood products and ecosystems services at different levels of forest governance.

Level of governance	***Troitsko-Pechorsk***	***Skole***	***Vilhelmina***
Local	Self-subsistence	Self-subsistence	Landscape values, non-wood goods, wood
Regional	Self-subsistence	Tourism and wood production	Landscape values, non-wood goods, wood
National	Attempts to develop tourism, mining and oil and gas	Tourism, wood and biodiversity conservation	Wood production, biodiversity conservation
International	Conservation of intact forest landscapes	Biodiversity conservation	Maintenance of Sami First Nations

The transition from planned towards market economy that took place in remote the Komi Republic's Troitsko-Pechorsk region of NW Russia has made transportation costs prohibitively high and the interest in investing in value added production very low. The social consequences of the related societal changes are immense. Securing Europe's last large intact forest areas is another challenge. Taken together, a holistic approach is needed to develop sustainable forest management, including continued industrial development, maintenance of local livelihoods, and forestry based on marketing landscape values for tourism and recreation. In the Skole District (Ukraine) there is insight among several key actors that different forest users have to coordinate their approaches across the whole landscape. This requires, however, that the Ukrainian forest-related policies need to be adapted to different regions according to their nature and history.

In addition, the policy process needs to include better dialogue between policy, science, and practice. A conclusion is that there is a need to define different among zones that specialise on economic wood production, maintenance, and restoration of ecological functions, and to maintain social functions. Regarding tourism that is dependent on the cultural landscape values maintained by villages, there is the risk that those making money on tourism are not sufficiently aware of the need to maintain the traditional culture in terms of cultural biodiversity, landscape and buildings.

Finally, in Vilhelmina there are signs of a shift towards more local businesses based on landscape values. But does the declining paradigm (industrial forestry) compete with a new paradigm (multiple use, reindeer herding, tourism)? This also raises the issue of scale in an economic sense. At what spatial and temporal scale is traditional forestry for wood production beneficial (national – yes indeed; regional – yes; local – well it depends). An important challenge is that of comparing the outcomes of actors' desires at different levels of governance. It is difficult to compare traditional full time employment jobs provided by large enterprises (for which there are good statistics) with self-employed entrepreneurs and part time jobs (for which there are poor statistics, Thellbro 2006).

To develop sustainable forest management locally and regionally, iterative approaches to adaptive management and governance are needed, including both top-down and bottom-up governance (e.g., Campbell and Sayer 2003). As discussed in detail by Angelstam (1997) and Vos and Meekes (1999), an inclusive holistic approach is needed. To understand landscapes in this way requires interaction among different actors in society. This applies to policy-makers, institutions, and the actual actors within one sector affecting landscapes on the one hand, and among the different sectors acting at all levels with the chosen landscape on the other..

Within a given sector or policy area there are several levels of governance (Primdahl and Brandt 1997). First, the "ecosystem approach" called for by the Convention on Biological Diversity can be used as one starting point for understanding the international level of governance. The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Application of the ecosystem approach will help to reach a balance of the ecological, economic and socio-cultural objectives of the Convention. The approach should be based on the application of appropriate scientific methodologies focused on levels of biological organisation, which encompass the essential processes, functions, and interactions among organisms and their environment. It recognises that humans, with their cultural diversity, are an integral component of ecosystems. For forests, sustainable forest management as defined by Rametsteiner and Mayer (2004) can be interpreted as an example of policy that advocates an ecosystem or landscape approach (Angelstam et al. 2004a, Dudley et al. 2006).

Second, at the national level, policy instruments are then gradually developed, and may include legislation, information, subsidies, monitoring, vocational training etc. However, the maintenance of natural and cultural biodiversity is usually not maintained by institutions, but rather by local people acting in different formal and informal governance systems. Consequently, several policy areas with their respective planning traditions coincide: forestry, agriculture, transport infrastructure and the energy sector, as well as regional and urban planning (Angelstam 2006). There are many unresolved challenges related to the integration of ecological, economic and socio-cultural dimensions of sustainable forest and woodland landscapes.

We argue that the viability of landscapes can best be maintained with local and regional territorial approaches that target multiple complementary sectors in the economy. There is also a need to establish arenas where people representing practice and policy can interact both bottom-up and top-down. Model forests, biosphere reserves, national and regional parks, ecoregion planning and watershed management are examples of international concepts for integrated natural resource management using the landscape as an arena for partnerships among owners, managers, and other stakeholders. However, their effectiveness in delivering sustainability needs to be evaluated (Axelsson et al.2009).

9.3.3 Landscape as Concept and Tool for Sustainability Science

Individual landscapes can be viewed as units that offer a sense of place to stakeholders, thus representing a wide range of issues of concern and solutions. Working with a complex concept, such as sustainability, requires special emphasis on finding a common platform for communication among different elements (representing ecological, economic, socio-cultural values, including related disciplines and actors), as well as from policy to practice, and back again. The landscape concept is useful to achieve this integration. Landscape is an important concept within humanities (history), social sciences (human geography) as well as in natural sciences (ecology and geography). The landscape concept can thus be used as an interface for improving communication between social and natural sciences, between policy and users to increase the understanding of the dependencies, and between social and ecological systems (e.g., Grodzinski 2005).

In the European Landscape Convention, "landscape" is defined as a zone or area as perceived by local people or visitors, where the visual features and characters of the landscape are the result of the action of natural and/or cultural factors. This definition reflects the idea that landscapes evolve through time. The landscape concept also reflects the need to expand the spatial scale of management, in effect to move from smaller spatial units or objects to the scale of landscapes and regions, including micro, meso and macro levels of governance. Additionally, all social organisational scales must be considered, from the individual, households and families, to community, county, nation and global. To study and improve resource management we must view natural and socio-cultural resources in a temporally and spatially expanded context, and one less restricted by administrative and political boundaries. Thus, a landscape forms a whole entity, where natural and cultural components are intermingled, and cannot be viewed as separate entities or processes, i.e. it represents a social-ecological system that includes both tangible and intangible variables representing values from all dimensions of sustainable development.

In an increasingly globalised world, it is essential to understand how factors at local, regional, national and international levels affect the future development of sustainable forest management that satisfies ecological, economic and socio-cultural dimensions at different levels in society. An in-depth multiple landscape case study approach satisfies this need.

9.3.4 European Landscapes as a Laboratory

Implementation of sustainable development, both as a means and an end, in a given landscape is highly dependent on the type of ecoregion and economic history, and the systems for government and governance, both of which to a great extent determine the socioeconomic status and trends. With its great cultural and ecological diversity the European continent can be viewed as a unique "landscape laboratory" for the development of Integrated Natural Resource Management (INRM). Firstly, there are steep gradients from centers for economic development to peripheral regions. This is clearly related to the pattern of gradual expansion of the EU, with countries like Georgia and, partly, Ukraine at the fringe, showing a great interest in integration with the EU. Secondly, there is a wide range of regionally evolved practices for natural forest and cultural woodland planning and management in different ecoregions, which are adapted to the local natural conditions and patterns of land ownership and tenure. Experiences from a suite of European landscape level management units as case studies representing different starting points and trajectories towards sustainable rural landscapes in these dimensions is an important resource for mutual learning among stakeholders from business, authorities, general public and academia.

Ideally a network of transdisciplinary case studies on INRM approaches towards sustainable landscapes should be established in a suite of landscapes with diverse natural conditions and different settings of socio-economic development (Angelstam et al. 2004b). This network should focus on synthesis and development based on exchanging experiences among existing landscape management units with long experience of INRM using both bottom-up and top-down approaches.

We recommend adevelopment of common toolboxes for learning toward comprehensive and flexible regionally adapted INRM in different natural and socio-economic environments throughout Europe. Internationalisation is a good tool to improve the mutual understanding among scientific disciplines, societal sectors and institutions, as well as different cultures and countries. The gradients between civilizations (sensu Huntingdon 1997) and economic history development in different dimensions of sustainability formed by the Fennoscandian countries, the new EU member states, and non-EU post-Soviet states are a grand resource for improved understanding of how to understand sustainability and how it can be implemented (Angelstam et al. 2005, see Table 9.2).

Table 9.2 To explore the regional variation in the perception of the Sustainable Forest Management concept, a suite of case studies can be used as a landscape laboratory. Governance system and economic history are two dimensions of paramount importance. Here we stratify a suite of existing development projects such Model Forest (1), Biosphere Reserve (2), National Park (3), Experimental forest (4), Zapovednik (5) and local ENGO (6) in geographical Europe's East and West using the civilisation concept of Huntingdon (1997) (columns) and the history of economic development (e.g. Gunst 1989) (rows), see also Angelstam and Törnblom (2004a, b).

	Western civilization	***Intermediate***	***Ortodox civilization***
Short history of economic development	Vilhelmina (1), NW Sweden	Skole (3), Ukraine	Troitsko-Pechorsk (5), Southeast Komi
Intermediate history of economic development	Bergslagen (1), central Sweden	Polesia (3), Ukraine/Belarus	Pskov Model Forest (1), W Russia
Centre of economic development	Kristianstad Vattenrike (2), south Sweden	Poltava (4), Ukraine	Lori Ecoclub (6), north Armenia

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Значення традиційних знань для сталого менеджменту лісових ландшафтів на Сході і Заході Європи

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Потреба розвитку сільської місцевості є ключовою проблемою для запровадження сталого лісокористування та лісоуправління. Роль традиційних знань у забезпеченні сталого розвитку ландшафтів змінюється в часі і просторі. Аналіз інтерв'ю з основними землекористувачами на різних рівнях управління природними ресурсами та офіційних статистичних джерел дав підставу для визначення траєкторій розвитку сталого лісокористування та лісоуправління у трьох різних європейських регіонах, та вмявив потребу обговорити значення усталених підходів для розвитку сільської місцевості. Троїцько-Печорський район у Республіці Комі пройшов шлях від стрімкого економічного зростання після Другої світової війни до жахливого занепаду після розпаду Радянського Союзу. Віднедавна останні роки далекі перевезення та великі транспортні витрати стали перепоною для експорту деревини, що призвело до скорочення об'єму лісозаготівель більш, ніж удвічі. Тепер місцеве населення або мігрує, або цілковито узалежнене від власного господарства.

В Українських Карпатах (наприклад, у Сколівському районі) система сільських поселень із чітким зонуванням території на сади, поля, луки, пасовища та ліси підтримується вже століттями. Економічна криза після розпаду Радянського Союзу привела до відновлення традиційних підходів як важливого засобу для розвитку сільської місцевості, підтримки біорізноманіття та цінностей культурних ландшафтів. У Вілхелміні у Швеції використання природних ресурсів розпочалося понад 150 років тому. Лісокористування за умови збереження суцільності лісового покриву та випасання саамі – корінним народом Швеції, північного оленя – це два традиційних види природокористування. Навіть попри те, що економічна вигода від лісокористування обмежена, збережені цінності ландшафту забезпечують почуття "дому" і соціальний капітал для розвитку сільської місцевості, а система забезпечення добробуту на національному рівні підтримує місцеве населення. Тобто, традиційні знання можуть підтримувати розвиток сільської місцевості, заснований на принципах сталого лісокористування та лісоуправління на локальному та регіональному рівнях. Одначе, для задоволення потреб природокористувачів та зацікавлених сторін на національному та міжнародному рівнях, треба також забезпечити рівень підтримки природного, культурного і соціального капіталу регіонів.

Chapter 10

Afforestation for Multiple Purposes: a Focus on Ukraine

Maria Nijnik[1]*, Arie Oskam*[2]*, and Albert Nijnik*[3]

Abstract This chapter addresses afforestation[4] as a long-term policy for sustainable management of resources and addresses the economics of planting trees on marginal lands in Ukraine. We consider a multiple role of projected forests across forestry zones, with a comparison of costs and benefits from woodlands expansion for timber production and erosion prevention. By using regression, simulation and linear programming, the research reveals that afforestation to increase timber production and alleviate soil erosion is economically and environmentally justified in some regions. The chapter then goes beyond the analysis of "user" components of benefits from afforestation by linking the tree-planting in Ukraine to climate change mitigation opportunities that are deemed to offer multiple social benefits worldwide.

10.1 Introduction

A millennium ago the territory of Ukraine was extensively covered with forests[5] (with the exception of the Steppe), but it was deforested[1] extensively, and today, the forest share comprises only 16.5 % of its land area. This share is among the lowest in Europe if compared with those for France 28 %, Germany 31 %, Poland 29 % (FAO 2006), or other countries with similar tree growing conditions. Given that 15 % of Ukraine's land is under extreme environmental pressures, and in con-

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[4] Afforestation is an expansion of forest area on lands which more than 50 years ago contained forest but later have been converted to another use. Reforestation is a restoration of degraded or recently (20-50 years ago) deforested lands (IBN-DLO, 1999). In this paper these terms are considered jointly.
[5] Definition of forest in the present assessment applies to a minimum crown cover of 20% (FAO 1996).
I.P. Soloviy and W.S. Keeton (eds.), Ecological Economics and Sustainable Forest Management, UNFU Press, 2009

sideration of a multiple role of forests, an expansion of wooded cover is important for attaining of ecological sustainability in this country (MENR 2003). Moreover, if the social value (Perman *et al.* 2003) of wooded land is higher than the social value of the same land when used for other purposes, afforestation is also economically reasonable. Financial returns from forest management should incorporate the shadow values to reflect the true opportunity costs of the resource, in particular accounting for environmental and social externalities. The recent shift in management towards the use of multiple forest functions of the formation of environment and climate, water balance regulation and the protection of land from erosion (The Forest Code 2006) might have significant implications for the long-term forestry development.

The European Forestry Institute used the European Forest Information (EFISCEN)[6] modelling approach to gain insights into the effects of changing management practices on European forests across 30 countries under different scenarios (Nabuurs *et al.* 2001; 2002). The necessity of maintaining national diversities that constitute European forestry within the harmonised forestry strategies is being recognised. The Ukrainian Research Institute of Forest Agro-Melioration contributed to the scenario analysis through the development of long-term predictions for forests in Ukraine. The scenarios are consistent with the projections developed at International Institute for Applied Systems Analysis (IIASA), at the Ukrainian National Agricultural University and at the Ukrainian National University of Forestry (Shvidenko and Andrusishin 1998; SCF 2007; Soloviy 2000). Numerous forestry studies support the idea that a larger forest area would be attractive in Ukraine, but only limited knowledge in available where and how such areas should be established to address both nature protection and forestry and agriculture production goals.

Based upon both international and national studies on this topic, our paper considers the economics of afforestation in Ukraine for timber production, soil protection and carbon sequestration benefits.[7] Firstly, we consider "user" benefits of afforestation that accrue to two primary sectors of rural economy, i.e. forestry and agriculture. Evaluation of soil protection role of forest is a complement to an initial assessment of timber supply benefits from establishment of forest plantations. The paper defines key objectives of woodlands expansion. It analyses the potential for tree-planting and estimates its costs and benefits. An initial cost-benefit analysis (CBA) of the establishment of forest plantations, with an LP model that serves a basis for land use policy assessment, is elaborated. If afforestation adds to the welfare of society, it is economically sound. This is observed in some areas in Ukraine, and the paper includes a discussion on where and why it is the case. Then by considering of carbon sequestration in trees under the storage policy scenario[8] the paper goes beyond the "user" benefits of afforestation that accrue to forestry and agriculture in this particular country. It links the planting trees in Ukraine to global climate change mitigation policy objectives.

[6] European Forest Institute (EFI) Scenario Modelling – the analysis with EFISCEN model.

[7] The economics of carbon sequestration through afforestation in Ukraine, with an assessment of the carbon storage scenario, is considered in a stand-alone paper by Nijnik (2005).

[8] The policy option with the strategy of C fixation presumes one-time tree planting for a period of 100 years, without accounting for future use of wood and land. For more information on the economics of carbon uptake in trees see Van Kooten *et al.* (2000). This issue for Ukraine is developed in Nijnik (2005).

10.2 Economic Analysis of Afforestation

10.2.1 Background

The history of establishment of forest plantations in Ukraine for multiple purposes is dated back to the 17th century. However, until the 1920s, the tree-planting activities were isolated and episodic (Gensiruk and Nizhnik 1995). The protection of land through woodland creation was considerably hampered by economic and social conditions, and then by the shift of forest policy from afforestation towards natural regeneration of forest. In the 1990s, the decreasing scale of afforestation was also caused by difficulties of the transition process, such as the lack of well-defined and ensured property rights; shortage of investment and economic incentives, and an increasing attention paid by forest management to short-term financial objectives. Nevertheless, planting on forestland amounts to about 28.5K ha; protective plantings on eroded and unproductive agricultural lands total about 7K ha; and shelterbelt plantings total about 1.1K ha per year (Strochinskii *et al.* 2001). The necessity of afforestation is pointed out in the President's Decree aimed to reform forestry in Ukraine (2004) and in the State Programme "Forests of Ukraine, 2002-2015" (EFI 2003).

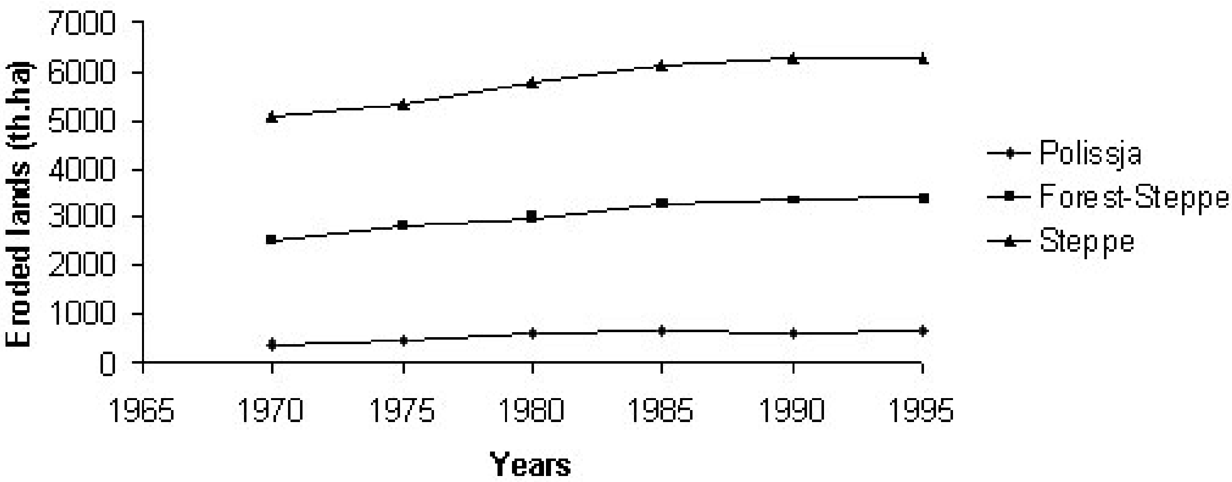

Fig. 10.1 Erosion across forestry zones in Ukraine (Source: NAS (1999))

Currently, in a country with extensive agriculture when the level of cultivation is 54.8 % of its territory, Ukraine faces with partial erosion on 35 % of its arable land. Annual increment of eroded land accounts for 80K-90K ha and differs across zones

Annually, 4 Mt of fertile soil are washed out of the fields, and the damage to agriculture from erosion exceeds M€8. In addition, water erosion and floods in the Carpathians cause annual damage of about M€40 (Gensiruk and Ivanytsky, 1999; Zanuda 2008).[9] According to the National Academy of Sciences (NAS 1999), the

[9] The economics of water erosion and floods in the Carpathians are beyond the limits of this paper. This is an ongoing research, the results of which will be discussed separately. For ecological and hydrological aspects of soil erosion see Kopiy (2007) and Kovalchuk *et al.* (2008).

optimum wooded cover (although different across zones) should be of 20 %[10] on average in Ukraine. It is anticipated that the expansion of wooded cover in this country to 20 % will prevent further spatial spreading of erosion and will alleviate its intensity. Moreover, afforestation has taken an important role as a carbon dioxide reduction measure (Bun *et al.* 2006). Since 2001 it has become an eligible component of climate policy, meaning that over and above emissions reduction, an enhancement of GHG "sinks" and "reservoirs" via afforestation is becoming increasingly important.

10.2.2 Afforestation Potential

Comprehensive forestry zoning of Ukraine (Gensiruk and Nizhnik 1995) divides the territory of the country into main forestry areas: the Polissja (Woodlands), Wooded Steppe, Steppe, Crimea and the Carpathians with their subdivision into spatial units of lower levels of hierarchy, by taking into consideration landscapes development, soil distribution, climatic conditions, distribution of the fauna and flora, etc. Afforestation potential was assessed across these forestry zones (Table 10.1) [11].

Table 10.1 Potential for afforestation by land use across zones (1000 ha)

Zones	*State Forest Fund*			*Agricultural land*			*Total*
	ravines	sand	rocks	eroded	deflated	Rocky	
Polissja	65.0	82.0	0.5	73.7	0.7	26.1	248.0
Wooded Steppe	95.0	84.0	0.6	451.6	18.3	61.0	710.5
Steppe	24.0	64.0	n.a.	669.4	40.6	137.5	935.5
Carpathians	1.6	n.a.	1.4	24.6	n.a.	143.4	171.0
Crimea	0.8	n.a.	1.8	13.1	1.8	206.8	224.3
Ukraine	186.4	230.0	4.3	1232.4	61.4	574.8	2289.3

Source: Estimated on basis of data of the SCL and SCF (1998)

The land that is suitable for afforestation includes marginal land of the State Forest Fund (SFF)[12], and bare and marginal agricultural land. It also includes some land which is associated with forage and pasture, and some marginal agricultural land used for wheat production but where the net returns from its current use are low. Initially, 2.29 Mha were considered as suitable for tree-planting, in total.[13] Taking into account the tree growing conditions and making simple assumptions based on interviewing of forest specialists in Ukraine, the following main tree species were considered for planting: pine in the Steppe, Crimea and Polissja; pine and oak in the Wooded Steppe; and beech and fir or spruce in the Carpathians.[14]

[10] The NAS projections (1998) are based on ecological/environmental criteria, with the focus primarily on hydrological and soil protection forest functions. These forest functions are seen as the priorities in Ukraine, and the 20% share of wooded cover is deemed to deliver a sustained ecological balance.

[11] Spatial classification was developed as a separate study to enhance sustainability of forest resource use. See Gensiruk and Nizhnik for more information (1995).

[12] Nearly 66% of the forestland (7.1 Mha) is under the direct and permanent management of the State Committee of Forests (SCF); this area of forest is referred to as the State Forest Fund (the Inventory).

[13] After the estimation of net present value (NPV) benefits of afforestation the area initially advocated for forest development was reduced to exclude the land for which the opportunity costs appeared to be high.

[14] According to the MEP (1998), 1.14 Mha are to be planted with trees until the year 2010. This includes the creation of forest shelterbelts and tree-planting on steep banks, sands, river and reservoirs' banks, as well as on eroded and contaminated land.

10.2.3 Costs of Afforestation

The costs of afforestation of marginal/bare land of the SFF include primarily tree-planting costs (€100-200/ha) and silvicultural expenses (care and protection costs, annual basis, €12.5-30/ha).[15] These costs vary, but given that within each zone the tree-growing and forest management conditions are relatively stable, they are assumed to be the same within each forestry zone: 1 ha of forest plantation requires c. €200 and establishment costs of 1 ha of forest shelterbelt are of about €125 (MEP, 1998). They were calculated on the basis of factual costs used for elaboration of the National Land Protection Programme until 2010.

Marginal agricultural land has alternative options to afforestation and its costs differ from those for forest land within the same zone. In addition to direct costs of tree-planting and silvicultural expenses, the net returns associated with the current use of agricultural land, were therefore considered. The estimates for net annual returns to current wheat production were computed on basis of the data on land productivity, costs of wheat production and output prices. An estimation of the costs for the land used for forage production and pasture was based on land productivity and on prices which agricultural enterprises pay for the equivalent cattle feed (Table 10.2).

Table 10.2 Net annual returns to current agricultural activities (€ per ha)

Forestry zone		*Forage and pasture*	*Wheat*
	eroded and deflated land	8.0	37.8
Polissja (Woodland)	rocky land	7.8	n.a.
Wooded-Steppe	eroded land	10.0	52.1
	deflated lands	9.2	14.7
Steppe	rocky land	8.0	n.a.
	eroded land	20.0	61.5
	deflated land	6.0	27.2
Carpathians	rocky land	n.a.	n.a.
	eroded land	7.8	0
Crimea	rocky land	7.0	0
	eroded and rocky	7.0	0

Source: NAS (1998)

Based on the data presented earlier, we computed annual costs across zones, and allowing for 100-years of stipulated ages of timber harvesting (SCF 2007) the present value (PV) costs occurring over this time horizon were estimated at several discount rates[16] (Table 10.3).

The results of the estimation are highly dependent on the discount rate. At a 4 % discount rate, the PV of afforestation costs is €484 per ha on average for the country. The highest PV of costs is in the Steppe (€609.5 per ha) with the lowest of €288 per ha in the Carpathians. The divergence in cost estimates across zones is explained by the diversity of tree-growing and socio-economic conditions across such a vast country as Ukraine.

[15] The estimates were initially computed in Ukrainian national currency Hryvnya which roughly corresponds to 0.14 €. (2007).
We didn't consider additional expenses for afforestation of contaminated land and transaction costs.
[16] The 2% and 4% discount rates were kept as central.

Table 10.3 Afforestation costs by forestry zone, M€

Forestry zone	*Annual costs by zone*			*PV costs*			
	Oppor-tunity	Planting	Care/ Protection	r=0 %	r=2 %	r=4 %	r=6%
Polissja (Woodland)	1.4	16.1	2.0	356.3	162.7	99.5	72.7
Wooded Steppe	6.4	32.8	4.1	1084.3	486.0	290.5	207.5
Steppe	14.1	49.8	7.1	2173.3	965.0	570.2	402.7
Carpathians	0.8	7.5	0.9	177.9	80.9	49.2	43.8
Crimea	0.8	19.6	2.5	345.0	159.9	99.4	73.7
Ukraine	23.5	125.8	16.6	4136.8	1854.5	1108.8	792.4

10.2.4 Timber Supply Benefits

A sum of monetary value from additional timber yield to be obtained from the plantations (direct user benefits) and monetary estimates of soil protection forest function pertaining to arable land (indirect user benefits) comprise the total benefits of afforestation as deemed at this stage of the research (when "user benefits" to forestry and agriculture sectors in Ukraine are considered). For the monetary value of timber yield changes, the employed model multiplies estimates of a physical crop change based on acreage in production by the price of timber (Hanley and Spash, 1993). This implies a simplified assumption that timber use and prices remain constant. Allowing in the long-run for a stable average annual timber cut of about 2 m^3/ha, which corresponds to 50 % of mean annual increment (MAI) at present, some 4.6 Mm^3 of additional timber could be produced, bringing annual returns of M€23, if the stumpage value of timber is c.€5/m^3 (Nilsson and Shvidenko, 1999).[17] This volume of wood comprises c.30 % of country's current annual timber production. The benefits from an increased timber production were also computed across forestry zones over a 100-year period, and previously made estimation of annual returns to forestry is compared with the sum of the estimates received across zones. Table 4 presents the results when only commercial timber cut is taken into account and the area suitable for tree-planting in each zone is taken from Table 1.

Table 10.4 Initial estimates of the returns from timber harvesting

Zone	Species	Stock of stands in 100 years, m^3/ha	Returns in the year of harvesting, €/ha	PV returns €/ha,	PV returns by zone M€			
				4 %	0 %	2 %	4 %	6 %
Polissja	pine	250	1250	24.75	310.0	42.8	6.1	0.9
Wooded	pine	350	1750	34.65	612.9	84.6	12.1	1.8
Steppe	oak	350	1750	34.65	612.9	84.6	12.1	1.8
Steppe	pine	250	1250	24.75	584.7	27.7	11.6	1.7
Carpa-	beech	350	1575	31.18	134.7	18.6	2.7	0.4
thians	fir	400	2000	39.6	171.0	23.6	3.4	0.5
Ukraine					2304.0	318.0	45.6	6.8

Source: Computed on basis of data from the SCF (1998).

[17] These are therefore initial estimates which do not take into account changes in domestic prices.

The following assumptions were made: stand composition in the Wooded Steppe comprises 50 % of pine and 50 % of oak trees; half of the Steppe is planted with trees which would be harvested, and beech stands in the Carpathians are planted on 50 % of the area, as are fir stands. The Crimea where forests play primarily environmental role was not considered.

At the discount rate of 0 %, PV returns from timber harvesting in Ukraine are M€23.04 which is comparable with the annual returns of M€23 approximated earlier. The highest returns per ha are the Wooded Steppe and the Carpathians. However, only the timber benefits do not really justify the tree-planting in any of the forestry zones.

10.2.5 Soil Protection Benefits

An expansion of woodlands, in addition to the above benefits of an increased timber production, will lead to increasing of indirect "user" values of forests to agriculture. The soil protection role of new forests is discussed in this section.[18] Economic attractiveness of planting trees to mitigate erosion is assessed, and the estimates obtained in this section are compared with the figures put forward by other authors. The notion that the scale of erosion depends on forest cover (NAS, 1998) [19] is put to an empirical test by using regression analysis (Fig. 10.2).

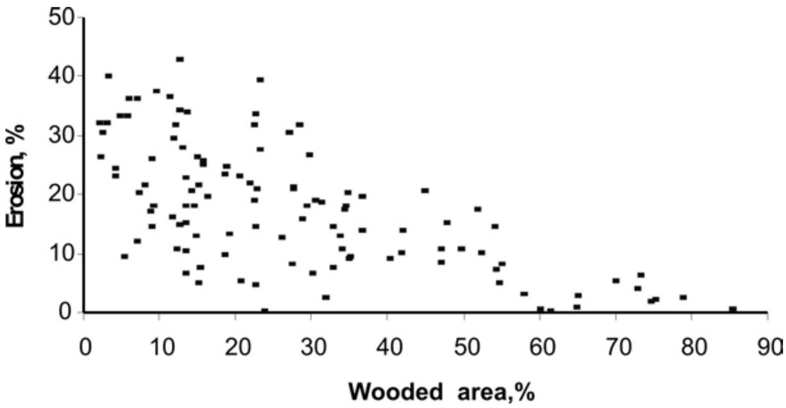

Fig. 10.2 Relationship: Wooded cover – Erosion

The results of the estimation show statistically significant (at 1 % significance level) negative relationship between the share of eroded land (E, %) and the share of wooded land (W, %):

$$log(E) = 3.4653 - 0.0329*W;^{20} \text{ or } E = 31.986e^{-0.0329W}, R^2 = 0.45' \quad (1)$$
$$(29.13) \quad (-9.38)$$

For the Carpathian Mountains where the conditions differ substantially from elsewhere in the country (lowland) the estimated equation is as follows:

[18] Forest starts providing protection benefits after the age of 5 years and with its gradual regeneration, it keeps providing these benefits indefinitely (Gensiruk and Ivanytsky, 1999).

[19] Conversion of forest to row crops increases erosion by a factor of 20-1000, depending on the conditions (Van Kooten, 1993). By Lampietti and Dixon (1995) forest function to alleviate erosion is around $30/ha.

[20] The t-statistic of -9.38 suggests that the negative coefficient on W is significantly different from 0, and with the increase of forest cover, the erosion rates decrease. The value of R^2 allows us to advocate that there is a room for the model improvement.

$$log(E) = 4.3702 - 0.0523{*}W;\ or\ E = 79.059e^{-0.0523W};\ R^2 = 0.50 \qquad (2)$$
$$(5.46) \qquad (-3.99)$$

Simulated rates of erosion at different levels of wooded cover are shown in Table 10.5.

Table 10.5 Simulated rates of soil erosion

Wooded area (W), %	*Erosion (E), Ukraine, %*	*Erosion (E), Carpathians, %*	*Elasticity, Ukraine, %*	*Elasticity, Carpathians, %*
0	32.0	79.1	-1.05	-4.13
5	27.1	60.9	-0.89	-3.18
10	23.0	46.9	-0.76	-2.45
15	19.5	36.1	-0.64	-1.89
20	16.6	27.8	-0.54	-1.45
25	14.1	21.4	-0.46	-1.12
30	11.9	16.5	-0.39	-0.86
35	10.1	12.7	-0.33	-0.66
40	8.6	9.8	-0.28	-0.51
45	7.3	7.5	-0.23	-0.39
50	6.2	5.8	-0.20	-0.30
55	5.2	4.4	-0.17	-0.23
60	4.4	3.4	-0.15	-0.18
65	3.8	2.6	-0.12	-0.14
70	3.2	2.0	-0.11	-0.11
75	2.7	1.6	-0.09	-0.08
80	2.3	1.2	-0.08	-0.06
85	2.0	0.9	-0.06	-0.05
90	1.7	0.7	-0.05	-0.04
95	1.4	0.5	-0.05	-0.03
100	1.2	0.4	-0.04	-0.02

From the estimated equations, marginal changes in erosion rates to marginal changes in wooded cover rates are for Ukraine: $dE/dW=-0.0329E$, and for the Carpathians: $dE/dW=-0.0523E$. These estimations show the "elasticity" of erosion with respect to wooded cover in Ukraine and in the Carpathians.[21] Until wooded cover is up to 27 % in the Carpathains and when in Ukraine it is really low, the erosion is elastic, i.e. when wooded cover is increasing marginally, the erosion is reduced proportionally as much. This is observed up to the point when the share of eroded land is around 30 % in Ukraine, and as far as it falls below 19 % in the Carpathians. The results suggest that if there were no woods in rural areas the share of eroded lands would comprise 79 % in the Carpathians and 32 % on average in Ukraine.

Using the results of regression analysis on the "elasticities" of erosion with respect to forest cover initial average indicative estimates of soil protection role of forests in each zone, were computed. In the Polissja where wooded cover comprises c. 26 %, the elasticity of erosion is -0.43 %. This means that a 1 % increase in wooded cover leads to a 0.43 % decrease in the erosion rates. A 1 % increase of forest cover, i.e. an increase of 0.029 Mha, will mitigate erosion on 0.2 Mha of land.[22] These figures are considered as indicative measures of soil protection bene-

[21] $\Delta E/\Delta W=\varepsilon\%$, 1% increase in W leads to ε % decrease in E. The figures on W and E are already given in percentage, thus it is not a precise computation of elasticity.

[22] Net annual returns from agricultural land were calculated on basis of the data from Table 10.3.

fits to agriculture from marginal expansion of forest cover in the Polissja. The estimations were made for all forestry zones, and the equation for calculation is as follows:

$$X = {}^{\varepsilon}\cdot E/W \qquad (3)$$

where: *X* indicative measure of soil protection benefits to agriculture from marginal expansion of forest cover;
where ε – "elasticity" of erosion with respect to forest cover, % (Table 10.5);
W – share of wooded lands in rural landscapes, %;
E – share of eroded agricultural lands, %;

Soil protection benefits to agriculture in the mountainous areas appear to be rather low due to the absence of wheat production, and because pastures are not common in the Crimea. Still, mountain forests provide essential environmental benefits, and their hydrological function is regarded to be particularly important (Gensiruk and Ivanytsky 1999; Zanuda 2008).

In the Steppe, where forest cover comprises c.3.5 %, 1 ha of wooded land mitigates soil erosion on 7.5 ha of land and enlarges yield on agricultural land in the area of up to 25-30 ha (NAS 1999).[23] On average in the Steppe, agricultural productivity is 15-20 % higher compared with shelterless fields (MEP 1998). These considerations were taken into account when computing indicative economic estimates of soil protection function of forest to agriculture (Table 10.6). The potential for forest expansion across zones is taken from Table 1 and the assumption is made that in non-mountainous areas, 30 % of agricultural land is used for wheat production.

The results of this research indicate the dependence of erosion from the share of wooded land in Ukraine. Annually, 1 ha of forest provides soil protection benefits to agriculture in the range of €1.6 to €58.2, with €19.3 on average in this country. The soil protection benefits of afforestation to agriculture are the highest in the Steppe.[24]

Table 10.6 Indicative measures of soil protection benefits to agriculture

Forestry zone	*Annual average benefits, €/ha* Wheat	*Forage/Pasture*	*Annual benefits M€/zone*
Polissja (Woodland)	7.6	1.6	0.8
Wooded Steppe	33.0	9.0	11.5
Steppe	58.2	17.0	27.5
Carpathians[25]	0	9.7	1.7
Crimea	0	12.2	2.7
Ukraine			44.2

[23] Together with the share of wooded cover, spatial distribution and the distance between fields and woods in rural landscapes play important role in erosion mitigation, particularly in low-forested areas.
[24] According to Gensiruk and Ivanytsky (1999), forest provides benefits at €86-93/ha for the prevention of sandy storms in the Ukraine's Steppe.
[25] These figures are relatively low, because they correspond to benefits that accrue solely to agriculture. A shortage of data didn't allow us to carry out a more detailed analysis.

10.2.6 An LP Model for Forest Plantations

The analysis of afforestation is carried out at various levels of hierarchy. In this section, "user" NPV benefits of afforestation to forestry and agriculture in Ukraine are considered by taking into account different land users, tree species and management regimes. Then, the analysis is performed at a higher hierarchical scale, but without such level of details. However, in addition to "user" benefits of afforestation that accrue to forestry and agriculture in Ukraine, the carbon sequestration in trees (under the storage policy scenario) is incorporated in the analysis.

The general idea of the model discussed in this section is to provide some guidelines for the establishment and management of future forests in a way that allows achieving maximum cumulative net present value of benefits from them over the period of timber rotation subject to the constraints. The model is manageable and may serve as the first approximation of the scheme for a decision support system that addresses the production side of forestry.

The model considers bare and marginal agricultural lands suitable for afforestation in all forestry zones in Ukraine, excluding the Crimea. The timber production benefits from newly planted forests and soil protection forest functions are taken into consideration. Theoretical representation of the model presumes that the production function is multi-input and multi-output. The land and management regimes across forestry zones are inputs to the production system. Trees can be planted on bare land, for which the value of current use is deemed to be zero, and on the land that is suitable for pastures and forage production. Further, it might be economically reasonable to establish plantations on some marginal land currently used for wheat production, which provides positive but insufficient net returns associated with agriculture that allow the conversion of this land into forest.

The scenarios analysed in this paper consider planting of pine and oak in the Wooded Steppe and Polissja; of pine in the Steppe; and of fir and beech, in the Carpathians. Three forest management regimes are considered. The first regime is a basic silviculture (m_1) is based on quick replanting of the desired tree species after harvesting that is often followed by brushing and weeding of tree stands. The second regime (m_2) is that of planting trees and then attending all silvicultural operations recommended by the Ukraine's forest legislation. The rotation ages are the same as under the first management regime.[26] The third regime (m_3) considers basic silviculture with the rotation period of timber that corresponds to maximum sustainable yield (MSY). The computed MSY rotation ages for the selected tree species across zones are 65-70 years (Nijnik 2004). The output of the model comprises a marketed commodity (timber) and soil protection benefits of the forests, for which the values are imputed. The model, a simplified mathematical framework of which is seen below, provides some guidelines for the establishment of

[26] The Law recommends harvesting of pine stands at 90 years, fir at c.100 years, and oak and beech stands at 100 years of age. Before the main cut, felling operations, called improvement fellings, take place. They include clarification and cleaning operations carried out in stands of up to 10 and 20 years of age, respectively. Then, thinning is carried out at the age below 40 years. Increment felling is the last operation usually performed in forests one age class before the main felling. Incremental forest management increases total productivity of forest stands by 5-10%, and of oak stands up to 16% (Gensiruk 2002).

forest in a way that it maximises cumulative NPV of benefits to be attained from it over a specified period subject to the constraints.

$$Max\left\{\sum_{zatm} X_{zatm}\cdot O_{zatm}\cdot P_{at}+\sum_{zatm} B_{zatm}\cdot X_{zatm}-\sum_{zatm} X_{zatm}\cdot C_{zatm}\right\} \tag{4}$$

Where: z = 1, 2, 3, 4 forestry zones (1 – Polissja; 2 – Wooded Steppe; 3 – Steppe; 4 – Carpathians);

a = 1, 2, 3 types of land (1 – bare; 2 – pastures and used for forage; 3 – used for wheat production);

t = 1, 2, 3, 4 tree species (1 – pine; 2 – oak; 3 – beech; 4 – fir);

m management regimes (m_1, m_2, m_3);

X_{zatm} the hectares of land "a" allocated in the zone "z", to be planted with "t" species scenario when management regime "m" is applied;

O_{zatm} timber output per ha of "z" zone of land "a" planted with tree species "t" and treated with management regime "m", m^3/ha;

P_{at} the discounted stumpage price of 1 m^3 of timber of tree species "t" grown on the type of land "a", €/m^3;

B_{zatm} the discounted soil protection benefits of 1 ha of forest planted in the zone "z" on the land "a" with tree species "t" and treated with management regime "m", €/ha;

C_{zatm} the discounted costs per ha during the rotation period in the zone "z" on the land "a" planted with tree species "t" and under the management regime "m", €/ha. The costs include direct tree-planting costs, including soil preparation, care and protection costs, timber harvesting costs and the opportunity costs of land.

The acreage constraints are as follows:

$$\sum_{tm} X_{zatm} \le F_{za} \forall z, a \tag{5}$$

where F_{za} is total area in the zone "z" of the user "a".

$$X_{1a3m} = 0 \forall a, m$$
$$X_{1a4m} = 0 \forall a, m$$
$$X_{2a3m} = 0 \forall a, m$$
$$X_{2a4m} = 0 \forall a, m$$
$$X_{3a2m} = 0 \forall a, m$$
$$X_{3a3m} = 0 \forall a, m$$
$$X_{3a4m} = 0 \forall a, m$$
$$X_{4a1m} = 0 \forall a, m$$
$$X_{4a2m} = 0 \forall a, m$$

The above constraints imply that only main tree species "t" chosen for planting are to be planted across zones "a", whatever management regime "m" is applied.

$$X_{424m} = 0 \forall m$$

$$X_{43tm} = 0 \forall t, m$$

The last two constraints mean that in the Carpathian Mountains, beech forests do not grow on high altitudes, where main pastures are located, and that there is no land suitable for wheat production in the mountains. The software used to run the model is Visual Xpress. The results of LP modelling provide evidence that under the considered assumptions and at discount rates 4 %, it is reasonable to plant trees only on bare land allocated in the Wooded Steppe, Steppe and in the Carpathians, and the total area to be converted in forest is 0.42 Mha (Table 10.7).

Table 10.7 Major outcomes of the model, 4 % discount rate

Forestry / zone (z)	*Land (a)*	*Area to be forested, Mha (Fza)*	*Tree species (t)*	*Management regime (m)*	**Shadow prices, €/ha**
Wooded Steppe	bare	0.28	oak	basic m_1	41.2
Steppe	bare	0.13	pine	basic m_1	245.2
Carpathians	bare	0.01	beech	basic m_1	59.5

The dual-primal property of LP problem is one of its useful features, because it yields shadow prices for the constraints. A shadow price indicates how much the value of the objective function changes if the constraint is changed by one unit. This is important for sustainable management of forest, when shadow prices take the place of actual market prices as guides to the evaluation of non-marketable environmental services.

The shadow price of bare land appears to be the highest in the Steppe. Overall, it appeared to be more economical to establish monoculture plantations. Regarding management regimes, basic silviculture proves to have a better economic performance in all zones. These results can be explained by the fact that neither non-use values of species and ecosystems (existence value), nor option and quasi option values were considered in this model. Its scope was limited to user values to forestry and agriculture, and the purposes were to serve (1) as a basis for economic appraisal of practical aspects of land management and (2) as a basis for developing of a decision support tool.[27]

10.2.7 Economic Analysis of Afforestation with the Inclusion of Carbon Uptake Benefits

In addition to domestic gains to forestry and agriculture (of timber production and erosion prevention discussed above) woodlands expansion in Ukraine provides climate change mitigation benefits. Economic evaluation of tree-planting for multiple purposes, including for carbon sequestration was carried out across zones when maximising of net present value (NPV) of afforestation is considered as the crite-

[27] Better results are anticipated when a longer time horizon is considered and several timber rotations can be observed. Then, from purely economic considerations, the harvesting of timber sooner, rather than later will likely appear as more efficient (i.e. more revenue flows will occur).

rion for project evaluation. NPV determines the PV of net benefits by discounting the stream of benefits (*B*) and costs (*C*) back to the beginning of the base year *t=0*:

$$NPV=\sum_{t=0}^{n} B_t/(1+r)^t - \sum_{t=0}^{n} C_t/(1+r)^t \quad (6)$$

Benefits of afforesation are expected to accrue over a long period of time, and 100 years are chosen to capture most of the benefits and costs. In addition to timber production and soil protection benefits from the potential forests to alleviate soil erosion discussed correspondingly in Sections 2.4 and 2.5, the carbon (C) uptake benefits from afforestation have been approximated through the following procedure. The functional forms for stand growth of the tree species were estimated, with the equations provided in Nijnik (2004). The coefficients of Lakida *et al.* (1995) were used to translate the stem biomass into total above ground biomass. The volume of stem wood was multiplied by 0.2tC/m^3 for its translation into carbon (Jessome 1977). Carbon sequestered by the root was estimated, depending on the species, either on basis of the relationships presented in Van Kooten and Bulte (2000), or in Lakida *et al.* (1995). Then, based on Nijnik (2005), the sequestered C was computed across zones. The price of 15€ per tonne of C was used to calculate carbon uptake benefits based on Sandor and Skees (1999).[28] To justify the economic efficiency of the project, discount settings of 0 %, 2 % and 4 % were applied and the carbon storage option was considered. The estimates of PV benefits from afforestation are seen in Table 10.8.

Table 10.8 Afforestation benefits across zones, PV, M€

Forestry zone	*r%*	*Production*	*Soil protection*	*Carbon uptake*
Polissja (Woodland)	0	310	84	362.6
	2	42.8	36.2	49.1
	4	6.1	20.6	6.6
Wooded Steppe	0	1125.8	1150	1255.9
	2	169.2	495.6	170.1
	4	24.2	281.8	23.0
Steppe	0	584.7	2750	1237.4
	2	80.7	1185.2	167.5
	4	11.6	673.9	22.7
Carpathians	0	305.7	170	660.7
	2	42.2	73.3	89.4
	4	6.1	41.7	12.2
Crimea	0	0	270	437.3
	2	0	116.4	59.2
	4	0	66.2	8.0

The results of the computation based on the data from Tables 10.4 and 10.6 suggest that e.g. in the Polissja, the highest benefits will be from timber production and carbon uptake, whilst in the Steppe zone – from soil protection forest

[28] The fact that an increase in the amount of C credits available to buy especially pertaining to “hot air” is pushing the price of C credits down was not taken into account.

function. The initial economic evaluation of afforestation in Ukraine for multiple purposes is seen in Table 10.9.

Table 10.9 Initial economic evaluation of afforestation across zones, PV, M€

Forestry zone	*r %*	*Total benefits*	*Costs*	*NPV*
Polissja (Woodland)	0	756.6	356.3	400.3
	2	128.1	162.7	-34.6
	4	33.3	99.5	-66.2
Wooded Steppe	0	3531.7	1084.3	2447.4
	2	834.7	486	348.7
	4	329.0	290.5	38.5
Steppe	0	4572.1	2173.3	2398.8
	2	1433.4	965	468.4
	4	696.6	570.2	126.4
Carpathians	0	1136.4	177.9	958.5
	2	204.9	80.9	124
	4	59.9	49.2	10.7
Crimea	0	707.3	345	362.3
	2	175.6	159.9	15.7
	4	74.2	99.4	-25.2

Again, the results vary substantially depending on discount rates. The NPV of afforestation is positive for the majority of the zones, for discount rates of up to 2 %. At these discount rates, afforestation enlarges social benefits, including those of climate change mitigation, and adds to the welfare of society. At a discount rate of 4 %, the area to be planted with trees in Ukraine is to be 1.82 Mha, excluding the Crimea and Polissja. In the Carpathian and Crimean Mountains, commercial timber harvesting is restricted, and economic benefits from an enlarged timber supply are therefore modest. Agricultural production is also limited in the mountainous regions. The benefits that accrue to agriculture from soil protection forest function are therefore moderate either.

10.3 Conclusions

Afforestation in Ukraine is seen as a means to contribute to sustainable land management and to climate change mitigation. Vast areas in this country are suitable for tree-planting and the costs of afforestation, particularly direct tree-planting costs, are low due to good forest growing conditions on average in Ukraine and because of relatively low labour costs. For an excessively ploughed and sparsely wooded Ukraine, an expansion of forest cover is important with regard to soil protection. Annually, 1 ha of forest in Ukraine provides soil protection benefits to agriculture in the range of €1.6 to €58.2. Such a broad range can be explained by the variety of conditions. The results provide evidence that a low share of forest cover is among the causes of erosion and that planting of trees is a possible measure to alleviate it, particularly in the Steppe where soil erosion causes sandy storms and brings substantial economic losses to agriculture. When only timber production gains and those from the protection of agricultural land against erosion are taken into account, the benefits from afforestation are high in the Steppe, Wooded Steppe and in the Carpathians. Planting of trees is not economically justified in the Polissja and Crimea, at 2 % and higher discount rates. Thus, considering only timber supply and soil protection benefits, the tree-planting is economically justified on c. 1.82 Mha of land in Steppe and Wooded Steppe, and in the Carpathians. When a discount rate of 4 % is used, the planting of trees is to be limited to bare land in these zones, with a total area of 0.42 Mha.

The results are more positive when afforestation is considered for multiple purposes, including those of climate change mitigation, because more social benefits are then captured. Both, with or without consideration of carbon uptake forest function, the results of the research indicate that the costs for afforestation in the majority of zones in Ukraine will be covered by the returns at 0 % through 2 % discount rates.

The analysis across zones indicates the following. Whilst soil protection benefits from afforestation in the Steppe are expected to be very high, carbon sequestration and timber production activities in the Steppe are not cost-efficient due to low rates of tree growth and because when trees reached maturity, the discounted opportunity costs of maintaining forests on agricultural land for the rest of the period appear to be high. Afforestation in the Polissja is cost-inefficient (at 2 % and higher discount rates) because of comparatively high agricultural land values in this zone, especially of the marginal land used for wheat production.

Importantly, that there is a difference between the determined in this paper benefits of afforestation, and the benefits for the planter of the trees. Although tree-planting would enlarge social gains, welfare maximisation conditions would hardly be met because of market failures. The problem: "who pays for tree-planting and who receives the benefits" can scarcely be solved in Ukraine through the market, and is therefore to be regulated by government. It seems necessary that government justifies public policy concerning tree-planting and balances costs and benefits to provide incentives for the planter of the trees. According to the SCF (2007) annual planting in Ukraine was as follows: 1949-1965, 100000-200000 ha, 1966-1990, 55000-100000 ha and in 1995-2005, 35000-40000 ha per year. Therefore, providing favourable institutional setting and economic conditions, it would have taken c. 25 years to implement afforestation of the area as identified in this paper. Such a comprehensive programme, if accepted, should be elaborated in a close dialogue with stakeholders, and public involvement should include an in-depth consideration of various scenarios of woodlands expansion. The deliberative processes will increase capabilities of policy actors, assisting them in the delivery of sustainability objectives to forest management practices on the ground.

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Перспективи багатоцільового заліснення в Україні

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У розділі зосереджено увагу на лісорозведенні у контексті довготермінової політики сталого менеджменту ресурсів, а також на економічних аспектах заліснення низькопродуктивних земель. Автори аналізують багатоцільову функціональність лісів, які заплановано створити, у розрізі природних зон, порівнюючи витрати і вигоди, пов'язані зі збільшенням площі лісів задля отримання деревини і запобігання ерозії. Дослідження, виконані із використанням регресійного аналізу, моделювання і лінійного програмування, виявили, що заліснення з метою отримання деревної продукції є економічно й екологічно виправданим у певних регіонах. Далі розгляд проблеми лісорозведення в Україні поєднується із вивченням можливостей пом'якшення наслідків глобальних змін клімату, тобто йдеться про багатоцільові суспільні вигоди на світовому рівні.

Chapter 11

Practical Economics of Forest Ecosystem Management: the Case of the Ukrainian Carpathians

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Abstract Forests conditions in the Ukrainian Carpathians are the result of a century or more of land use changes, management choices, air pollution, and natural stand development. Interacting with these, subtle changes in climate are likely amplifying stresses on the forest. At present, concerns focus heavily on the spruce stands, which are felt to be unnaturally uniform. They are suffering a widespread decline which likely renders long rotations ages, set by policy, academic. At the same time, emerging forest management paradigms call for a shift to "close to nature" management practices. A principal goal is to replace spruce monocultures with more diverse mixes of spruce, beech, and fir. To succeed in implementing this new paradigm, we argue, a series of new problems must be solved. This must be done at a time when the overall national economy places severe limits on the funds that can be expected. As a result, financial feasibility of the proposed new paradigm will receive intense scrutiny. As well, the region's forest economy is still reeling from post-socialist change and has not yet found a path to financial sustainability. Discussing longterm biodiversity and social issues, from an environmental economic viewpoint, must take account of these practical issues. Ukraine has the scientific skills and the resources of field experience to address these challenges; we hope that a thorough professional debate over propositions advanced in this article will prove useful.

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11.1 Introduction

In the Ukraine, Carpathians contain just under 20 % of the country's forested area, but account for a higher portion of total growing stock due to favorable growing conditions. The Carpathian region's forests have been heavily influenced by harvesting and planting in Austro-Hungarian times. Since nationalization in the late 1940's, all forests are now state lands. Some of the stands are older than 120 years. The region's spruce forests currently suffer from a generalized "decline syndrome" affecting most stands aged 40 or older. Partly as a result, windthrow is increasing. The decline's immediate causes are debated; it reflects the effects of a "pest complex" including fungi and bark beetles. Stand maturity and overstocking are likely contributing causes. Further, many scientists agree that the region's climate has shifted in ways less favorable to Norway spruce, the predominant conifer in the region's managed forests.

Accelerated salvage efforts are being undertaken. The decline threatens current plans to manage these stands to ages as long as 80-100 years. Low road density in the mountains has prevented active management. Also, large areas of Ukrainian forest were designated to serve primary functions as scenic and recreational backdrops in Soviet times; and hence, were long undermanaged, as production expectations for them were minimal. This history of minimal management has undoubtedly set the stage for the current conditions of overstocking and low vigor. Ironically, "preserving" these stands has ended up accomplishing no such thing.

On July, 23-28, 2008, the Ivano-Frankivsk, Lviv, Ternopil, Zakarpattia, Chernivtsy and Vinnitsa areas suffered from unusual flooding with significant damage.. Forest practices were immediately labeled a prime suspect as a cause (we comment more fully below). Emergency measures are being advocated at the highest levels to address reserves, cutting practices, "deforestation" (an obvious misconception), and the transition to stands of a more mixed composition. Specific reforms remain to be issued.

Some of these forests, managed by four different Oblast (or "provincial") branches of the State Forest Committee (SFC), have received a Green Certification from an international certification body, the Forest Stewardship Council.[3] To forestall future forest declines, SFC managers plan to move toward a forest species composition judged to be more natural. Cutting and planting practices are attempting to introduce more beech (*Fagus sylvatica*) and white fir (*Abies alba*) into the new stands. This is an example of the new emphasis on "close to nature" forestry that is widespread across Europe. Ukrainian foresters note that they are adopting practices, such as Certification, to become "more like Europe."

Planned shifts toward more natural forest composition, and accompanying wildlife re-introductions (e.g., bison in National Park Skolivsky-Beskidy), represent moves toward long-term sustainability. Fully implementing them will require many decades occupying the careers of the foresters and managers. This proposed shift raises many significant and interlacing issues, including updating long-term

[3] One certificate was later suspended due to several issues. The Zakarpatska Oblast certificate remains in force. The SFC hopes to bring all state forests under certification.

yield projections, developing scientifically defensible choices of rotation ages and management strategies, road development, and managing on a landscape scale (Irland 1994, 1996).

Our paper will discuss these issues in a very broad manner,[4] with the purpose of fostering discussion. At present, we ourselves do not have all of the answers. In some instances, we offer hunches and conjectures based on judgment and experience; detailed study may show these to be of limited applicability or even false. These problems have deep historical roots. It is not our purpose to criticize particular organizations. We hope as well to better inform observers outside Ukraine of the issues, and perhaps in a limited way bring to bear some literature and experience from outside the country on the SFM debate in the Carpathians. At one level, this essay is about the basics of practical economics that are yet to be put in place before more sophisticated assessment of ecological economics will be possible.

11.2 The Forest

Data are not readily obtainable for the Carpathians region, as the region is part of several nations. Even within Ukraine, four separate SFC districts manage portions of the region. General data were compiled for the Scandiaconsult and SFC report (2000, esp. p. 76-84). Site quality for major species is fairly high. For fir, pine (*Pinus sp.*), spruce (*Picea abies*), and beech, more than two-thirds of the forest hectares are in Site Class I and higher. This high productivity can be supported by informal inspections of growth rings on log decks around the region. Regionwide, stand origins are primarily natural except for the small area of pine which is 75 % planted.[5]

The region's land use history is complex, It includes plantings and regeneration from the Austro-Hunarian era, Soviet-era plantings on meadows at upper elevations, as well as more recent abandonments of farmland in the post-socialist times (Kuemmerle, et. al. 2008). Afforestation history nationally has been reviewed by Soloviy and Yaremchuk (2001).

Roughly half of the forest is now in spruce and fir types, although mixtures are not readily determined from these data (Table 11.1).

Table 11.1 Carpathians Forest Area Managed by SFC by Forest Type

Type	*Hectares*
Spruce	445,227
Beech	426,663
Oak	88,037
Fir	63,428
Hornbeam	11,562
Pine	5,940
Total	1,040,857

Source: Scandiaconsult and SFC (2000, p. 87).

[4] We had hoped to consult the final report of the SIDA project, which is to be available sometime this year, but it was not available at this writing.

[5] This is not consistent with claims often heard that spruce decline was caused by Austrians planting so much out of area seed stock.

It is well recognized that, due to past history, the age class structure of the forest is unbalanced (Figures 11.1-11.3, in attachment). In one sense, the situation is favorable for management. Over coming decades, more and more acres will grow into harvestable age classes. Unfortunately, the spruce in particular will also grow into age classes needing thinning, and will become increasingly vulnerable to damaging agents and decline. It is not clear, given practical constraints, that thinning programs can keep up with the aging of these age classes. Depending on species, in 20-50 years, harvestable age classes will be in a very large surplus compared to a regulated forest (Figures 11.1-11.3). The youngest age classes are now seriously underrepresented. This will not present a management problem for half a century, but ignoring it now will limit future options. Policies preventing early final harvest of the stands that are now in age classes 40-60 will perpetuate a most unsatisfactory age class distribution. For spruce, 15 % of the area exceeds 100 years of age, for beech, 17.4 % exceeds 120 years, and for oak high forest, only 2.3 % exceeds 130 years.

The observations in the preceding paragraph are based on describing "young" and old" in terms of the existing rotation age policies. Other standards for regulating the forest can be analyzed in a similar manner. If, for example, the standard for "old" is age 200 or more, then a different picture emerges. Many different age class goals could readily be analyzed in the same manner as our examples. Our argument is simply that the future age class structure will not be chosen on the basis of a comparison of likely conditions, management practices, and a broad range of policy goals, but will come about almost by accident. Simply assuming that most of the existing spruce stands in the age 50 age class will ever reach planned rotation age at 80 or 100 years seems difficult to justify given their current condition and management outlook.

11.3 The Nature of the Decline and Response

At present, a broad overview of the forest decline situation in the Carpathians in English is not available.[6] On 62,400 hectares, there are centers of insects and disease, which include root rots (*Heterobasidion annosum (Fr.) Bref.*) and *Armillariella mellea* (*Fr. Ex Vahl.*) *Karst*). Spruce stands can be damaged as young as 20-30 years. Full dieback of stands occurs at the age of 60-70 years. Damage by *Heterobasidion annosum* is also common in oak, beech, fir types, in particular on rich soils. Another mortality agent is bark beetles. The most serious is *Ips typographus L*. Outbreaks of *Ips typographus* are observed basically in places where the root decay (*Heterobasidion annosum*) has already infected the stand. Damage by *Ips typographus* and its associates is frequently found in stands on the periphery of clearcut areas, especially on slopes of southern exposure, and in stands with windfalls and snow damage. The largest outbreaks of bark beetles in the Ukrainian Carpathians occur in pure stands (Slobodyan, Y. 2006, Slobodyan, P. 2006, Slobodyan, Y. et. al. 2007).

[6] Interestingly, in the SFC's 2007 booklet, p. 30, the monitoring results presented do NOT show unusual levels of defoliation or discoloration in Lviv or the other Carpathian districts compared to national figures. For a wider view, see Badea et al. [2004].

Another fungus (*Armillariella mellea*), damages mixed forest stands of different age. The pathogen has the greatest distribution in a belt a beech -fir woods of Carpathian Mountains (fresh and wet types of soils). The soil dries up during droughts and then becomes boggy in rainy periods. These stresses favor the pathogen (Slobodyan 2006b).

Windthrow risk and storm frequency have been analyzed in depth by Lavnyy and Lessig (2003, 2007).

Management changes are only beginning, but a great deal of work has already been done on the issues of forest decline and the potential transition to a new forest management system. Spruce decline has been observed for some years across Central Europe, often in connection with air pollution or other suspected causes (Antoni, Somsak, and Janksy 2000, Koziol n.d.). One result of the Swiss and Ukrainian project of development of forestry in Zacarpatska District is the publication: "Back to Nature: Forestry in the Ukrainian Carpathian mountains" (Chernyavsky, et. al. 2006). The authors advocate introducing a gradual transition from prevailing clearcuts to a selection and shelterwood system. The goal is to convert even-aged stands to structurally complex, uneven-aged stands. Further, in 2008 the Ukrainian Scientific Research Institute of Mountain Forestry (USRIMF) (situated in Ivano-Frankovsk) published its "Collection of Recommendations: Scientific Substantiations of Conducting a Stable Forestry in Carpathian Region."(USRIMF, 2008) Our purpose in this essay is to further this discussion.

Propositions for Discussion

We offer the following seven propositions for discussion. Certainly it is essential to develop a sound diagnosis of the situation as we go about attempting to prescribe and implement remedies. The transition to new silvicultural methods in this region is in very early stages, so abundant opportunities for learning by doing lie before us.

1. Forest decline in the Carpathians is at least partly self-inflicted
2. Numerous silvicultural questions remain unanswered
3. Future climate change makes prescriptions risky
4. A prescription development and risk rating system is needed
5. Economic challenges are likely to be serious
6. Organization and management efficiency must be evaluated
7. Forest Regulation planning needs to be re-visited.

11.3.1 Forest Decline in the Carpathians is at Least Partly Self Inflicted

Forest stand vigor has been compromised largely by growing dense spruce stands without adequate thinning to maintain crown vigor. Specifying long rotation ages by policy has likely exacerbated the decline, especially to the extent that some plantings of spruce are likely to be off-site. Long rotations and bans on green tree harvesting prevent managers from correcting the situation by promptly harvesting and replacing high –risk stands with better-adapted mixtures. Widespread monoculture contributed to the situation. Normally, managers would respond to such a situation by accelerating harvest of high risk stands (see remarks below on risk-rating). But in the Carpathians, the forest has been harvested below its calculated allowable cut. From 1990-1996, actual cuts under-ran the calculated AAC's by a total of 2.4 million cubic meters. (Scandiaconsult and SFC 2000, p. 87). The situation persists nationally (World Bank 2006, p. xii).

11.3.2 Silvicultural Questions Need Further Understanding

To implement a shift in management practice of the kind envisaged for spruce stands across Central Europe, considerable research and practical experience will have to be gained (Oliver and O'Hara 2005). A few of the questions will include:

Management of Severely Stressed Stands

Forest decline in the Carpathians is already widespread. Silvicultural plans and statements to the public must recognize that orderly transitions in silvicultural systems are one thing in a healthy forest, and quite another in heavily stressed or dying stands.[7] The future extent of decline in terms of area and intensity is difficult to predict. A flexible approach to managing these stands will be needed. Overall allowable cut planning will have to be re-adjusted periodically as experience develops. Dogmatic statements about silvicultural practice will need to be avoided (see, among others, Koch and Skovsgaard 1999).

Thinning Regimes

Spruce can grow very well in this area. Anecdotes of extremely high harvest volumes can be found. This means that stands can soon become overstocked. Thinning is constrained by markets for wood, operating costs, and by access. Casual observation of growth rings on log decks at several locations on the northern slope of the Carpathians indicates that the stands being harvested now, however, may be receiving one less thinning than they need[8]. In this admittedly limited sample (visit of March 2008) it was almost impossible to find logs whose growth rings display evidence of sustained rapid growth to the present. It could be that in stands where thinning is practical, spruce and fir mixes can be carried to longer rotations than now contemplated in the normatives. Some foresters and scientists believe, however, that early thinnings cause stand damage that offsets any improvements to growth. Further discussion of stocking practices, thinnings, and intermediate cuts designed to increase species diversity need, we think, further field work, analysis and discussion.

All-Aged Management

It is much easier to declare a goal of "all-aged management" than it is to actually implement it in the forest. In Central Europe within the range of Norway spruce, there has been experience with managing such stands in multi-aged or all aged

[7] The senior author has had extensive experience with this problem in dealing with a massive outbreak of spruce budworm, *C. fumiferana*, in Maine during the 1970's and 1980's. See Irland and Dimond [1991].

[8] Alternatively, were they established at densities that were too high?

fashion. But it is usually on fairly small, intensively supervised areas where net financial returns are not a critical issue, or where aesthetic or other constraints dominate management practice. Features favorable to immediate transition to all-aged mixes may exist on only limited areas; management regimes suited to a more patient transition will be needed elsewhere. A detailed analysis of Swiss plenter systems, using data over six to nine decades, found that "the common perception that the plenter system ensures a stable structure may be unfounded" (O'Hara, Hasenauer and Kindermann 2007).

Some SFM Questions

What are the silvicultural unknowns?
Where and when will natural regeneration adequately improve stocking of fir and beech?
When will planting be needed? How much will this cost? Implications for tending practice?
How will the proposed shift in composition be constrained by access, wood market, and logistical factors?
Does P. abies in this region need a "pathological rotation?"
What will be the financial implications of such a shift?
How will a new species mix affect the overall forest yield?
Relative values of different species?
How will wildlife habitat be affected?
How will future climate change affect regeneration, growth, water yields, and the shrub and understory plant layers?
How will the new paradigm for forest management affect flooding and water yields?

Regeneration Issues

Planting techniques for establishing fir and beech in the spruce stands will need to be worked out by trial and experience. In Germany, at least two contrasting approaches can be observed. One is to make 30m×30m patch clearcuts, which are then planted to beech or fir (Hanewinkel 2001 models such an approach). This amounts to a choice in favor of a patch clearcut regime at least during the transition. In other situations, dense beech underplantings are made, well before opening the canopy (Irland personal observations, Bavaria 2008). Otherwise, the aggressive natural regeneration characteristic of spruce will overwhelm the planted beech.

In stands adjacent to pockets of fir, there could be a potential role for natural regeneration to boost fir representation. How this will work in practice will need to be determined. In those large areas where insufficient mature fir is present, one form or another of underplanting will be needed.

Development of the necessary seed collection, nursery capacity and production, and techniques for these species will need to be carefully staged to match emerging planting requirements. Funding to support this large investment will have to come from current harvests unless the State is prepared to fund it.

Mixed-Species Management

Many countries are now initiating programs of planting to enrich uniform spruce stands with fir and beech. Achieving such enrichment is a stated goal in at least parts of the Carpathians. Unfortunately, operational experience with this transition is limited. There is little operational experience for benchmarking stand development, management practices, cost performance, and yield. In many instances, studies assessing silvicultural and economic feasibility have had to rely on simulation modeling (as noted previously by many, e.g., Gamborg and Larsen 2003).

This means that a transition program must be designed explicitly as an adaptive management scheme. One approach might be to conduct full-scale intensively monitored pilot tests in one or more pilot regions, before committing heavily to the strategy regionally. Very likely 10 to 20 years of assessment would be required.

Snags and Down Woody Debris

In "close to nature" silviculture, an increasing role is envisioned for retaining portions of the forest that are already dead. These elements serve important habitat and ecological process goals. Yet, one searches in vain for such elements in managed stands in Ukraine. The response to questions on this is usually, "no problem – that is handled in the riparian zones and reserves." That mindset is slowly being abandoned in other countries. We think that, promptly revising this mindset in Ukrainian silviculture would produce more near-term benefit for habitat and ecological functioning than would a slow transition to Dauerwald/mixed stands stretching over a century or more.

Ending the Decline?

It has been assumed, with little concrete evidence, that the virtues of mixtures and all aged stand structures will cause the "decline syndrome" to fade away. This ought rather to be posed as a working hypothesis than a premise underlying the massive conversion of an extensive forest to a new and really untried system. If the new stands are managed to overly long rotations, at excessive stocking levels, and in dogmatic and highly uniform ways, can we expect results to be different? A casual inspection of forest health survey data for this region (at least so far as defoliation may considered a proxy) does not suggest any great difference in vulnerability to stress between beech, fir, and spruce (e.g., Lorenz, et. al. 2004, Badea, et. al. 2004).

11.3.3 The Likelihood of Future Climate Change Renders Predictions Risky

Rotation ages are now based on policy declarations rather than on a realistic understanding of the practical silvicultural regimes, the practical thinning opportunities, the differing growth dynamic of spruce, fir, and beech in mixture, and the potential effects of future climate change. Administrators say the rotation age is 80 to 100 years, and also then observe that all spruce age classes above age 45 are declining. Many are being cut prior to planned rotation ages, yet rotation age policies not being adjusted to reflect this reality.

In the context of a SFM approach, it may be desirable to hold selected managed stands to rotations longer than 100 years to maintain representation of mature forest features. The species proposed for the new mixed forest may be well suited to this. Economic and silvicultural implications need to be explored.

Carbon

The use of forest management as an active program to sequester carbon is separate topic (see, e.g., Nijnik 2005) needs to be considered in the overall management system, as does the role of fuelwood production in the region's energy economy and carbon balance.

11.3.4 Needed: a Formal Prescription Development and Risk-Rating Process

Managing mixtures of several species, in a Dauerwald or multi-age setting, will create interesting new opportunities and challenges. As experience is gained with these, practice will need to be adjusted. An approach based on meeting prescribed "normatives"[9] and predetermined schedules simply will not work. Further, the many stands that will continue to be managed with their existing composition will need to be treated in ways that will initiate the conversion process. Where natural regeneration is expected to be abundant, the initial treatment may be nothing more than a heavy commercial thinning. Following salvage cuts, developing all age stand structures will take decades. Prescriptions should probably be designed when the nature of advanced regeneration can be assessed.

Most importantly, a new variable is needed in scheduling stands for harvest – risk-rating. Surely, local management foresters consider disease and insect and windthrow risks in scheduling stands for harvest. Whether this is done in light of the best current science and evolving experience is less certain. Even more uncertain is whether the implications are being fed back into overall District allowable cut calculations. Risk-rating must be introduced into "Group I" stands as well. A policy of banning all final harvest of green trees in the face of a widespread forest decline is simply folly. Continuing in this folly will maximize the costs and damages of the continuing decline, and will minimize the resources available to foster the transition to the desired future forest.

One point in this process should be to identify situations in which existing single-species stands seem likely to succeed. It would be a mistake to replace one single-prescription orthodoxy – long rotation monoculture everywhere – with another one – mixed species Dauerwald everywhere (see, e.g., nuanced discussions in Hansen and Spiecker 2005, and Mikulowski, et. al. 2005).

11.3.5 Economic Challenges are Likely to be Serious

In asking about how rotation age calculations are done, we were told that "we do not need that information." The rotation ages are not calculated on silvicultural or

[9] "Normatives" is the English translation of the term referring to rules and practices, e.g., rotation ages, specified by SFC policy.

economic grounds but are based on policy from the Centre.[10] It appears that rotation ages are determined on the basis of biological models that attempt to maximize mean annual increment. As a result, there is no maintenance of the kind of economic data that would support a richer approach to thinking about management options. Most seriously, the cost of capital is taken for granted under such a philosophy. This is not a recipe for long-term financial sustainability.[11]

The high yield potential of Norway spruce stands should not be lightly thrown away. On suitable sites, and on a suitable landscape model, *P. abies*, managed on sensible rotations and with sound thinning schedules, and using natural regeneration, can be an important part of the management mix. A country in Ukraine's economic position cannot afford to act as if it were Switzerland.

True uneven-aged management typically involves cutting in all age classes to maintain negative exponential or sigmoidal diameter distributions. This may require the harvesting or at least deadening of small and low value trees, often at a net cost. Thus, it could depress net revenues. Clearly, the successful implementation of this proposed transition depends on developing a competitive processing industry capable of using rising amounts of fir and beech, and also logs of the technical and pulpwood grade. We may suppose that fir and beech will gradually begin to appear in the harvest mix after four or five decades. When they do, it will be in logs of the lower grades and lower values. Current high energy prices will likely promote stronger demand for wood to use for energy, which will be a major aid in this transition.

A shift toward mixed stands will change the forest's annual timber yield and the unit value of the harvest. Growth rates for hardwoods will be lower than for spruce, and unit values at final harvest may be higher. The market data from one District in the Carpathians serve as an illustration (Table 11.2). Here, we can see that woodyard prices of fir are lower than for spruce, while those for beech are higher. The weighted average woodyard value for this data is UAH 157/m^3. We have been told anecdotally that logging and hauling costs to the woodyard can amount to \$150-170 UAH/m^3, and tax can be 30-60 per m^3 on the higher log grades, down to nominal amounts on thinnings and fuelwood. From such rough information, of course, no strong conclusions can be derived, other than a strong motivation to obtain better data. Logyard prices for conifer sawlogs roughly doubled in Ukraine from 2002 to 2006 (Polyakova n.d.). But we have no estimates on how stumpage level values fared over this period.[12]

[10] Determined by the Cabinet of Ministry. See, for another view, Nijnik [2004], and others. Note that Nijnik did not consider the effect of thinning on optimal rotation ages.

[11] Very thorough analyses of the economics of such transitions are proved by Knoke and Pluszyk [2001], and Hanewinkel [2001].

[12] Tracking down what is paid to the State as harvest tax, or as "stumpage" revenue to Districts is difficult. In a 2006 World Bank document, [2006, p. 44], what is termed “stumpage prices: are given. Apparently these are national averages. Note that these are not market – determined as basically there exists no stumpage market as such. Strangely, the prices take a larger portion of delivered market prices for low grade than for high grade wood, the precise opposite of what might be expected. These data cannot be taken as actual net stumpage values, whose estimation would take a laborious inspection of the accounts of the Districts.

Table 11.2 Typical District in Carpathians, 2007 Species, Grade Mix, and Log Prices. (Prices represent a mix of woodyard, landing, and FOB railcar prices.)

Item	*Hrvna/m³*	*Percent of Quantity*	*Percent of Sawlogs (Volume)*
All roundwood	141	100.0 %	
Industrial wood	188	55.8 %	
Sawlogs	210	39.6 %	100.0 %
Spruce	218	29.9 %	75.4 %
1	243		
2	223		
3	203		
Fir	185	9.7 %	24.6 %
1	206		
2	191		
3	178		
Beech	236	0.2 %	0.5 %
1	259		
2	na		
3	234		
Pulp	120	13.6 %	
Technical	90	33.1 %	
Fuel	55	11.0 %	

Source: SFC.

The opportunities presented by the Carpathian forest are numerous. Decisions about long-term policies should not be based solely on Faustman-style bare land analyses, but rather on assessments of current conditions (including decline risks) and the immediate options as well. For example, on suitable sites, thinning strategies might well be designed to carry some stands to rotations longer than current practice, with material gains in wood values, and deferral of regeneration costs. If natural or planted regeneration of fir/beech are added in to such a regime, several goals would be served, including maintaining in the landscape a high representation of mature and tall stands. Given the decline, though, maintaining areas of unmanaged pure spruce beyond even age 60 seems risky (see, e.g., Lavnyy and Sukhariuk 2007).

Rotations prescribed for the principal forest management groups in the Carpathians vary by management category, species and site (Table 11.3). In the former Group II areas, the rotations are similar to those employed elsewhere in Central and Eastern Europe. The rotations for former Group I and protected areas(many of which are in fact managed), are extremely long. They do not appear to reflect a realistic view of either the financial costs of such long rotations, or of the wind, insect, and pathological drama now playing out in the Carpathians.

Some assume that once stands are largely in the mixed species and uneven aged condition, the notion of a rotation age will fade away, but this is only an illusion. There will still be a role for decisions to determine target sizes for the largest trees to be retained in such stands.

Table 11.3 Optimal Rotations for Forest of Ukraine – Carpathians

Forest Type	*Former Group I*	*Protected, Lower Value*	*Former Group II*
Spruce, fir, mountains	141-160	121-140	Site I 81-100 II or less 101-120
Spruce, lowlands, or in mixtures	121-130	91-100	71-80
Oak (high forest)			
Site III	161-170	131-140	111-120
Site IV	91-100	71-80	61-70
Beech			
Lowland	121-140	101-120	81-100
Mountains	91-100	121-140	101-120
Pine, Larch	121-130	101-110	81-90

Source: SFC.

Thinning and intermediate partial cuttings relate to several key sustainability issues, which is why their economic and technical feasibility require intensive exploration. First, by thinning at suitable stages of stand development, stand growth rates are sustained, enabling higher returns on investment. Interim yields of products, even if only used for fuel, are important to financial returns under long rotations. By maintaining vigorous crowns, thinning will assist stands in resisting effects of "decline" or climate change. Finally, late in the life of stands, proper final thinnings may become the initial cuts of shelterwood regeneration methods. Thinnings may also assist in fostering ingrowth of fir and hardwoods into these stands. Policies that ban green tree harvesting in large areas ignore all these considerations.

A key issue in long-run financial sustainability is access costs. The more rugged areas of the Carpathians are not fully roaded for modern forest management. It is not clear to what degree horse logging can compensate (see, e.g., World Bank 2006, p. x111). In addition, the region is burdened by a heritage of low standards in construction of roads, culverts, and landings (see also World Bank 2006, p. 30). The question is, can improved forest yields carry the long-term costs of accessing the forest? If not, from where will the funds be found?

Roading, road maintenance, and logging costs will constrain stand entries, and even place certain areas off limits to treatments or final harvest at least for periods of time. Based on road costs, slopes, risks of erosion and landslides, timber values, and site quality, it is likely that certain areas will not prove to be economical for management at all, at least in the near decades. This needs to be examined at least in a shorthand way, and implications for overall allowable cut and for harvest schedules built into operational planning. There are other reasons for access than just timber harvesting. Recreation, pest management, and local transport needs all will play a role.

Repeated entries for light partial cuttings will strain the road budget because each cutting will yield less revenue to pay for roads and stream crossings. Further, repeated entries will have potential soil and habitat implications. Every hectare of managed forest will be disturbed by machinery more frequently under uneven-aged management.

11.3.6 Organization and Management Efficiency

A shift toward management of uneven-aged mixed stands will have a significant effect on costs of management, record-keeping and supervision. All agree that management and administration costs will be much higher in a regime built around multi-aged management of mixed stands. Practical year to year planning will have to allow for this.

Further, many specific management practices will need to be value-engineered for cost-effectiveness. Anecdotal observation turns up a few examples. How representative these may be we cannot say:

- Cleaning out birch in young pine plantings in Group I areas (silviculturally unnecessary; not obviously cost-effective in terms of future yield; not to mention inconsistent with the avowed purpose of a Group I area).
- Collecting and using extremely tiny material.
- Shipping marginal material extremely long distances to users.
- Extremely intensive early treatments in pine management.
- Under-use of natural regeneration.
- Extreme planting densities in some situations.

These practices were adopted for some reason in the past. The question is whether they are always needed and always cost effective now in a marketizing economy. We do not by any means argue for scrapping these practices, only for conducting thorough technical, economic, and management reviews of these and other practice in order to "value engineer" them.

Intensive treatments in young stands are common in all Ukrainian regions. The issue of cost-effectiveness is already a serious one. Given the many economic obstacles, it remains to be seen whether such intensive practices will prove to be financially sustainable in the long run.

Administrative practices are major sources of waste. Multiple re-cruising of stands to be harvested for tax assessment employs many technicians in work that yields nothing but cost and delay. Additional audits of various kinds by tax and environmental agencies consume time of the forest managers and waste funds. There are better ways, but no apparent motivation to find them. These audits and re-cruisings are essentially parasitic; there is no indication that management improves as a result.[13] Worse, they supply numerous opportunities for minor shakedowns of the organization by the auditors and inspectors. One may ask, why, with all this auditing, do we still hear such loud calls for action against illegal logging? Thoughtful SFC officials and outside observers have long known that a massive re-engineering of the administrative system is in order.

Some managers in the system are interested to learn if different methods for outsource management functions by creating independent contractors could be beneficial. This is not an easy question that deserves careful exploration; it would be premature to assume that by itself such outsourcing would save cost.

An underlying purpose of the SFC's management program is to sustain employment in rural Ukraine communities. Anyone traveling in those regions can appreci-

[13] Note the depressing observation of Kummerle, "In Ukraine, harvesting rates inside and outside protected areas did not differ appreciably…" [2007, p. 1279].

ate the importance of this objective. But a program increasingly weighed down by administrative waste and lack of accountability for resources will not be a reliable employer for the future.

11.3.7 Forest Regulation Planning Needs to be Revisited

The transition to new management practices will affect the overall regulation of the cut. It will affect growth rates, species mix, and timing of yields by decade. Because of the more complex stand structures and regimes, the transition will render long-term allowable cut planning more uncertain. Fortunately there is time to adapt methods, and to integrate the forthcoming National Forest Inventory into the system as a control method. Analytical challenges will be numerous (Irland 2006, 2007).

The Scandiaconsult report of 2000 explored a number of regulation options using their own models (2000, p. l 94 ff). Their results showed that significant improvement in aggregate yield could result for small reductions in the prescribed rotations. An interesting paper by Polyakov and Teeter (2003) studied two other Oblasts in Ukraine. They showed the tradeoffs between long rotation ages and non-declining timber flows, versus the benefits of more flexible approaches to cut regulation.

What is now happening in the Carpathians is a de facto deviation from the officially programmed allowable cuts due to the decline. It may be that the best response for forest regulation is simply to wait until the most vulnerable stands appear to have been treated (or lost), conduct a new inventory, and begin with a new Plan.[14]

Kuemmerle and co-authors (2007) have observed cutting rates in the Carpathians by remote sensing. They observe that while their method does not detect partial cuts, the data do not seem inconsistent with long-term sustainability on an area basis. They do observe, however, that illegal logging makes it difficult to conduct an accurate assessment of whether actual cutting levels are consistent with any calculated long-term AAC.

11.4 Further Questions

Floods during 2008 in the Carpathians reignited controversy over forest management[15]. In place of facing other contributing factors, attention is always drawn to forest management as the cause. A classic review of the issue in humid forest regions of the eastern US concluded:

"With reasonable care, the forest can be cut with little detriment to its site-protective capability.

Under sustained yield programs of forest management, and with great diversity in age classes of private forest ownership, the extent of forest cutting offers no flood threat.

[14] Based on recommendations of SIDA, a National Forest Inventory has been proposed following extensive pilot testing. One must hope this it will be carried out with all due speed and care [see also, Irland 2006, 2007].

[15] As this article was being completed, the Cabinet of Ministers issued new rules for the Carpathians. WE have not been able to review them in time for this chapter. See Cabinet of Ministers, 2008.

The flood reduction role of the forest can be realized through continued fire protection and careful logging, and can be enhanced by reforestation of abandoned land" (Lull and Reinhart 1972, p. 86).

These conclusions have not been superseded (see, e.g., Grant, et. al. 2008).

Extreme floods occur when watershed soils are fully saturated; normal forest management will have little effect on them. Extensive removal of forest, or widespread overcutting combined with shoddy roadbuilding and inadequate maintenance, can increase erosion and can affect flood conditions on small streams at some times and in some places. A recent CIFOR/ FAO report concludes: "Sound science provides little evidence to support anecdotal reports of forest harvesting or rural land-use practices leading to lower basin catastrophic floods" (2005, p. 11). This report has generated considerable subsequent controversy.[16]

To the extent that a move away from clearcutting is already underway, there may be little conflict here. But catastrophes often generate ill-considered rules that can inflate costs, cut revenues, and in fact have no long-term benefit. At the same time, such emergency decrees often fail to address the actual problems, which are more likely to have to do with road and bridge design and maintenance and poor land use practices in flood plains.[17]

11.4.1 Land Use Allocations

Under Ukraine's Forest Code, the principal land use allocations are those traditionally described as "Group I" and "Group II" areas, and those allocating lands to parks or specialized uses. The terminology has changed with 2007 Amendments to the Code, but not the substance (to avoid confusing readers, we will continue to use the Group I, II terms here). Forest management occurs to some degree in most of these areas, but in varying ways. Wherever final harvest of green trees is not permitted, this will likely slow down the achievement of overall goals for forest structure as well as financial goals. Where decline is severe, or stands have been annexed by low-value tolerant species, it certainly reduces the values of the wood and it places management in a responsive mode. Harvest scheduling is set by insects, diseases, and wind, and not by silvicultural prescriptions and long-term plans. When a forest must be managed according to plans set entirely by damaging agents, good results cannot be expected.

There is a new interest in reviewing land use allocations for reserves and more restrictive categories to sustain biodiversity (WWF 2008). Existing land allocations

[16] The debate touched off by this publication can be followed at: http://www.cifor.cgiar.org/Publications/Polex/PolexDetail.htm?pid=790.

[17] We would observe that foresters and forest scientists invite such behavior whenever they indulge in vague, sweeping statements about how important forests are for watershed protection [see Eisenbies, et. al. 2007]. Also, see Grant, et. al. [2008]: "Effects of forest harvest on extreme flows cannot be detected using current technologies and data record lengths, but hydrologic theory suggests that such effects are likely to be small. … The magnitude of effects of forest harvest on peak flows in the Pacific Northwest, as represented by the data reported here, are relatively minor in comparison to other anthropogenic changes to streams and watersheds. The impact of forest harvest in the Pacific Northwest on peak flows is substantially less than that of dams, urbanization, and other direct modification of channels". (p. iii).

are based on past history. Such decisions were made at times when biodiversity knowledge was limited, and when the trade-offs between ecological and economic values were quite different than today. Indeed, there are likely to be good candidates fore reserves, based on present knowledge, that are not yet included in the system. Re-examining allocations to reserves could materially change the operable forest base in the Carpathians. At the same time, if planted stands of softwoods are simply allocated to reserves, an opportunity to accelerate the development of mixtures would be foregone for a long time.

Previous observers have noted that the former Group I/Group II system was unsound. It was all too easy for the Center to pacify some complaining lobbying group by casually tossing more land into Group I. This resulted in ever larger areas moving into Group I. In the Carpathians, the share in Group I ranges from above 50 % in Zakarpatska to about one-third in Lvivska. But Group I is not really a preservation prescription, it is just a bad compromise between competing goals.[18]

Reserves and parks have increased, as they should – roughly a 50 % increase in Nature Reserve Fund acreage in SFC lands from 1988-2006 (Figs 11.4 and 11.5 in attachments) (Polyakova n.d., Anon. 2006, Popovich 2007). Decisions such as these, however, become a one-way ratchet; if each generation tosses aside more productive potential and management flexibility, there will be none left. Do the politicians suppose that they will then buy Ukraine's wood from Switzerland? The question of the "Illusion of Preservation" becomes relevant here (Ortloff 1999, Koch and Skovsgaarden 1999, Berlik, Kittredge, and Foster 2002, Oliver 2003).

11.4.2 Future Climate Change

The transition plan for the Carpathian forests needs to be viewed as an adaptive management strategy, one that builds on experience a decade at a time. It needs to begin by explicitly testing a range of management prescriptions at the outset as a hedge against climate change impacts. It is impossible to specify what changes in future climate regime must be anticipated, or even at what pace those changes may be experienced. Further, ecosystem and forest health and productivity effects may only become evident with long lags. Choices of species mixes suited to different soils or elevational belts will necessarily be tentative ones. They may be difficult to tease apart from decadal weather anomalies, effects of past management or land use practices, episodic pest outbreaks, or other factors. More complete documentation and analysis of past climate regime change in the Carpathians, as it may affect forests and water resources, would be most helpful.[19]

11.5 Concluding Remarks

We think enough has been said to show that the proposed transition to multi-aged management of mixed stands will be a highly *intensive* form of management. Pro-

[18] We have not been able to analyze whether the Amendments have changed this system or not.
[19] Lavnyy and Lassig [2007] for example, show a significant increase in mean January temperatures from 1945-2000, and they follow the incidence of large windstorms as well.

gress toward SFM in the Carpathians needs to be guided by an explicit philosophy of adaptive management, recognizing that several important transitions are under way at once:

- The economic transition, including marketization, which will affect timber values and markets and the local economy, as well as nontimber values of the forest;
- The silvicultural transition toward greater use of mixed stands and partial cutting regimes;
- The climate transition, which may easily upend all of our best-laid plans based on past ecological and yield relationships.

Managing through any single one of these transitions would be a daunting challenge. Ukraine now must deal with all of them simultaneously.

It is premature to assume that a mixed species Dauerwald regime will actually work – economically or silviculturally. Settling all the implementation details will require a lot of work. Ukraine's policymakers should not declare any one approach to be a uniform system for the whole forest. This would simply replace one inflexible dogma with another one. Profit from the existing spruce stands can help pay for the transition if managed well. We are not certain, though, whether the current management regime yields cash sufficient to pay its costs including road access. Much less can we say whether the proposed future regime can do so. If this is in doubt, the means to pay for costly hardwood plantings, continued reliance on long rotations, and for upgrading and extending roads is in question.

It has long been recognized that land use allocations need to be reviewed in light of all these factors. Most importantly, the (former) Group I concept banning felling of green trees needs to be abandoned. It is a major impediment to managing this important transition. It impedes measures needed to address a lopsided age class distribution.

It will not do to build these decisions on abstract concepts that sound good in press releases. All silvicultural tools will likely be needed. Some areas will not be economically available for active management for some time due to inadequate roads. Reliance on natural regeneration will require flexibility in final harvest ages and methods to develop and release new age classes effectively. This cannot be scheduled from the Centre according to rigid normatives. A cultural change is needed, built around a prescription development process that is much more ground-up in nature.

The transitions planned for stand composition and structure will bring environmental benefits over many decades. But other measures, including better control over roads, bridges, and skidding impacts on waterways, better provision for snags and coarse woody debris, and eliminating economically marginal practices that needlessly simplify stands, can be implemented now. These will yield environmental benefits immediately.

A vast and complex agenda for applied silvicultural, ecological, and management research is implied by the approach to SFM being undertaken in this region. Ukraine's forestry and scientific community possess the capabilities to address all of these issues technically and managerially. Whether the policy and institutional structures can respond remains to be seen. There is a fruitful agenda of issues here for deploying innovative methods of environmental economics.

We have ample motivation for improvement and change. We hope that ways will be found to conduct a thorough technical, managerial, socio-economic, and public debate about all of these questions and more, one at a time, and in a variety of regional and national groups. We all have so much to learn.

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Практична економіка менеджменту лісових екосистем на прикладі Українських Карпат

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Умови для росту лісів в Українських Карпатах змінились унаслідок понад столітніх змін у землекористуванні під впливом різних методів господарювання, забруднення повітря та природних процесів. Разючі зміни клімату у взаємодії із цими чинниками зумовлюють стресовий вплив на ліси.

На сьогодні увагу привертають насамперед смерекові насадження, які, зазнавши у минулому неприродної уніфікації, повсюдно відмирають, що потребує коригування встановленого віку для рубань головного користування у них. Водночас, актуальна парадигма менеджменту лісового господарства грунтується застосуванні методів "наближеного до природного лісівництва", метою якого є заміна смерекових монокультур на змішані насадження з участю смереки, бука і ялиці.

Щоб досягти успіху у запровадженні цієї парадигми, варто вирішити низку супутніх проблем. І це у час, коли національна економіка не готова до фінансування цих потреб. Тому фінансові можливості реалізації запропонованої парадигми стають критично вагомим чинником. Це ж можна сказати і про лісову економіку регіону, яка все ще перебуває у неналежному стані і, далекому від економічної сталості. Питання довготривалого збереження біорізноманіття і соціальних гарантій теж є предметом розгляду. Україна має достатній науковий потенціал і набутий практичний досвід для реалізації цієї ідеї.

Chapter 12

Forest Stand Dynamics and Close to Nature Forestry

Mykola V. Chernyavskyy[1]

Abstract Close to nature forestry is based on methods of forest management directed towards ensuring continuality of forest cover, biodiversity conservation, restoration and formation of natural unevenaged forest structure, and sustained yield of timber equal to annual growth increment. It is a multistage process which includes different measures spread over time and space, applied over both the near- and long-term (at least 50-60 years).

Primeval or primary forests, which have complex morphological structure and high stability and productivity, represent a reference condition or model for developing principles of close to nature forestry. This applies to beech (*Fagus sylvatica*), fir (*Abies alba*), and spruce (*Picea abies*) forests, which are the most widely-distributed forest types in the Carpathians.

To promote development of structurally and compositionally complex forest characteristics, close to nature silviculture employs a "re-formation" (or conversion) type of felling in the now dominant semi-natural stands formed by past intensive forest management. The re-formation process achieves phased transformation of single-species, even-aged forest stands into uneven-aged stand by means of gaps formation in places with advanced regeneration of mixed endemic species. This stimulates forest restoration processes through regeneration and release effects, increasing the vertical differentiation of the canopy (i.e. vertical complexity) in mixed-species, uneven-aged stands of natural regeneration origin. Maintaining existing unevenaged forest stands and conversion of single-species stands to unevenaged, mixed-species stands are viewed as key mechanisms for implementing close to nature forestry.

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Динаміка деревостанів і наближене до природи лісівництво

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12.1. Вступ

Одним із найважливіших завдань лісознавства та лісівництва є здійснення наукових досліджень і спостережень, спрямованих на вивчення та розроблення наукових основ охорони, збереження та відтворення природних біоценозів. Ліси Українських Карпат досить змінені внаслідок антропогенного втручання. Тому, крім заходів збереження природних екосистем і ландшафтів, важливим напрямком природоохоронної та лісогосподарської діяльності є відновлення (ренатуралізація) вторинних екосистем і їхніх компонентів.

Відтворення природних ресурсів є одним із десяти стратегічних принципів Панєвропейської стратегії збереження біотичного та ландшафтного різноманіття.

Зважаючи на те, що лісові екосистеми зазнали змін внаслідок багатовікового втручання людини, зокрема і на територіях природно-заповідного фонду, для них важливо вміло застосовувати систему господарювання, наближену до природного лісівництва.

Наближене до природи, або природоохоронне лісівництво, окремі принципи якого вперше обгрунтували класики лісівництва (Арнольд 1860, 1895; Gayer 1880; Морозов 1912) і надалі поглиблено розвинули інші відомі лісівники (Leibundgut 1958; Mayer, Ott 1991; Шютц 1999; Schuetz, 2001), має на меті створення стійких продуктивних лісостанів, близьких за параметрами до природного лісу. Такий тип лісогосподарської системи проф. П.С.Погребняк (1968) називав заповідно-природоохоронною і вважав, що головне користування тут грунтується на вибірковому принципі лісового господарства.

Проф. Г.Ф. Морозов у праці "О лесоводственных устоях" (1918) зазначав: "Лес наш должен проявлять во всех деталях акт приспособления всех внутренних сторон его жизни к внешним условиям. И если приемы хозяйства нашего будут отвечать природе леса, т.е. природе составляющих его единиц и их взаимных отношений, природе внутренней среды, создаваемой ими, и внешней географической среде, то наши насаждения, несмотря на вмешательства человека, будут сохранять необходимую и достаточную для неё устойчивость". Великий лісівник ще в ті часи вважав найкращим для природи і людини ведення лісівництва, наближеного до природи.

Наближене до природи лісівництво ґрунтується на розумінні лісу як екосистеми і є альтернативою суцільнолісосічному господарству. Стійкі, наближені до природних ліси можуть і мають бути багатофункціональними, тобто спрямованими на виконання багатьох функцій (Шютц 1999; Швіттер 2005; Чернявський, Швіттер, Ковалишин та ін. 2006).

Для цього застосовують вибіркові системи господарювання, які тепер отримали загальну назву – "різновікове лісівництво" у Швейцарії та Болгарії, "наближене до природи лісівництво" у Німеччині, Чехії, Словаччині, Польщі, "відповідне середовищу лісівництво" в Австрії, "неперервний лісовий покрив" у Великобританії й США та "наближене до природи лісівництво" і, як синонім, – "природоохоронне лісівництво" в Україні (Oliver, Larson 1996; Helliwell 1997; Mason, Kerr, Simpson 1999; Mason, Kerr, Pommerening et al.l. 2005; Чернявський, Швіттер, Ковалишин та ін. 2006).

Природоохоронне лісівництво провадять методами та способами, завдяки яким можливо що забезпечити формування і підтримання функціонування лісових екосистем.

Такий перехід до формування і вирощування лісів у довготерміновій перспективі здатний забезпечити сталість лісокористування в усіх регіонах держави, значно поліпшити якісний склад лісів, оптимізувати їхню вікову структуру. Це також дасть змогу домогтися поновлення деревостанів природним шляхом, підвищити стійкість і стабільність лісів та забезпечити їх реальну багатофункціональність роль.

Концепція класичного лісівництва реально може бути реалізована на практиці за відповідної системи господарювання, насамперед – вибіркової. В Українських Карпатах домінує суцільнолісосічна система господарювання, частка вибіркової – надто мала і становить у різних регіонах не більше декількох відсотків.

12.2. Мета роботи

Ліси Українських Карпат – переважно умовно одновікові, природне поновлення типоутворювальних порід у них недостатнє через переважно суцільнолісосічну систему господарювання, а тому опрацювання способів несуцільних рубок, а також природного насіннєвого поновлення та підтримання оптимальної вікової, породної і просторової структур змішаних деревостанів є вкрай актуальним. Головною метою роботи є визначення на типологічних засадах оптимальних параметрів деревостанів у динаміці залежно від їх стану, вікової, породної і просторової структур.

Головна мета довготривалого експерименту з рубок переформування як одного із дієвих засобів наближеного до природи лісівництва – запропонувати оптимальний режим переформування і параметри цільових (бажаних) насаджень під впливом різної інтенсивності рубок та динаміки деревостанів із з'ясуванням: інтенсивності вибірки, черговості і повторності заходів, напрямку і ходу сукцесійних процесів у деревостанах, зокрема природного поновлення.

12.3. Методика досліджень

Методологія наближеного до природи лісівництва охоплює передовсім моделювання природних процесів, а відтак – запровадження такої системи заходів, яка посилює стійкість деревостанів і їх багатофункціональність за мінімально доцільного втручання (Шютц 1999; Чернявський 2005; Швіттер 2005). Методичні засади досліджень структури і динаміки лісів грунтуються на типологічній основі (Воробъев 1967) та біометрії дерев з переліковою їх таксацією (Анучин 1982), вивченням процесів природного поновлення і розвитку деревостанів на популяційній основі. Для аналізу стану деревостанів використовували уніфіковані показники просторової організації фітоценозів (Уткин 1975). За віковою структурою деревостани поділяли на: абсолютно різновікові – з перепадом віку дерев у насадженні понад 120-160 років, різновікові – 100-120 років, умовно різновікові – 20-100, умовно одновікові – до 20 років (Смаглюк, Питикин, Маркив 1973). Вертикальну структуру намету деревостанів поділяли на: ступінчасту, вертикально-ступінчасту, горизонтальну.

Природне поновлення оцінено за наявністю придатних місць для появи підросту (сприятливі, відносно сприятливі, несприятливі умови) та за категорією успішності (добре, задовільне, недостатнє, незадовільне) на 25 площадках розміром 4 м^2 кожна.

Для оцінки реального стану кожного насадження здійснено його типологічний опис та оформлено облікову картку переформування. Оцінку стану лісової екосистеми та прогноз її розвитку здійснено за такими показниками: породний склад деревостану, його вікова, вертикальна і горизонтальна структури, остійність дерев, категорії стану дерев, природне поновлення, проекційне вкриття трав'яних видів, кількість відмерлих дерев.

За матеріалами лісовпорядкування визначено категорію захисності лісів. Для конкретного масиву лісу змодельовано ймовірні природні загрози (вітровали, буреломи, ерозія, заростання травами, лавини, зсуви тощо).

Для прогнозу розвитку екосистем і їх класифікації застосовували системний підхід (Буш, Иевинь 1984) за параметрами, запропонованими для цього швейцарськими лісівниками (Fregner, Wasser, Schwitter 2005), які ми уточнили (Чернявський, Швіттер, Ковалишин та ін. 2006). Фази розвитку пралісів встановлено за Г.Ляйбундгутом (1958).

На одногектарних стаціонарних пробних площах закартовано всі дерева, виміряно їхні діаметри і висоти, протяжність і ширину крони, встановлено форми крони, оцінено санітарний стан, визначено кількість підросту і його стан. Вивчено грунтово-гідрологічні умови шляхом закладання грунтових профілів і здійснено типологічний опис ділянки.

Параметри цільових деревостанів розроблено на підставі вивчення буково-ялицево-смерекових пралісів, а також за результатами експериментів з рубок переформування на 32 пробних площах для переважного за площею типу лісу у Карпатах – вологої буково-ялицевої сусмеречини.

12.4. Об'єкти досліджень

Дослідження здійснено в Українських Карпатах у пралісах (4 ділянки), природних і штучних деревостанах (7 ділянок) за участю бука (*Fagus sylvatica* L.), ялиці (*Abies alba* Mill.) і смереки (*Picea abies* L.) на 11 стаціонарних пробних площах.

Порівняно невелика кількість праць, у яких описано формування і розвиток змішаних мало порушених лісів Карпат (Гниденко 1967; Смаглюк, Питикин, Маркив 1973; Чернявский 1975, 1977) і потребу вивчення таких деревостанів для обґрунтування складу та структури майбутніх лісів, визначили напрям досліджень, виконаних навесні – восени 1974-1977 рр. У Горганах і Чорногорі закладено 4 пробні площі за апробованою в лісовій таксації методикою. Вікову структуру визначали за віком вітровальних модельних дерев, які становлять основні лісотвірні породи і покоління, а також пнів на суміжних з дослідними деревостанами зрубах.

Праліси вирізняються складною морфологічною будовою. Поділяючи думку проф. М.М. Орлова (цит. за Смаглюк, Питикин, Маркив 1973) про їхню органічну цілісність, ми умовно розділили такі деревостани на покоління для оцінки їх морфологічної структури (табл. 12.1-12.3).

Буково-ялицево-смерекові праліси займають висотні ступені від 1000 до 1150 м н.р.м. і розвинулися на бурих гірсько-лісових суглинкових грунтах, які формуються переважно на елювіо-делювії кислого карпатського флішу і глинистих сланцях. У надгрунтовому покриви переважають мезотрофи і мегатрофи. У підліску, який ніколи не створює суцільного ярусу, постійні жимолость чорна, малина і горобина, часто трапляються спірея в'язолиста, верба козяча і вовче лико.

Деревостани на пробних площах 5, 14, 31 та 10 дещо різні за складом, складні за вертикальною, віковою і просторовою структурами. У першому ярусі домінують смерека і ялиця, у другому – бук. У пралісах чітко вичленовуються три-чотири покоління дерев, це позначається на будові деревостанів. Крива розподілу дерев за ступенями товщини має "дже" – подібну форму (рис. 12.1).

Другу серію із сімох пробних площ закладено 2003-2007 рр. у типових буково-ялицево-смерекових деревостанах різного походження у Закарпатті під час виконання швейцарсько-українського проекту розвитку лісового господарства FORZA.

Деревостани, які є природно-штучними (пробні площі 4МН-06, 23Р-06, 3БР-06, 12Р-06, 13Р-06, 14Р-06, 5Р-06), – типові насадження, сформовані активними господарськими заходами (рубки догляду та вибіркові санітарні рубки). Вони, зазвичай, двоярусні, вікова структура їх досить проста (табл. 12.4).

12.5. Результати досліджень

Наближене до природи, або класичне лісівництво базується на таких способах лісокористування, за яких безперервно існує лісовий покрив, зберігається біотичне різноманіття, відтворюється і формується структура природних різновікових лісів, постійно підтримується стійкість деревостанів, деревину вирубають в обсязі річного приросту. За такої системи господарювання характерною є постійна стабільність водоохоронних, захисних, кліматорегулювальних, санітарно-гігієнічних, оздоровчих та інших корисних властивостей лісів, а заготівлю деревини здійснюють із застосуванням природоощадних технологій (Чернявський, Швіттер, Ковалишин та ін. 2006).

Таблиця 12.1 Лісівничо-таксаційна характеристика буково-ялицево-смерекових пралісів

Пробна площа	*Місцезнаходження ділянки*	*Верхній намет*									*Деревостан загалом*		
		склад деревостану	перепади віку, років	число стовбурів, шт./га	середня висота, м			середній діаметр, см			сума площ перетину, $м^2$/га	запас стовбурової деревини $м^3$/га	поточний річний приріст, $м^3$/га
					См	Яц	Бк	См	Яц	Бк			
5	Довжинецьке л-во Надвірнянського ДЛГ. 1150 м н.р.м.	5См3Яц2Бк од. Яв	53-214	360	33,1	32,0	29,6	42,7	49,4	48,5	61,9	735	9,0
14	Річанське л-во Надвірнянський ДЛГ. 1110 м н.р.м	3См5Яц2Бк од. Яв	100-280	351	31,6	32,2	29,4	37,8	55,4	34,2	57,5	720	11,1
31	Щаульське л-во Рахівського ДЛГ. 1000 м н.р.м	6См2Яц2Бк од. Яв	79-219	377	34,0	31,1	32,0	42,3	48,1	31,0	50,0	861	13,0
10	Довжинецьке л-во Надвірнянського ДЛГ. 1140 м н.р.м	5См2Яц3Бк од. Яв	70-210	420	33,2	31,6	28,8	41,6	42,9	35,7	58,8	638	9,3

Таблиця 12.2 Склад деревостанів за ярусами, запас і кількість стовбурів за елементами лісу у пралісах

Пробна площа	*Деревостани*									*Підріст*	
	I ярус			II ярус			III ярус				
	склад	запас, $м^3$/га	кількість дерев, шт./га	склад	запас, $м^3$/га	кількість дерев, шт.\га	склад	запас, $м^3$/га	кількість дерев, шт./га	склад	густота, тис. екз./га
5	5См3Яц2Бк од. Яв	697	360	6См3Яц1Бк	30	90	2См4Яц4Бк	8	22	2См4Яц4Бк+Яв	8,1
14	3См5Яц2Бк од. Яв	640	351	3См2Яц5Бк	37	160	5См2Яц3Бк	42	563	4См2Яц3Бк1Яв	10,2
31	6См2Яц2Бк об Яв	826	377	6См4Бк од. Яв	23	62	4Яц6Бк+См	12	295	1См4Яц3Бк2Яв	18,4
10	5См2Яц3Бк од. Яв	589	420	4См4Яц2Бк	30	128	3См5Яц2Бк	18	394	1См4Яц3Бк2Яв	10,6

Таблиця 12.3 Відпад дерев у буково-ялицево-смерекових пралісах

Пробна площа	*Відпад на всі яруси, шт./га*	*I ярус, відпаду %*				*II ярус, відпаду %*				*III ярус, відпад %*			
		відношення відпаду до числа дерев, що ростуть	смерека	ялиця	бук	відношення відпаду до числа дерев що ростуть	смерека	ялиця	бук	відношення відпаду до числа дерев що ростуть	смерека	ялиця	бук
5	39	8,3	6,4	4,8	0,8	44,4	11,2	4,8	8,8	81,8	54,4	16,0	1,6
14	167	11,4	8,4	13,2	2,4	19,4	13,2	1,8	3,6	17,1	47,9	3,6	5,9
31	139	22,8	10,8	46,8	4,3	4,8	2,1	-	-	16,9	-	15,1	20,9
10	310	13,3	16,2	1,3	0,6	45,3	13,5	3,9	1,3	49,7	43,2	14,8	5,2

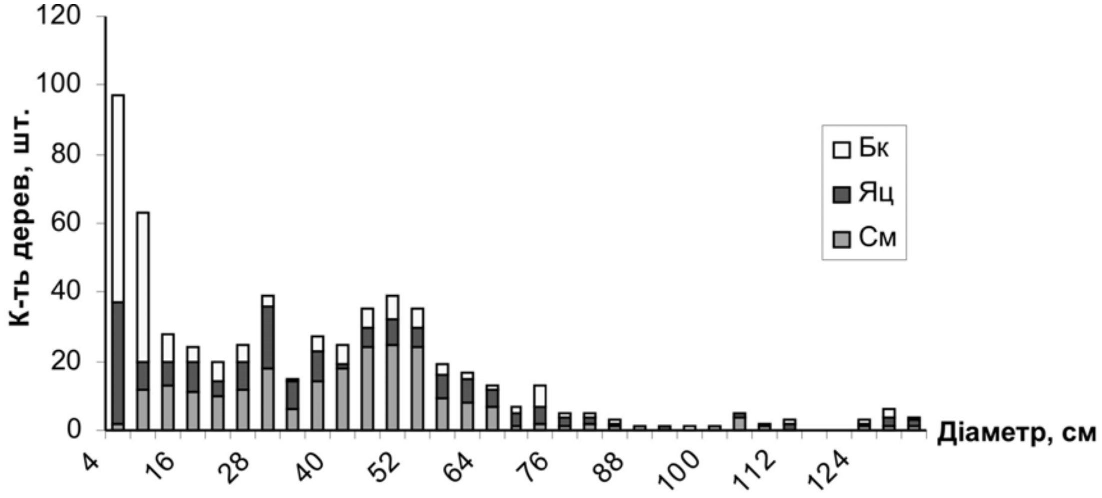

Рис.12.1 Розподіл дерев за ступенями товщини у буково-ялицево-смерекових пралісах (пр.пл. 5)

Таблиця 12.4 Лісівничо-таксаційна характеристика природно-штучних буково-ялицево-смерекових деревостанів

Пробна площа	*Верхній намет деревостану*			*Деревостан загалом*					
	вік, років	висота смереки, м	діаметр смереки, м	Склад	Покоління і вікова структура, років	Запас, $м^3$/га	К-сть вирубуваних дерев, шт./га	Вирубуваний запас, $м^3$/га	% вибірки
4МН-06	100-120	33,0	37,1	10См+Бк	См - 10-80, 100-120 рр.; Бк – 40-80 рр.	474	14	31	6,5
23Р-06	90-110	35,0	61,9	8См2Яц+Бк+Яв	См і Яц - 80-110 і 3-15 рр.; Бк і Яв- 1-20 рр.	440	16	19	4,3
3БР-06	140-160	32,4	40,8	9См1Бк	См – 1-40, 120-160 рр.; Бк – 120-160 рр.	520	24	16	3,1
12Р-06	80-100	36,5	54,9	10См+Бк+Яв+Яц	См і Яц - 3-15 і 80-100 рр., Бк, Яв - 1-20 рр.	217	4	12	5,5
13Р-06	80-90	31,7	38,7	9См1Яц+Бк од.Яв	См і Яц - 3-15 і 80-100 рр., Бк, Яв - 1-20 рр.	577	17	38	6,8
14Р-06	90-100	32,5	36,5	10См+Яц+Бк+Яв	См і Яц - 3-15 і 80-100 рр., Яв - 1-20 рр.	304	11	24	7,9
5Р-06	100-110	24,0	67,0	10Бк+См од.Яц Яв	Бк 30-40, 70-80, 90-120 рр., Яц - 20-30 і 60-80 рр., Яв - до 40, См- до 20 р.	214	3	5	2

Таблиця 12.5 Параметри сучасних буково-ялицево-смерекових деревостанів до і після переформування

№ ділянки, лісництво, квартал/ділянка, в н.р.м, м, площа виділу, га	*Теперішній деревостан*			*Цільовий деревостан*	
	склад насадження, переважний вік, років	Покоління, вікова структура, вік	Природне поновлення, склад, тис.шт./га	Цільовий склад деревостану*	стратегія переформування на першому етапі
4МН-06, Мокрянське, 7/15, 900, 22	10См+Бк, 100-120	См - 10-80, 100-120 р.; Бк - 40-80 рр.	7См1Бк 1Яв1Яц; 6,1	5См3Яц 2Бк+ Яв	Сформувати двоє вікон 15×15м та 20×15м для появи підросту См, Яц, Бк, Яв. Вибрати частину сухостійних дерев. За відсутності підросту протягом 2-3 років треба буде спушити ґрунт. Надалі – розширювати вікна і здійснювати вибірку одиноких дерев.
23Р-06, Білотисянське, 6/1,8, 750, 5,6	8См2Яц+Бк+Яв, 90-110	См і Яц – 80-110 рр. і 3-15 рр.; Бк і Яв – 1-20 рр.	7Яц2См 1Яв+Бк; 11,2	5-6См2Яц 2Бк+(1)Яв, Яс,Ілг	Розширити існуючі прогалини в наметі лісу для активізаціїї процесів поновлення лісу. Сформувати нові двоє вікон 20×15м. Вздовж узлісся і на крутішій частині схилу завжди підтримувати більшу густоту деревостану і поступово, за рахунок процесів природного відпаду і поновлення формувати різновіковий ліс.
3БР-06, Турбатське, 23/13, 1100, 6,9	9См1Бк, 140-160	См - 1-40, 120-160 рр.; Бк – 120-160 рр.	10См+Бк; 3,2	5См3Бк 2Яц+Яв	Сформувати двоє вікон 15×15м та 20×15м для появи підросту См, Яц, Бк, Яв. Розширити прогалини в лісовому наметі для сприяння природному поновленню.
12Р-06, Щаульське, 19/2 700, 7,2	10См+Бк+Яв+Яц, 80-100	См і Яц – 3-15 і 80-100 рр., Бк, Яв – 1-20 рр.	6См1Яц 1Яв2Бк; 1,9	5-6См2Яц 2Бк+(1)Яв, Яс,Ілг	Сформувати двоє вікон 30×15м та 20×15м для появи підросту См, Яц, Бк, Яв. На крутішій частині схилу завжді підтримувати більшу густоту деревостану і поступово, за рахунок процесів природного відпаду і поновлення, формувати різновіковий ліс.
13Р-06, Щаульське, 20/20, 1200, 12	9См1Яц+Бк од.Яв, 80-90	См і Яц – 3-15 і 80-90 рр., Бк, Яв – 1-20 рр.	5См5Яц; 0,6	5-6См2Яц 2Бк+Яв,Яс	Розширювати під час рубок двоє природних "вікон" в наметі лісу для сприяння появі природного поновлення.
14Р-06, Щаульське, 22/13, 950, 26	10См+Яц+Бк+Яв, 90-100	См і Яц – 3-15 і 80-100 рр., Яв – 1-20 рр.	4См5Яц 1Бк1Яв; 3,1	5-6См2Яц 2Бк+(1)Яв, Яс	Вибірка дерев окремими біогрупами (5×6 м) внаслідок того, що ділянка розташована на крутосхилі. Надалі – розширювати вікна.
5Р-06, Устєріцьке, 1/24, 775, 15	10Бк+См од.Яц Яв, 100-110	Бк 30-40, 70-80, 90-120 рр., Яц - 20-30 і 60-80 рр., Яв - до 40, См- до 20 р.	8Бк1Яв1Яц +См,Яс,Ілг; 11,4	5Бк2Яц2 См1Яв+Ілг +Яс	Вибірка дерев у 5 біогрупах і створення вікна розміром 5×10м. Вздовж потічка і на крутішій частині схилу не вирубувати дерев під час переформування.

Примітка. * Для типу лісу - діапазон відхилення у межах ±10% від пропонованого

Еталоном деревостанів, які відповідають принципам наближеного до природи лісівництва, є праліси. Буково-ялицево-смерекові праліси Українських Карпат, які формувались впродовж століть, є збалансованими динамічними саморегульованими екосистемами з оптимальною структурою і функціонуванням усіх складових компонентів. Вивчення таких деревостанів, порівняно зі штучно створеними, є основою обгрунтування оптимального варіанта використання багатогранних функцій лісу.

Інтенсивна експлутація карпатських гірських лісів, яка триває ще з X століття (Смаглюк, Питикин, Маркив 1973) і посилилася за останні три століття, супроводжувалась дуже істотними їх змінами, тому тепер тут майже не можливо знайти ділянки, яка не зазнавала тією чи іншою мірою впливу антропогенних чинників. Лише в глухих урочищах і значно віддалених від доріг місцях збереглись невеликі плями і пасма буково-ялицево-смерекових лісів.

Питання продуктивності різновікових деревостанів вивчені вкрай недостатньо, а літературні дані дуже суперечливі. Одні автори вважають, що вищі запаси притамані різновіковим деревостанам складної структури (Смаглюк, Питикин, Маркив 1973; Чернявский 1975, 1977), інші спостерігають підвищення продуктивності внаслідок спрощення структури деревостанів (Буш, Иевинь 1984). Наші дослідження показали, що запаси стовбурової деревини буково-ялицево-смерекових карпатських пралісів досить великі, хоча змінюються у значних межах: від 638 до 861 $м^3$/га. Найпостійніші запаси характерні для складніших за структурою деревостанів. Основну масу дерев таких деревостанів (59,2-86,8 %) сконцентровано у верхньому ярусі. Крони бука наближаються за формою крон до хвойних. Інтенсивність нагромадження біомаси в таких деревостанах найвища.

Дослідження підтвердили відому закономірність: продуктивність змішаних деревостанів збільшується з перевагою у складі хвойних. На верхній ярус припадає від 89,9 до 98,4 % стовбурової деревини, хоча кількість дерев (табл. 4) становить 32,7 – 89,0 % (Чернявский 1975, 1977).

Зміна віку порід і співвідношенння різних за віком дерев у деревостані більшою мірою, ніж будь-який інший чинник зумовлюють регуляцію взаємовідносин і взаємовпливу смереки, ялиці і бука, а, відповідно – і будову, стійкість, продуктивність, динаміку складу і сукцесії в цих лісах. Вікову будову зумовлює історія формування деревостанів і тому вікова структура конкретного деревостану відображає певний статичний етап в неперервному циклі розвитку цього лісу (Leibundgut 1958; Чернявский 1977; Hellivell 1997). Зважаючи на безперервність розвитку деревної рослинності, всі ліси, як чисті, так і змішані, мають бути різновіковими. Одновікові, умовно одновікові і умовно різновікові деревостани, які виникли внаслідок сильнодіючих лісотвірних чинників, можна розглядати як такі, що перебувають на ранній стадії розвитку, а різновікові і абсолютно різновікові – на більш пізній.

Аналіз складу деревостану за ярусами (табл. 12.2) у зіставленні з особливостями росту модельних дерев, тривалістю періоду пригнічення окремих порід, кількістю природного поновлення і даними природного відпаду (табл. 12.3) пояснюють деякі закономірності формування різних за структурою деревостанів. В абсолютно різновікових (пр. пл. 5, 14) і різновікових деревостанах (пр. пл. 31, 10) більш або менш рівномірний ріст притаманний деревам, які виросли без пригнічення, а середня тривалість пригнічення і відсоток пригнічених дерев у таких деревостанах значніший, ніж у менш різновікових. Як вже зазначено, в другому і третьому ярусах сконцентрована найбільша кількість дерев. Позиції смереки в деяких випадках (проба 31, 10) послаблюються, а в підрості вона взагалі рідко переважає (такий виняток – проба 14). Найбільшу кількість сухостою також спостережено для смереки, значно менше – ялиці і ще менше – бука. Висновки багатьох дослідників про зміну смереки буком, пов'язані з загальним потеплішанням клімату і збільшенням вологості, наші дослідження все ж не підтверджують, оскільки подальше поновлення смереки частіше запобігає таким сукцесіям.

Зі зменшенням різновіковості морфологічна структура деревостанів спрощується. У природних абсолютно різновікових і різновікових деревостанах структура намету ступінчаста (пр.пл. 5, 10, 14, 31), в умовно різновікових – вертикально-ступінчаста (пр. пл. 4МН-06, 23Р-06, 3БР-06, 5Р-06), в умовно одновікових – горизонтальна (пр.пл. 12Р-06, 13Р-06, 14Р-06). Варіювання висот у природних деревостанах порівняно з перетвореними господарською діяльністю, в декілька разів більше. Вікова структура деревостанів до певної міри позначається на будові деревостанів за діаметром. Ідеальними з погляду постійності і неперервності користування є абсолютно різновікові деревостани, в яких відношенння між числом дерев у суміжних ступенях товщини наближається до сталої величини. Ряд розподілу дерев, порівняно з нормальним, розтягнений у бік товстомірних ступенів, а крива розподілу має "дже" – подібну форму (рис. 12.1). Зі зменшенням різновіковості ряд розподілу наближається до нормального, хоча і трохи зміщеного вліво (рис. 12.2).

12.6. Опис результатів досліджень

Одновікові деревостани, як результат попередніх суцільнолісосічних систем господарювання, є характерними для всіх лісів Українських Карпат. Тому перехід від вирощування одновікових чистих за складом деревостанів до формування різновікових змішаних є важливим чинником наближеного до природи ведення лісового господарства. Його треба здійснювати поетапно залежно від типу лісу, складу і структури конкретного лісостану. Це – багатоступеневий поступовий процес, який потребує здійснення різних, зміщених у часі і просторі, лісогосподарських заходів не тільки на найближчий період, а і на перспективу (не менш, ніж на 50-60 років).

Методологічні аспекти концепції рубок переформування ґрунтуються на: вимогах та критеріях оптимальності майбутніх деревостанів; прогнозуванні й аналізі сучасного стану деревостану і прогнозу динаміки його розвитку; плануванні та здійсненні диференційованих лісівничих заходів; організації й технології лісозаготівельних заходів залежно від машин і механізмів та мережі лісових доріг; періодичного контролю успішності здійснених лісівничих заходів. У майбутньому вони повинні бути розширені щодо всього типологічного різноманіття лісів і типів деревостанів, а також уточнені стосовно параметрів цільових лісостанів.

Механізмами реалізації концепції є планомірний і поступовий перехід до з'ясування обсягів вибіркового господарства, призначення лісовпорядкуванням відповідних заходів, а також перетворення одновікових однопородних деревостанів у різновікові змішані. Рубки переформування є першим етапом переходу до різновікового лісівництва у ослаблих або не відповідних типові лісу деревостанах (пр. пл. 4МН-06, 23Р-06, 3БР-06, 5Р-06,12Р-06, 13Р-06, 14Р-06). Здійснюють їх різними способами і методами, передовсім застосуванням індивідуального прогнозу щодо подальшого росту окремих дерев чи біогрупи в деревостані, сприянням природному поновленню та здійсненням постійного контролю за ходом відновних процесів і ростом деревостану. Їх здійснюють тоді, коли інші лісівничі системи не дають належного ефекту (Чернявський 2005).

Цільовий породний склад встановлено за еталонами деревостанів (пралісами), матеріалами грунтово-типологічного картування, результатами наукових розробок (Посібник.., 1980), реальний – на підставі переліку дерев і відповідних замірів на пробній площі. Під час прогнозування і оцінювання вікової структури насамперед визначено максимально можливий доцільний вік вирощування кожної породи залежно від мети господарювання (захисні ліси – пр.пл. 3БР-06 та 12Р-06, решта – експлуатаційні) і вік покоління дерев за породами. Горизонтальну структуру встановлено за двома показниками: зімкненістю крон і розміром прогалин, які визначають у лісостані окомірно. Встановлено, що ступінчаста структура властива деревостану на пр. пл. 5Р-06, горизонтальна – на пр. пл. 3БР-06 та вертикально-ступінчаста з різним ступенем прояву – на всіх інших.

На підставі даних облікової картки вказують цільові, граничні чи мінімальні значення параметрів бажаного і теперішнього деревостану. Цільові параметри (склад, вікова, горизонтальна і вертикальна структура, успішність природного поновлення порід переважно насіннєвим шляхом) визначають головним чином мету і стратегію вирощування деревостану. Граничні параметри (зімкненість крон, розмір прогалин, остійність дерев, стійкість до природних загроз) визначають можливість успішного вирощування деревостану в конкретних умовах і є основними під час вибору тактики лісовирощування. Мінімальні параметри (розвиток крони, стрункість, наявність придатних місць для поновлення, проекційне вкриття травами, кількість мертвих дерев, приріст, запас, товарна структура ростучих дерев) є допоміжними під час вибору тактики лісовирощування, тобто сукупно з цільовими і граничними параметрами їх враховують під час призначення заходів на конкретній ділянці лісу.

Для лісостанів, які підлягають переформуванню, на підставі досліджень та за участі в їх оцінюванні фахівців ДП "Рахівське ЛДГ", ДП "Хустське ЛДГ", ДП "Мокрянське ЛГ" та ДП "Брустурянське ЛМГ" для вологої буково-ялицевої сусмеречини визначено оптимальний склад цільових деревостанів у діапазоні від 5См3Яц2Бк+Яв, 5-6См2Яц2Бк+(1)Яв, Яс, Ілг до 5Бк2Яц2См1Яв +Іл+Яс. Такий широкий діапазон складу деревостанів зумовлений їх теперішнім станом і будовою. Він, поза сумнівом, враховує також реальні можливості здійснення заходу з найменшим втручанням у перебіг природних процесів. Не завжди цільовий склад деревостану точно відповідає такому у пралісах, адже з одного боку, склади деревостанів у пралісах у межах типу лісу не всі абсолютно однакові, а з іншого боку – відтворити праліси практично неможливо. Природне поновлення загалом майже у всіх лісостанах сприятиме відтворенню близьких до природних деревостанів, бо у його піднаметовому складі є всі головні типотвірні та супутні породи (виняток – поновлення на пр. пл. 3БР-06 та 13Р-06).

У межах одного типу лісу корінними (близькими до цільових з позицій наближеного до природи лісівництва) можуть бути як один, так і декілька типів деревостанів. Корінними вважають деревостани, які утворюють клімаксові угруповання.

Для планування лісогосподарських заходів, спрямованих на підтримку якісної структури, максимально можливої продуктивності і стабільної біотичної різноманітності, потрібно знати характеристики корінних і змінених природними чинниками та людським втручанням деревостанів. Їх доцільно поділити на такі типи: 1 – близькі до цільового: ±8-10 одиниць типотвірної (-них) породи (порід) за складом; наявні всі інші корінні породи; 2 – перехідні: ±6-7 одиниць типотвірної (-них) породи (порід) за складом, але наявні ±2-4 одиниці інших корінних порід; 3 – віддалені від природних: ±3-5 одиниць типотвірної (-них) породи (порід) за складом, але наявні ±1-2 одиниці інших корінних порід; 4 – похідні: ±1-2 одиниці типотвірної (-них) породи (порід) за складом, але наявні ±1-2 одиниці інших корінних порід, або немає типотвірних порід. До похідних типів деревостанів належать передовсім насадження штучного походження. Деревостани, в складі яких присутні інтродуценти (модрина, сосна, горіх, дуб червоний та ін.), незалежно від їхньої частки у складі деревостану, належать до похідних. Насадження на сімох ділянках природно-штучного походження (табл. 12.4), переважно близькі до цільового деревостану.

Під час переформування насаджень на сімох ділянках лісів, які зазнали відчутного впливу господарських заходів, застосовували різні прийоми. Узагальнено стратегію рубок переформування на них можна звести до таких прийомів:

1. Перетворення майже чистих одновікових насаджень у змішані різновікові за допомогою формування вікон у місцях, де є підріст всіх порід (пр.пл. 4МН-06). Сформовані вікна у наметі деревостану стосовно невеликого розміру потрібно на майбутнє розширити, а також здійснювати вибірку одиноких дерев для сприяння появі підросту См, Яц, Бк, Яв. За відсутності достатньої кількості підросту протягом 2-3 років потрібно буде здійснити спушення ґрунту у врожайні роки, щоб домогтися появи сходів. Можливо доведеться приземлити частину сухостійних дерев, особливо у місцях скупчення сходів;
2. Підсилення лісовідновних процесів за рахунок достатнього попереднього поновлення (пр. пл. 23Р-06 та 14Р-06) у насадженнях, де вже різ-

новікова різнопородна структура частково сформована. Для цього доцільно розширити існуючі прогалини в nameті лісу для активізації процесів поновлення. Сформувавши нові вікна розміром 300-400м^2, поступово їх розштрювати та доповнювати новими прогалинами. Вздовж узлісся і на крутішій частині схилу завжди підтримувати більшу густоту деревостану і поступово, за рахунок процесів природного відпаду і відновлення формувати різновіковий ліс;

3. Перетворення майже одновікових насаджень у змішані різновікові за допомогою утворення вікон у місцях, де є, або може потенційно з'явитися підріст всіх порід (пр. пл. 3БР-06, 13Р-06 14Р-06). Сформувавши середні за розміром (близько 300 м^2) двоє-троє вікон, поступово їх розширювати, а також утворювати нові. У разі недостатності підросту і відсутності окремих видів у ньому здійснювати спушування грунту у прогалинах намету, а також, за потреби, підсіяти окремі види;
4. Перетворення поростевих низькостовбурних різновікових насаджень у змішані переважно насіннєві високостовбурні (пр.пл. 5Р-06). Внаслідок високої розімкненості намету і низької повноти деревостану здійснювати вибірку окремих дерев і створювати, за потреби, одне-двоє вікон. Вздовж потічка і на крутішій частині схилу не вирубувати дерев під час переформування, створюючи вітроударну стінку;

Під час здійснення рубок переформування на першому етапі, зазвичай, зріджують деревостан за рахунок дерев центральних ступенів товщини і окремих малих дерев, а великі дерева залишають (рис. 12.2). Залишають обов'язково дуплисті дерева і дерева, на яких поселяються птахи.

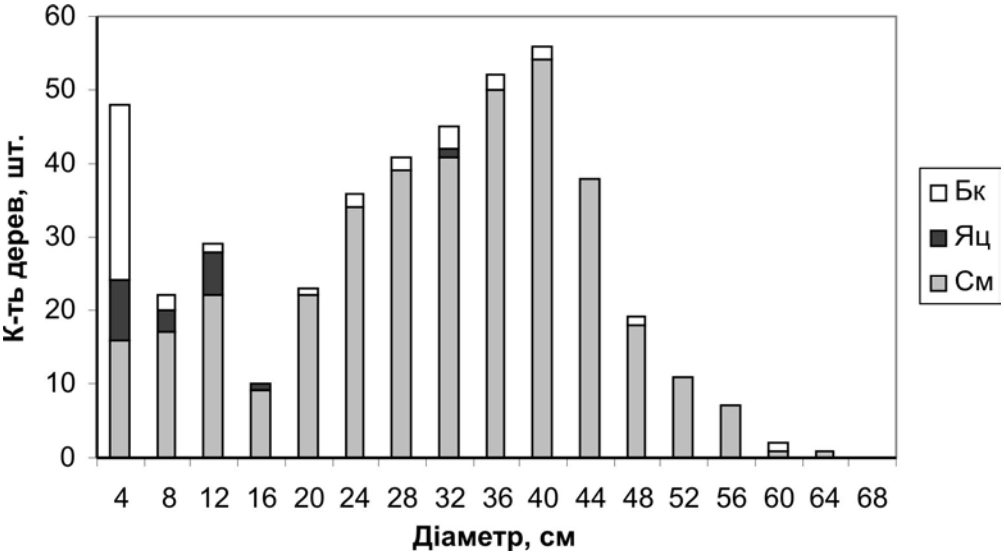

Рис. 12.2 Розподіл дерев за діаметром у господарсько-освоєних буково-ялицево-смерекових лісостанах

Важливе, а то й вирішальне, значення має вітростійкість насаджень. Вона посилена за рахунок подальших прийомів. Одним із структурних варіантів стійкості насаджень, як свідчать найновіші дослідження, є співвідношення протяжності крони до висоти дерева. Для оцінки остійності (проти вітровалів, лавин тощо) дерев застосовують також співвідношення висоти дерева до його діаметра (H/D). Цю оцінку (особливо важливу для гірських умов) здійснюють візуально за шкалою: стійкі дерева – ширина крони > 2/3 висоти, співвідношення H/D < 80, відносно стійкі: ширина крони 1/3 – 2/3 висоти, H/D= 80–100, відносно нестійкі: ширина крони > 1/3 висоти, H/D > 100. Ці показники оцінювали візуально для кожної породи і найстійкіші проти дії вітру дерева обов'язково залишали на вітроударних місцях. Під час зрідження куртин враховано їх розміщення для того, щоб запобігти виникненню вітронебезпечних прогалин. Давно відомо, що стійкість дерев і деревостанів зумовлені генетико-еволюційним процесом і тому під час відбору дерев це було також частково враховано.

У своєму розвитку деревостани проходять певні фази і стадії розвитку, які відповідно класифікують.

Виділення стадій і фаз розвитку різних за походженням, а значить і різних за розвитком деревостанів, не має абсолютно однозначного трактування. Діапазон тривалості фаз розвитку природного лісу і штучно створених деревостанів неоднаковий. У пралісах і природних лісах період від оптимальної фази до розпаду більш розтягнений у часі, ніж у лісових культурах (Смаглюк, Питикин, Маркив 1973; Чернявский 1975). Фактично, у лісових культурах нема фази старіння і розпаду, бо для суцільнолісосічної системи ведення господарства дерева вирубують до досягнення ними віку природної стиглості. Отож, виділення фаз розвитку змішаних буково-ялицево-смерекових лісів штучного походження і їх тривалість у часі є умовними.

Інструментами реалізації формування та підтримання різновікових лісів і переформування деревостанів є комплекс лісогосподарських заходів на підставі оцінки конкретного деревостану. Під час планування лісівничих заходів потрібно передбачити використання і підсилення позитивних тенденцій розвитку деревостану з лісівничого і природоохоронного погляду. Технологічні процеси і системи машин та розташування шляхів первинного транспортування зрубаної деревини мають забезпечувати мінімально допустимий негативний вплив на лісову екосистему.

Неперервний лісовий покрив означає застосування таких лісівничих систем, за яких намет деревостану підтримується постійно на одному або більше рівнях (ярусах) без суцільної рубки дерев на площі понад 0,25 га. Відмінний елемент "неперервного лісового покриву" – відсутність суцільного вирубування дерев на площі, значно більшій, ніж подвійна висота дерев у деревостані. Ці підходи, типові, наприклад, для британського лісівництва, ми застосували під час призначення рубок переформування на всіх сімох пробних ділянках. Вибірка дерев за масою становила від 2 % до 7,9 %, а за площею, з урахуванням уже існуючих прогалин, не більше ніж 20 %. Це дає резерв для здійснення на другому етапі переформування більш інтенсивних рубок і заготівлі якіснішої деревини.

Постійний лісовий покрив відповідає принципам багатофункціонального лісового господарства. При цьому заготівля деревини не є засобом скорочення чи зменшення користування лісом, а є лише тим принципом, за якого її використовують гнучкіше (передовсім щодо заготовлюваних сортиментів) у обсязі річного приросту.[2]

[2] На прохання автора замість віддієслівного іменника "рубання" у тексті залишено "рубка".

12.7. Висновки

1. Наближене до природи ведення лісового господарства ґрунтується на розумінні лісу як екосистеми і є альтернативою суцільнолісосічній системі. Стійкі, наближені до природних ліси можуть і мають бути багатофункціональними, тобто спрямованими на виконання багатьох функцій.
2. Наближене до природи лісівництво, або природоохоронне лісівництво базується на таких способах лісокористування, за яких незмінно функціонує лісовий покрив, зберігається біотичне різноманіття, відтворюється і формується структура природних різновікових лісів, постійно підтримується стійкість деревостанів, деревину вирубують в обсязі річного приросту. За такої системи господарювання характерною є постійна стабільність водоохоронних, захисних, кліматорегулювальних, санітарно-гігієнічних, оздоровчих та інших корисних властивостей лісів, а заготівлю деревини здійснюють із застосуванням природоощадних технологій.
3. Еталоном найпоширеніших в Українських Карпатах буково – ялицево – смерекових деревостанів, які відповідають принципам наближеного до природи лісівництва, є праліси (пробні площі 5, 14, 31, 10). Вони відрізняються складною морфологічною будовою: мають три чітко виражені яруси (покоління), характеризуються вертикально-ступінчастою структурою, вирізняються високою стійкістю і продуктивністю (запас стовбурової деревини в оптимальній фазі розвитку – 638-861 $м^3$/га). Тривалість фаз розвитку сягає, як мінімум, 280 років.
4. Буково – ялицево – смерекові деревостани, які є природно-штучними (пробні площі 4МН-06, 23Р-06, 3БР-06, 12Р-06, 13Р-06, 14Р-06, 5Р-06) – типові насадження, які сформовані активними господарськими заходами (рубки догляду та вибіркові санітарні рубки). Вони, зазвичай, двоярусні, вікова структура їх відносно проста. Для підвищення їхньої стійкості запроектовано рубки переформування, як складник способів наближеного до природи ведення лісового господарства.
5. Методологічні аспекти концепції рубок переформування ґрунтуються на: вимогах та критеріях оптимальності майбутніх деревостанів; передбаченні й аналізі сучасного стану деревостану і прогнозу динаміки його розвитку; плануванні і здійсненні диференційованих лісівничих заходів; організації та технології лісозаготівельних заходів залежно від машин і механізмів та мережі лісових доріг; передбаченні періодичного контролю ефективності лісівничих заходів. Усі ці параметри враховано під час призначення заходів у масивах лісу, де здійснювали активну господарську діяльність і у деревостанах, які потребують переформування.
6. Узагальнено стратегію рубок переформування, яка стосовно конкретних деревостанів базується на таких прийомах:

- перетворення майже чистих одновікових насаджень у змішані різновікові за допомогою формування вікон у місцях, де є підріст усіх порід (пр.пл. 4МН-06);

- підсилення лісовідновних процесів за рахунок достатнього попереднього поновлення (пр. пл. 23Р-06 та 14Р-06) у насадженнях, де вже сформовано частково різновікову різнопородну структуру;
- перетворення майже одновікових насаджень у змішані різновікові за допомогою створення вікон у місцях, де є, або може потенційно з'явитися підріст усіх порід (пр. пл. 3БР-06, 13Р-06 14Р-06);
- перетворення поростевих низькостовбурних різновікових насаджень у змішані насіннєві високостовбурні (пр.пл. 5Р-06).

Для здійснення цих заходів виконано комплексне оцінювання показників деревостанів і здійснено їх зріджування (як за рахунок окремих дерев, так і біогруп) залежно від поточного стану деревостанів і мети господарювання.

7. Інструментами реалізації формування і підтримання різновікових лісів і переформування лісостанів є комплекс лісогосподарських заходів на підставі оцінки конкретного деревостану. Під час планування лісівничих заходів потрібно передбачити використання і підсилення позитивних тенденцій розвитку деревостану з лісівничого і природоохоронного погляду.

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Chapter 13

Opportunities and Challenges in Promoting Sustainable Timber Harvesting in the Ukrainian Carpathians

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Abstract An overview of the opportunities and challenges of implementing sustainable timber harvesting practices in the northeastern Carpathian Mountains of Ukraine is presented. A number of historical antecedents, including political regimes, silvicultural practices and lack of investment, have led to the current status of timber harvesting in Ukraine. Unsound logging practices have caused soil erosion, sedimentation, and contributed to local flooding and mass movement. Continued use of current forest practices will further impair watershed functions and the forest's ability to provide ecosystem services. In the Ukrainian Carpathians, timber harvesting frequently utilizes obsolete and incompatible logging machinery that are legacies of the Soviet era and better suited for boreal conditions. The use of cable harvesting systems, the most environmental sound harvesting method for the rugged mountain terrain, has declined sharply (now < 5 % of harvests) and, currently, more than 80 % of all harvests utilize tractors. For the development of sustainable forestry in the Carpathian region, it will be necessary for a gradual and planned transition from even-aged forest management relying on clearcutting. Another necessity is substantial, long-term investments in forest technology, such as re-introduction of mobile cable harvesting systems and well-engineered and environmentally sensitive roadbuilding. Lack of infrastructure in roads has hampered

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sustainable forest management and overharvesting on the more accessible sites has contributed to the unbalanced diameter-class distribution characteristic of today's mountain forests. In 2007-2008, the Ministry of Environment made its first investment in the creation of a road network by constructing over 80 km of state-of-the-art forest roads in the Carpathians. Concurrently, there has been a gradual reduction and replacement of caterpillar tractors with wheeled skidders. In addition to an expanded road network and appropriate technology, implementing best management practices (BMPs) and reduced impact logging (RIL) are important components of transitioning to sustainable forest management (SFM). Notwithstanding the need for roads and modernization, a comprehensive analysis of the economic, social, and ecological impact of roadbuilding and monitoring of legal and illegal harvests should an integral part of a landscape-level planning in the Carpathians.

13.1 Introduction

Although Ukraine is regarded primarily as an agricultural country, forests represent a crucial natural resource – particularly in western Ukraine – and the sustainable management of these resources presents a significant challenge in the 21st century. Benefits provided by forests are known as ecosystem services, which are generally defined as the benefits people obtain from ecosystems. Ecosystem services are frequently split into four categories: 1) "provisioning services" such as food, water, timber, and fiber; 2) "regulating services" that affect climate, floods, disease, wastes, and water quality; 3) "cultural services" that provide recreational, aesthetic, and spiritual benefits; and 4) "supporting services" such as soil formation, photosynthesis, and nutrient cycling. (Millennium Ecosystem Assessment 2005). Forested watersheds are comprised of dynamic ecosystems that change over time and space in response to natural and anthropogenic disturbances. Timber harvesting and land clearing are man-made disturbances that have direct influences on all four categories of ecosystem services. Controlling the temporal and spatial extent of timber harvesting, the type of harvesting and methods of timber harvesting can impact the extent that functioning watersheds provide ecosystem services. Therefore, it is extremely important to harvest timber is a sustainable, environmentally sound manner that not only regulates the amount of timber produced and regenerated but that continues to provide for all ecosystem services.

In terms of percent forest cover, Ukraine has one of the lowest percentages in Europe – less than 15 % of the terrain is forested (Hensiruk 2002). However, in terms of the amount and productivity of forest, Ukraine, the second largest country in Europe, ranks eight out of 40 European countries (UNECE/FAO 2003). Forests are unevenly distributed on the territory of Ukraine and are concentrated mostly in four geographic regions: the Polissya (northern and western Ukraine), forest steppe, steppe (eastern and southern Ukraine) and a significant component of this forest cover is distributed in the four western provinces, where average forest cover in the Carpathian Mountain region reaches 42 % and as much as 60 % of the landscape is covered with forests (Hensiruk 2002).

According to official State Forest Committee of Ukraine (SFCU) figures, the current growing stock in Ukraine is approximately 1.8 million m^3 (SFCU 2008). Recent findings at the Ukrainian Mountain Forest Research Institute indicate that annual increment exceeds annual harvest by 10 % in the Carpathian forest region (Kraynij 2008). At the same time, Ukraine is one of the most forest deficient European countries and its own forest resources meet only 27 % of its timber needs. The annual consumption of forest products including, solid wood materials, cellulose, cardboard and paper production is equivalent to 25-30 millions m^3 of roundwood materials. The forest prosperity index (hectare/person) of Ukraine's population is only 0.12 ha/person. At the same time, neighboring countries are substantially higher: Poland – 0.24 ha/person, Romania – 0.29 ha/person and Bulgaria – 0.42 ha/person (Shkirja 2005).

By European standards, the mountain forests of Ukrainian Carpathian region are distinguished by a relatively undisturbed forest ecosystem with a high biodiversity index. The forests of Transcarpathia are also unique because they contain the largest remaining, contiguous stand of old-growth beech forest (*Fagus sylvatica*) in the Europe. The Carpathian Mountains occupy just 6 % of Ukrainian territory but 30 % of the state forest fund is concentrated in the Carpathians and an average of 252 m^3/ha of forest compared to the national average per hectare of forest of 186 m^3/ha (SFCU 2004). By the age structure, young and middle-aged ("poletimber"-sized) forest stands predominate, which occupy about 70 % of the forest area (Parfejnuk 2000). Due to a variety of social and economic factors, the annual volume of timber harvesting for last 15 years has decreased sharply and although it has rebounded somewhat, it is now about 1.1-1.3 million m^3. Commercial timberland is mostly located on the steep (21^o-30^o) and very steep (> 30^o) slopes (54 %), moderate (11^o-20^o) slopes (35 %) and just 12 % on the relatively level slopes (< 11^o) (Bybljuk 2000).

After the dissolution of the Soviet Union, the large-scale system of forest production, which integrated forest management and forest processing, collapsed. After of a decade of contraction and expansion, the forest products industry started to rebuild. The precipitous drop in forest manufacturing has stabilized and new initiatives in roadbuilding and the restructuring of the forest products market have reversed this decline. State funding for forestry has been chronically low but in 2006-2007, for the first time in more that 15 years of independence, the SCFU has allocated 60 million hryvnias (UAH) or approximately $12 million (USD) to build forest roads in the four western oblasts of Ukraine (Calna 2007). In 2007, approximately 50 km (55.1 km) of forest roads were built in the Carpathians Mountains of Lviv Oblast and in 2008; 36.6 km of roads are planning to be completed. (Deyneka 2008).

13.2 History of Forest Exploitation in Western Ukraine

Historical antecedents, including difficult political and economic conditions, have resulted in the current status of timber harvesting and degraded forest ecosystems.

An overview of the current status of sustainable forest management (SFM) in the Carpathians shows a legacy of traditional central European forest management, intensive forest usage, and the application of inappropriate timber harvesting in terms of scale and machinery suited to the site conditions. Unsound timber harvesting operations have resulted in a substantive change in the natural forest species composition and forest age structure as well as long-term damage to forest health including residual stand damage, soil compaction, soil erosion, destruction of understory, and disruption of watercourses.

Forest clearing and timber cutting have gone on for millennia in the territory of present-day Ukraine but it was not until the industrial revolution and 20th century that there was a substantial reduction of forest cover in western Ukraine (Hensiruk 1999). Intensive exploitation of the Carpathians forests began from the middle of XVIII century and continued until the present. Conversion of forests to farmland with the aim of increasing arable soils was put into practice first in the lowland rivers valleys and lower hillsides. Over time this extended to the upland mountain forests and the expansion of the alpine meadows for summer pasture. This forest clearing consisted of burning and utilizing woodlands for local building material and charcoal for iron production and resulted in the declining of forest cover by one and half times (Hensiruk 1999).

The most intensive management and industrial cutting of forests began in the middle of XIX and coincided with the Hapsburg regime in Galicia and western Ukraine. Considerable harm to the Carpathians forests was inflicted after the Second World War (1949-1970), when actual cutting of timber by the clearcutting method exceeded the scientifically substantiated norms (the allowed annual cut) by two-tree times. Every year, an average 11 million m^3 of timber were cut down instead of a 5 million m^3 according to the plan. During the period of 1947-1957, over 73 million m^3 of timber was cut down for the purposes of rebuilding the economy and infrastructure destroyed by the Second World War and its aftermath (Hensiruk 2006).

In addition commercial harvest of roundwood, between 1957-1960 years, over 500,000 hectares of forests were damaged by windthrow and large-scale blowdown. The severity of the wind damage was at least partially attributed to poorly planed clearcuts laid-out on the steep slopes without consideration of prevailing wind direction. The volume of windfall timber in 1957 alone was 5.2 million m^3 and between 1958-1964 more 21 million m^3 of spruce (*Picea abies*) forests by windthrow was destroyed. In comparison, during the same period in Romania, windfall destroyed just 4 million m^3 and in Czechoslovakia, 5 million m^3. As a rule, a large portion of merchantable timber from large-scale blowdown is lost because the terrain and site conditions. Poor access and machinery can cause exploitation or salvage to last up from three to five years (Hensiruk 2006). Windthrown timber also increases the risk of fire hazard and creates conditions for catastrophic insect epidemics and infestation of adjoining healthy stands. According to the data of noted Ukrainian forest scientists such as Hensiruk, Stoyko et al. over the last 150 years in Carpathians, bark beetles (*Dendroctonus* spp, *Ips* spp., etc.) have damaged three times more spruce forests than windfall (Hensiruk 2002).

In the United States, researchers, forest industry representatives, communities and environmentalists are hotly debating the ecological impact of salvage logging after natural disturbances such as fire, insects or windstorms. For example, a noted Oregon State University Study concluded that Oregon's Biscuit Fire of 2002 burned more severely in areas that had been salvage logged and replanted, compared to similar areas that were also burned in a 1987 fire but had been left to regenerate naturally (Donato et al. 2007). This discussion has not been an issue in Ukraine because most salvage is limited by access and economic constraints.

The gradual conversion of natural hardwood stands of beech and mixed hardwood-conifer stands (mostly *Abies alba* – European fir) in the Carpathians forests of Eastern Europe during XVIII-XX centuries resulted in their replacement by spruce monocultures from different geographic varieties or provenances. The main reason for the establishment of conifer plantations was greater income generation potential from faster growth, uniform timber quality, the ease of harvesting and replanting. However, this conversion eventually led to diminished productivity, decline, and severe spruce dieback. Retrospective analysis of Carpathian forestry shows that the first rotation of spruce gave a significant increase of merchantable wood – at the age of 75 years, average growing stock was 800m^3/ha. However, in the second and third rotations, a marked decrease sharply diminished economic returns and signs of degradation and dieback began to appear. The third rotation of spruce monoculture, particularly in the Lviv oblast, shows evidence of large-scale dieback when stand age reaches 40 (Hensiruk 2006). Unlike the counterpart lowland forests growing on fertile soils and protected sites, mountain forests are exceptionally sensitive to disturbance. Therefore, special attention has to be paid to their protection and renewal.

13.3 Current State of Timber Harvesting in the Ukrainian Carpathians

Since the mountain forests of the Carpathian region influence the climate and water resources of not only Ukraine, but also neighboring European countries, their protection and rational development is not only of national but regional importance. SFM demands the use of sustainable timber harvesting methods and technologies. Under the current conditions of Ukrainian forestry, this prerequisite of environmentally sound harvesting technology in that region by Ukrainian forest enterprises is not being met. At present, the principal method of timber harvesting in the region remains clearcutting, which accounts for 72 % of all removals. The maximum size of a clearcut is five hectares but sequential or staggered clearcutting is frequently practiced. Partial cuttings that maintain a continuous forest canopy, such as shelterwood systems or variable-retention models, make up approximately 24 % of planned cutting areas and only 4 % is harvested using the selection method (Kudra 2004).

Laying out a timber sale using the clearcut method needs to take into account a variety of site conditions: soils, landscape features, and characteristics of the forest stand as well the available technical equipment for felling, skidding and loading on the transport vehicles. In Ukraine, site conditions do not often mesh with the available equipment. At the present time, there are four main types of the timber yarding in the Carpathian region (Table 13.1) (Chernjavskyy 2006). On steep terrain in the Ukrainian Carpathians, almost 80 % of yarding utilizes tractors – caterpillar tractors (50 %) or wheeled skidders. Horse logging represents about 10 % of skidding, gravity systems (using sluiceways, skidways, etc.) represent 5 % and cable systems make up to 5 % of the harvested timber (Bybljuk 2004a). Skidders are used on the slopes up to 25^0 and cable systems on the slopes between $15\text{-}35^0$. Average length of skidding is about 1.5-2.0 km, but in some cases can be as long as 4-5 km.

Table 13.1. Principal types of timber yarding in the Ukrainian Carpathians

Types of Yarding	***Index***
Manual[1]:	
Distance for partial harvests	100 – 150m
Distance for regeneration harvests	≤ 250m
Animal (Horse):	
Distance from landing	≤ 150m
Distance in the forest (combined with skidder)	50 -70m
Grade (for transporting uphill)	$\leq 6^0$
Grade (transporting downhill)[2]	$17^0 - 36^0$
Tracked and Wheeled Skidders:	
Skidding distance	1500 – 2000m
Uphill passing capability	$\leq 12^0$
Downhill passing capability (stable soil)	$\leq 27^0$
Skidding trail grade:	
Soil with high erosion potential	$\leq 9^0$
Stable soil	$\leq 15^0$
Cable Harvesting Systems:	
Yarding distance	≤ 1000m (exception ≤ 2000m)

[1] Sluiceways, skidways, etc.

[2] Dependent on operator experience

Table 13.2. Projected need for forest harvesting technology by 2012 in LvivLis (Deyneka 2008)

№	***Forest Distict***	***Cable Systems***	***Skidders or Tractors***			***Hydraulic Loaders***
			MTZ-L-82	LKT-81T	LT-171	
1	Bibirskij		3		1	1
2	Borinskij			1		2
3	Brodivskij			1		1
4	Bouskij		3			3
5	Drohobytskij		8	1		2
6	Zolochivskij		8	3		10
7	Lvivskij		2			2
8	Zhovkivskij		5			2
9	Rava-Ruskii		1			2
10	Radekhivskij		2	2		3
11	Sambirskij		2	2		2
12	Skolivskij	1		3		4
13	Slavskij	1		5		9
14	Starosambirskij		1	1		2
15	Strijskij			1		2
16	Turkivskij		1	2		
	Totals	2	36	22	1	47

Although Ukrainian forest laws are in place, implementation of forest regulations is often ignored during the exploitation of the cutting area. One of the main reasons for these violations is the use of out-dated techniques and operational technologies in harvest areas. The percentage of the machinery that is obsolete or is physically derelict has reached critical levels in some regions. According to Bybljuk (2000), much of this machinery should be decommissioned or replaced. According to the SFCU, a significant portion of the timber harvesting machinery is worn out or unsafe and forest districts in the Lviv region are constantly updating the timber harvesting and yarding equipment. By 2012, the SFCU anticipates the purchase of two cable systems, 59 wheeled tractors or skidders and 47 hydraulic loaders (Deyneka 2008).

According to LvivLis (the SCFU Administration of Forestry and Game Management of the Lviv oblast), the current number of tractor vehicles in use in the Lviv oblast for timber harvesting was 216–186 wheeled skidders and 30 caterpillar skidders. According to these latest figures, Lviv oblast has been making progress in the transition to wheeled skidders. In mountain areas, there are four (4) cable skidding systems (LC-2-500, HUNTER, LARIX-3T). All the timber harvesting equipment belongs to the forest districts. There is one Valmet forwarder in the Strijski region that belongs to a private operator. In terms of timber transport machinery, there are four Veimer trailers with hydraulic self-loaders that belong to the forest districts.

Table 13.3 Breakdown of transport machinery by model and manufacturer (Deyneka 2008)

Model Number	*Country of Origin*	*Number of Machines*
TDT-55, TT-4	Russian	26
TLT-100	Russian	1
LT-171	Ukrainian	8
TAF-658	Romanian	11
LKT-81	Slovakian	7

In regards to the most widespread means of yarding, tractors cause the biggest damage, especially caterpillar tractors. Wheeled skidders cause less damage but are frequently limited by slope. According to recent data gathered by Bybljuk et al. (2004b), caterpillar tractor skidding damaged 60-85 % of the soil of a total square of cutting area through soil compaction, displacement and erosion. The average volume of disturbed soil is approximately 250-320 m^3/ha and sometimes as high as 520 m^3/ha, whereas the depth of soil damage is 0.2-2.0 m. Track skidding also destroys up to 90 % of the tree regeneration as well as the herbaceous vegetation and brush species in the understory, especially on skid trails that are not systematically laid out. Because of increasing erosion on steep slopes caused by timber harvesting in montane topography, timber harvesting exacerbates watershed degradation through erosion and sedimentation, which deteriorates conditions for aquatic habitat for fish and invertebrates and increases migration of toxic elements.

One of the biggest ecological, economic, and social problems in the Carpathian region is the insufficient road network, especially forest haul roads. The two available transport networks in the Carpathian Mountain forests are roads and narrow-gauge railway (track width = 750 mm). Without question, vehicular transport or "trucking" is the main type of timber transport, which carries more than 90 % of all harvested timber. All specialized forest haul roads are connected with roads for public transport. However, the network of hard-surfaced roads (gravel and asphalt) is unevenly developed and inadequate.

According to the most recent State Forest Committee of Ukraine (SFCU) data, the total length of forest roads on SFCU land in 2005 was approximately 74,400 km or 11.3 km per 1,000 ha. The total length of forest roads in the Ukrainian Carpathian Mountain region is 5,976 km and the road network density in the region is 2-2.5 times lower than average forest roads density in Ukraine, and makes 3.5-6.0 km for 1,000 hectares. It is five to eight times less than in mountain forests of the Czech Republic, Austria and others European countries. For example, in Poland for each 1,000 hectares there are 32 km of forest roads and in Hungary 36 km (Korzhov 2004, Golubchak 2004). In addition to road length and density of the road network, the quality of roadbuilding and technology for environmentally sound, long-lasting road building does not exist or meet acceptable ecological demands.

As a result of the socio-economic turmoil during the early phases of Ukrainian independence and the transition economy (1992-2006), there was little or no financial support from the federal budget for forest road construction and maintenance. Individual forestry enterprises invested their funds in operations that generated short-term returns, such as harvesting commercial stands, but very little was invested in infrastructure development, timber stand improvement, or long-term forest management planning. Road construction and maintenance did not have adequate funding.

For the whole region, only 80 % of the total road network is suitable for use. The rest needs capital investment and some roads need to be completely re-built. If 10-15 years ago in the Carpathian forests 40 km of new forest roads were built annually and about 50 km were maintained or repaired annually, then now, because of the lack of financial funds, these works practically stopped entirely (Golubchak, 2004).

In order to solve these problems, Ukrainian legislation in the 2007 Ukrainian State Budget purposely allocated financial support for building of forest roads in the amount of 60 million hryvnas (UAH) (Calna 2007). A large portion of this fund (87.7 %) was dedicated to building roads in the mountain forests. This was the first time in the history of independent Ukraine that the government appropriated funding for the creation new roads in forestland. The majority of the funding was distributed to the SFCU Regional Administration of Forestry and Game Management in four western oblasts of Ukraine: Lviv (16.4 million UAH); Ivano-Frankivsk (13.0 million UAH); Transcarpathia (6.4 million UAH); and Chernivtsi (6.6 million UAH). The average cost of constructing one kilometer of road was approximately 298,000 UAH. The total expenditures in roadbuilding in 2008-2012 period is estimated at close to 49.2 million UAH. The anticipated investment in the timber harvesting and transport machinery and the building of new forest roads are significant steps towards environmentally sound timber harvesting practices and sustainable forestry.

Roadbuilding commenced in the spring 2007 and major sections of the planned road network have been completed in several regions. In the Lviv oblast, for example, road design and construction was put out for competitive bid and a small Austrian firm won the tender for the construction; equipment was brought in specifically for forest road construction (Deyneka 2008). The total length of roads planned for construction with the appropriated money will be no less than 204.5 km, 165.6 km of which will be built in Carpathian region (Calna 2007).

For the sustainable utilization of forest resources and for protection of forest ecosystems in Ukrainian Carpathians, it is necessary to increase the density of hard-surfaced forest roads (asphalt, gravel, etc.) to at least 10-15 m/ha (10-15 km/1000 ha). In the case of cable harvesting systems, the necessary road network density in Ukrainian Carpathian should be not less than 16.5 m per hectare (Bojko, 1998). To achieve this figure, it is necessary to build about 12,000 km of forest roads, more than 95 % of them should be hard surfaced roads. Due to the poor condition of the existing forest road network, it is impossible to implement modern harvesting and SFM or to develop a robust forest-based tourism-recreational industry. Harvesting and transporting wood in rugged mountainous terrain and difficult working conditions requires specialized logging machinery to minimize impacts on fragile mountain sites and soils. Reduced impact logging (RIL), a system of low-impact, environmentally sound logging introduced to minimized impact of timber harvesting in tropical forest ecosystems, could easily be adapted to the Ukrainian Carpathians (Bihun 2004). Unfortunately, domestic production of forestry and timber harvesting technology (e.g. cable systems, skidding tractors, loaders, and high-quality chain saws) is practically non-existent in Ukraine.

In regards to the optimal type of timber harvesting method for the mountainous terrain of the Ukrainian Carpathians, research on commercial logging operations and a technical-economic analysis show that, for today's conditions, the main type of harvesting is "tree-length" timber harvesting. This technology is relatively simple, cost-effective to implement and already practiced by loggers on a variety of sites. Currently, this timber harvesting method is widespread throughout the world; about 70 % of timber globally is harvested using this technology. However, improving the effectiveness of tree-length harvesting technology by incorporating new technologies and alternative cutting and yarding methods is important to meet today's energy demands and increasing ecological restrictions (Adamovskyy 2004).

At this point in time, the "cut-to-length method" of timber harvesting is developing rapidly all over the world and today about 30 % of the total volume of harvested timber utilizes this technology. The leaders in establishing this technology are the Scandinavian countries and this technology is rapidly spreading and widely implemented in western Europe, USA, and Canada as well as Southeast Asia. This method is characterized by: a high yield of quality timber; the establishment of an efficient road network; the availability of a complex of specialized, modern machinery designed for cut-to-length harvesting technology; the ability to sort logs by end product; and ease of product transport from the forest to the sawmill or primary processing facility. "Whole-tree" harvesting (which removes the whole tree with crown and branches), is primarily utilized for biomass harvesting and is not widely practiced in the Carpathian region. Whole-tree harvesting has the potential to increase volume production but can also impair long-term site productivity by depleting nutrients through removal of course and fine woody debris. Proper operator training, management planning and site monitoring is required. Without proper controls and technology it is not an appropriate harvesting method for the site and current economic conditions in the Ukrainian Carpathians.

The recreational value, watershed protection, and ecological functions provided by Ukrainian forests are well known. Over the last decade, creating mechanisms to support and reinforce these functions has been the main priority of Ukraine's state forest policy. Considerable attention – at least on paper – has been paid to implementing modern, environmentally sound technologies of timber harvesting under the conditions of limited economic investment and continued pressure on forests for wood and non-wood products and recreational use. Based on an analysis of timber harvesting methods, economics, and site conditions, Table 13.4. represents a summary of the compatible characteristics of the different yarding systems, which are currently or have the potential to be used in Ukraine (Adamovskyy 2004).

Table 13.4. Technical Characteristics of Yarding Systems

Index	*Cable system unit ML-43*	*Cable system unit ML-59*	*Cable skidder TDT-55*	*Timberjack 1110 D (forwarder)*	*Helicopter MI-8MTV*	*Aerostatic-cable system Q=3,5 ton*
Scheduled payload (turn or hitch) (m^3)	2 – 4	5 – 8	6 – 12	8 – 10	2 – 3	2 – 3
Shift productivity (m^3/day)	30-50	80-100	45-65	200-250	100-150	100-120
# Operators per unit	6-8	6-8	4	1	5-6	7-8
Necessity of skidding trails	yes	yes	yes	yes	No	no
Understory damage by skidding (%)[2]	75	60	80	60	0	0
Soil damage (%)[2]	80	60	100	100	0	0
Skidding distance (km)	0.3 – 0.5	0.5 – 0.7	0.3 – 1.0	0.3 -1.0	3 – 5	1.5 – 2
Work safety (%)	80	80	50	50	0	80
Cost of equipment[2] (USD)	$45,000	$120,000	$25,000	$300,000	$3,500,000 +$800-$1000/hour	$200,000

[1]Damage to the understory and soil in the harvest unit area including skid trails
[2]Based on prices for the purchase of new equipment in 2004

13.4 Conclusion

Sustainable development of the forest industry in the Carpathian region depends on the intensification of primary and secondary forestry manufacturing and raising it a the higher technological level. It will be important to have a gradual and planned transition from clearcutting to partial harvests and the selection system as the dominant silvicultural method. However, all harvesting must meet acceptable management practices and be conducted using environmentally sound harvesting technologies. As the experience of developed countries demonstrates, effective methods to reduce the negative influence of harvesting on the environment requires the broad implementation of different cable timber transporting systems, first of all mobile cable units.

One of the conditions necessary for the rational use of mobile cable systems is creation of a more extensive forest road network. This includes an understanding of the impacts of the government's roadbuilding on forest ecosystems and watershed protection as well as traditional lifestyles and economic development. From an environmental perspective, road development is a double-edge sword and Ukrainian forestry community is charged with balancing roadbuilding with its impacts on fragmentation, unencumbered development without proper zoning and the potential of a significant increase in unregulated timber harvesting. Timber harvesting is directly tied to ecosystem services and, therefore, needs to have appropriate funding and controls. A landscape-level analysis of the potential ecological, social and economic impacts of large-scale roadbuilding needs to be integrated into balanced program for improved timber harvesting practices.

Another priority is the increased use of wheel skidders and forwarders or harvesters on moderate slopes with stable soils. This will provide an opportunity to considerably increase work productivity, improve manufacturing opportunities, and most importantly, integrate ecological principles into logging operations.

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Виклики і можливості запровадження екологічно безпечних форм лісозаготівлі в Українських Карпатах

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Нагальність вирішення екологічних проблем, пов'язаних із впливом на довкілля недосконалих технологій та обладнання лісозаготівель, зумовлює потребу запровадження щонайбезпечних технологій.

Як свідчить низка фактів з історії лісів та лісівництва, в Українських Карпатах виснажливе лісокористування призвело до деградації лісових екосистем, наслідки якої відчутні досі. На сьогодні панівними у досліджуваному регіоні є одновікові лісостани штучного походження. Поміж рубаннями головного користування переважають суцільнолісосічні. Трелювання деревини здійснюють, зазвичай, тракторами (80 %) і лише 5 % деревини трелюють канатними установками. Це завдає непоправної шкоди довкіллю.

Для сталого розвитку лісового господарства в Карпатському регіоні потрібний поступовий і плановий перехід від одновікових насаджень та здійснення суцільних рубань до поступових і вибіркових, а також значні довготермінові інвестиції у запровадження в лісозаготівельний процес екологічно безпечних технологій, таких як використання мобільних канатних установок, заміна гусеничних тракторів колісними та створення широкої мережі лісових доріг. Окрім потреб модернізації транспортно-шляхової мережі, ландшафтне планування в Українських Карпатах потребує також моніторингу дозволених і викорінення самовільних лісозаготівель.

Chapter 14

Understanding the hurdles to sustainable forest management through FSC forest certification in the Transcarpathian region of Ukraine

Volodymyr Kovalyshyn[1] *and Ivan Pecher*[2]

14.1. Introduction

In the Transcarpathian region, forestry is an important feature of the local economy. It also supports very important environmental functions related to natural values of the region. In recent years, the introduction of sustainable forest management (SFM) and rational use of forest resources has presented new challenges. Development of forest and economic policies that support sustainable management is a significant task for the Transcarpathian region. In 2005, forest management units in the Transcarpathian region were successfully certified in accordance to the Forest Stewardship Council (FSC) standard. The certification process revealed the main challenges to SFM in Transcarpathia. In the years since becoming certified, forest management units of Transcarpathia have worked to address issues and practices that do not comply with non-conformities the FSC standards and introduce sustainable forest management in everyday practice.

14.2 Characteristics of the Transcarpathia region

As of January 1, 2008, the total forest area of the Transcarpathian region was 695,700 ha or 52.2 % percent of the region. All of the forests are in state ownership and are used by many different state users. Table 14.1 displays a breakdown of forest users by area managed in the region.

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Table 14.1 State Forest Users in Transcarpathian region (2008)

Forest Users	*Hectares Managed*	*Percentage (%) of Region Managed*
State Forest Enterprises of Transcarpathian Regional Forestry and Hunting Administration	493,700	71 %
Ministry of Agrarian Policy	96,000	13.8 %
Ministry of Defense	9,800	1.4 %
Ministry of Environment Protection	79,200	11.4 %
Local Governmental Bodies	13,400	1.9 %
Ministry of Education	3,600	0.5 %

The largest group of users is State Forest Enterprises (FMUs) of State Forestry Committee of Ukraine, which are under the Transcarpathian Regional Forestry and Hunting Administration (RFHA). As of January 2008, the total area of the Transcarpathian RFHA (forest and non-forest) consists of 493.7 thousands ha and is managed by 18 forest and forest-hunting management units. Please refer to descriptions of these forest enterprises in Table 14.2 (Forest Management Certification Report, Transcarpathian RFHA 2005).

Table 14.2 Description of State Forest Enterprises under Transcarpathian Regional Forestry and Hunting Administration (Forest Management Certification Report, Transcarpathian RFHA 2005)

#	*State Forest Enterprise*	*Area in hectares*
1	Berehovo State Forest Enterprise	7,441
2	Brustury State Forest Enterprise	26,511
3	Bushtyno State Forest Enterprise	21,104
4	Velykyj Bereznyj State Forest Enterprise	29,530
5	Velykyj Bychkiv State Forest-Hunting Enterprise	53,416
6	Vynohradiv State Forest Enterprise	11,004
7	Volovets State Forest Enterprise	27,274
8	Dovhe State Forest Enterprise	19,875
9	Zahattya State Forest Enterprise	14,181
0	Mizhirja State Forest Enterprise	31,513
1	Mokra State Forest Hunting Enterprise	33,182
12	Mukachevo State Forest Enterprise	27,077
13	Perechyn State Forest Enterprise	31,506
14	Rakhiv state Forest-Research Enterprise	41,364
15	Svaliava State Forest Enterprise	38,657
16	Uzhgorod State Forest Enterprise	17,203
17	Khust State Forest Research Enterprise	33,764
18	Yasinya State Forest Enterprise	31,824

Transcarpathia is a very specific region. It is located in the western part of Ukraine bordering Romania to south, Hungary and Slovakia to the west, and Poland to the north-west. Transcarpathian region is crossed by two 24 meridian of east longitude and 48 parallel of north latitude, thereby this is the geographical centre of Europe. The main part of Transcarpathia Region is Eastern Carpathian Mountains with landscapes of high located meadows – so called polonyny and southern Carpathians slopes (located 1100 – 2060 meter above sea level). The entire region is located in water basin of Tisa River, which reaches the Danube River.

Climate of Transcarpathia is continental with mild winters and hot summers, however mountains modify temperatures and weather conditions in mountains are more severe. Precipitations in the region fluctuate from 665 mm on lowlands till over 1800 mm annually in the mountains. Temperate forest of the region is divided into two groups: lowland and mountain forests. Lowlands are covered by broad-leaves forest associations: oak, ash, maple, hornbeam and elm. Highlands and mountain slopes are covered by beech, fir and spruce. On the highest mountains there are habitats of mountain pine and green alder (Forest management certification report 2005).

14.3 Forest Resource Use, Restoration and Forest Protection in Transcarpathia

Actually forested area consists of 457.3 thousands ha or 92.6 % of total area submitted to these FMUs (other part is non-forested area). Of these hectares, 70 % are covered in species with hard leaves, 28 % are covered with coniferous species and another 2 % are covered by other soft-leaved species. Change in forest cover over the last sixty years is presented in Table 14.3 (Annual Statistical Report 2007).

Table 14.3 Transcarpathian Forest Cover by Year, 1946-2007 (Annual Statistical Report, 2007)

Year	*1946*	*1956*	*1966*	*1978*	*1988*	*1996*	*2000*	*2007*
Percent Forest Cover	42.6 %	45.7 %	46.6 %	48.8 %	50.0 %	50.7 %	50.8 %	42.6 %

The forests of Transcarpathia perform various functions, but dominant functions are ecological functions (water protection, soil protection), and recreational functions. For this reason, harvesting operations are limited.

The forests of Transcarpathia are designated for the following primary uses: water protection on 55,900 ha or 11.3 %; soil protection on 100,000 ha or 20.3 %; sanitary and recreational uses – 59,600 ha or 12.1 %; and other 34,900 ha or 7.1 % are forests special environmental significance, such as preserves, nature monuments, the natural protected boundaries. Another 212,900 ha or 43.1 % are available for exploitation.

In total, 250,500 ha of forests have some level of protection. The area of protected forests in Transcarpathia is considerably greater than the average in Ukraine and is also higher than average European indexes. Table 14.4 shows us comparison of protected forest areas in various European countries (Forest management certification report, Transcarpathian RFHA 2005).

The common growing stock of forests, which are managed by the Transcarpathian FMUs produce 166.3 million $м^3$, including 40.5 million $м^3$ of mature and over-mature forests.

The forests of the Transcarpathian region are largely comprised of highly productive, even aged stands of beech, spruce, fir, oak, sycamore and ash species. The forests in the region have high forest regulation indexes, namely: the average growing stock is 349 $м^3$ per ha, annual increment – on the average 4.5 $м^3$ per ha. The forests, which have the first and second index of quality (bonitet), occupy 95.7 percent of the total forest area of Transcarpathia (Annual Statistical Report of Transcarpathian RFHA 2007).

Table 14.4 Comparison of protected forest areas in European countries (Annual Statistical Report, 2007)

Country	*Percentage of Protected Area within Country*	*Percentage of Country's Forests that are Protected*
Austria	36.4	20.2
Germany	32.7	67.1
Switzerland	28.7	3.6
Poland	23.4	15.7
Slovakia	22.4	41.2
France	11.3	17.9
Italy	11.2	18.8
Spain	9.2	23.8
Croatia	6.4	23.2
Greece	3.2	29.1
Ukraine	4.6	16.9
Romania	2.4	7.4

The region's considerable growing stock support high timber production in the areas open to harvesting. The volumes of timber harvested annually in the region, as well as elsewhere in Ukraine, are determined by the condition of forests in accordance with national forest legislation. In recent years, harvested timber volumes have been considerably lower than in the past. Table 14.5 shows the calculated cutting area and volumes of timber harvesting from all kinds of harvesting cuttings in the past when harvesting on the territory of Transcarpathia was conducted by complex forest processing enterprises and in present times when FMUs make harvesting (Forest management certification report, Transcarpathian RFHA 2005).

Table 14.5 Calculated and actual annual allowable harvest volumes in thousands of m^3 and planned forest regeneration, 1955-2000 (Annual Statistical Report 2007)

Years	*Annual allowable harvest volume, thousands of м^3*	*Actual harvested volumes, thousands of м^3*	*Percentage of annual allowable volume actually harvested*	*Forest regeneration in hectares*		
				Planed regeneration	Actual regeneration	Percentage of planned actually planted
Indexes of forest management of complex forest processing enterprises (Existed earlier in Soviet times in Transcarpathia and belong to the Ministry of Forest Industry of Ukrainian republic)						
1955	1846.2	3410.6	184.7	7600	7716	101.5
1965	927.0	926.0	99.9	1876	1986	105.9
1970	765.0	762.0	99.6	1880	2274	121.0
1980	793.0	852.0	107.4	1900	1964	103.4
1990	929.0	891.3	95.9	2500	2560	102.4
Indexes of forest management of FMUs of Transcarpathia Regional Forestry and Hunting Administration						
1995	797.5	619.4	77.7	2050	1926	94,0
2000	777.2	507.8	65.3	1889	1948	103
2005	529.9	495.1	93.4	2158	2236	104
2007	532.9	478.6	89.8	2004	2132	106

It is obvious that calculated cutting area for the last period is used on average on 86 percents that meets legislative and scientifically substantiated norms and guidelines. Forest regeneration, both natural and planted, is generally carried out on the entire harvest area and, in recent years, exceeds the harvest area, which may result in an increase the forest area of the region.

The stock and potential of Ukrainian forests are substantial and, in the opinion of many specialists, is not effectively used (Oliynyk et al. 2002). Such is confirmed by statistics. In the European countries with environmental conditions similar to those in Transcarpathia, the average annual growth per hectare is up to 7 м^3, and the use of this growth is approximately 5 м^3 per hectare or nearly 80 %. In Transcarpathia, based on recent information (Annual Statistical Report of Transcarpathian RFHA 2007), use of average growth per hectare makes only 51 % (an average annual growth makes 4.5 м^3 and harvesting cuttings are about 2.3 м^3 per hectare).

In general, all forest operations are carried out by the FMU's own staff, however, a lot of timber harvesting operations are implemented by subcontractor organizations. The percentage of timber harvesting performed by subcontractors in 2007 was 52.4 % (Forest management certification report, Transcarpathian RFHA 2005).

Funds generated by FMUs through the sale of harvested timber are used for regeneration of forests, nature protection and other forest activities. FMUs also receive financing for forest management from the state budget, but this makes up only 8-10 % of the funds needed to conduct management operations.

14.4 Forest Certification and SFM challenges

In 2005, the Transcarpathian Regional Forestry and Hunting Administration successfully passed a forest certification assessment and received the certificate that confirms that forest management meets the requirements of FSC P&C. It is necessary to note that the Transcarpathian Regional Forestry and Hunting Administration was the first regional administration in Ukraine, which completely passed forest certification process. The issues of introducing of forest certification in Ukraine were considered by many scientists and specialists. Scientific results and recommendations gave a push to certification processes (Bondaruk and Lavrov 2004; Vedmid et al. 2002; Kovalyshyn 2002, 2004; Kravets 2001; Kravets and Lakyda 2002; Lavrov and Bondaruk 2004; Synyakevych 2001, 2002). It is necessary to note that during the certification assessment of Transcarpathian RFHA were identified about twenty non-conformities with the SGS Qualifor Standard, accredited by FSC. These nonconformities fall into two areas: socio-economic and forestry-ecological.

One of the most significant socio-economic non-conformities of Transcarpathian forest management is considerable volumes of illegal cuttings, especially in mountainous areas, where other sources of fuel and build materials are absent. Figure 1 shows trends in illegal harvest volumes for the last 10 years. The years 2002 and 2003 show the largest volume of timber from illegal harvest, when more than 17,000 м^3 of timber was illegally removed per year. Presently the volumes of illegal cuttings considerably diminished and make to 3 000 м^3 in a year, which, however, also is a considerable index (Annual Statistical Report of Transcarpathian RFHA 2007).

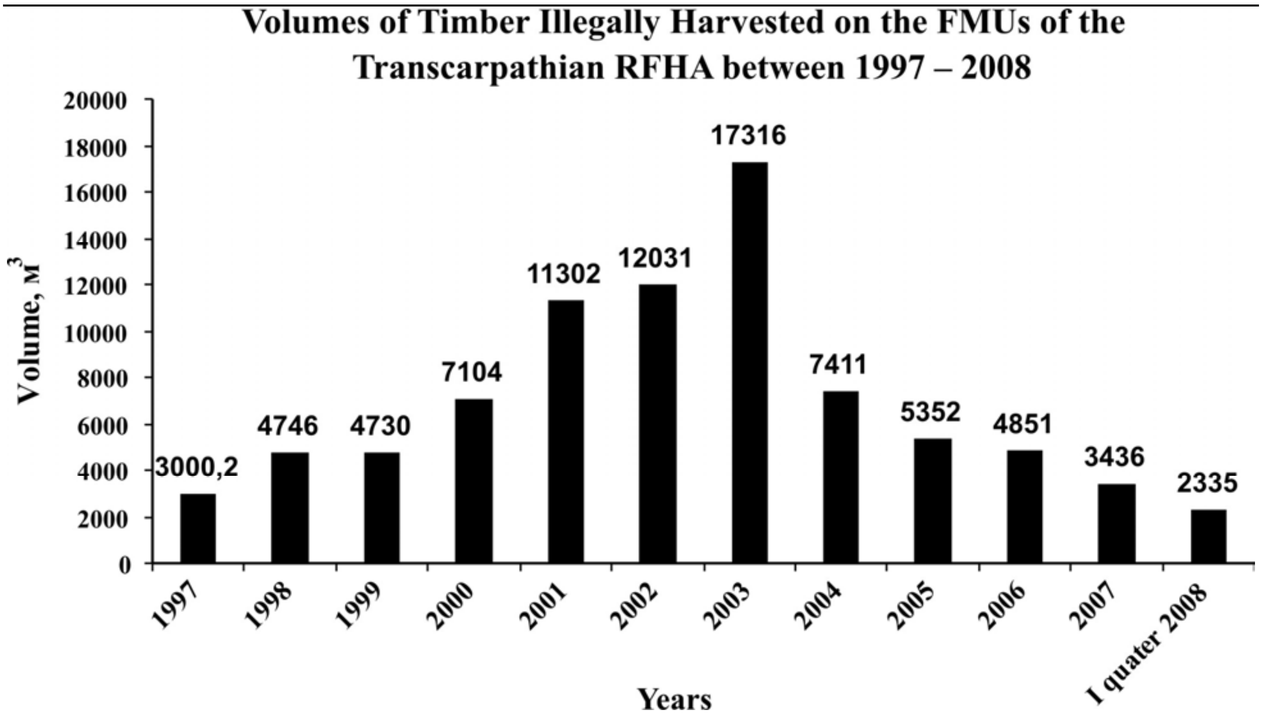

Fig. 14.1 Volumes of timber illegally harvested on the FMUs of the Transcarpathian RFHA between 1997 – 2008 (Annual Statistical Report 2007)

Because addressing the illegal harvest and subsequent sale of illegal timber is an important goal of certification, action against the illegal cuttings was one of the key challenges for the administration of the Transcarpathia RFHA. Table 14.6 presents the main factors influencing illegal cuttings in the Transcarpathia region.

In addition to FSC forest certification, the Transcarpathian RFHA also introduced a procedure of issuing of certificates on timber origin. This measure has been useful in reducing the volumes of timber illegally harvested.

Table 14.6 Main factors influencing illegal harvest activity in the Carpathian region

Economic	*Social*	*Legal*
• Proof of demand for timber on external and internal markets; • High profitability of illegal cuttings; • Low level of intensity forest use	• High unemployment; • Low personal incomes; • Markets for illegal wood (small private woodworking manufacturers)	• Lack of effective legal regulation and enforcement; • Lack of appropriate punishment for illegal harvesting

In addition, the Program of development of forestry in Transcarpathia for 2008 includes other goals for decreasing illegal logging and improving forest management:

- to mark %100 of the timber during its extracting from forest;
- to create mobile groups comprised of trained representatives of the State Forest Guard and local police in every FMU;
- to promote transparency in markets for timber through an auction process; seek to provide for the firewood needs of the local population; and
- to promote for the participation of public organizations and representatives of wood processing manufactures in auctions commissions.

It is clear that this problem will still exist during the long period, in view of difficult socio-economic situation in the region, big dependence of local population on forest resources and extraordinary diversity of different nationalities and social groups, which live in Transcarpathia region (Kovalyshyn 2006).

In addition, the unsatisfactory condition of forest roads, especially in mountainous areas, severely limits local transportation and timber transportation. The network of forest roads is poorly developed, making access to the separate forest areas difficult. For many years, the FMUs of the Transcarpathian RFHA did not build new forest roads generally because of the large capital investments required. However, in recent years, there is a trend toward improvement of the situation. The FMUs are getting funding from the state budget to implement a government program aimed at building new forest roads (Forest Management Certification Report 2005).

Forestry in Transcarpathia surely, as nowhere more in Ukraine, is branch of economics from which welfare of local population depends very much. Therefore, no wonder that public in the region shows large activity in all processes, which are related with forest management (Gensiruk 2002). The catastrophic floods of 1998 and 2001 years and related environmental issues left negative footprint on forestry of Transcarpathia, and together and critical public opinion. In spite of the fact that it was officially acknowledged that cuttings of forests were not main reason of these phenomena, popular media was critical of the FMUs forest management. It is obviously that one of the factors, which caused to such public opinion, was lack of publicly accessible information about the state and results of forest management from side of FMUs.

Public involvement processes remain weak, reflecting the inadequate practices under the Soviet system, in which public involvement in forest management activity was virtually nonexistent (Gensiruk 2002). Therefore, one of the main requirements, which were put before the FMUs during certification assessment, was requirement concerning openness of forest management activity and the involvement of a wide circle of representatives in the planning and implementation of forest management plans (Forest management certification report 2005).

To integrate public involvement into forest management decision-making, promote public education and build credibility, the Transcarpathian RFHA is encouraging Public Council involvement. In addition, the RFHA is also providing information about Transcarpathian FMUs activities and policies to mass media outlets.

Economic inefficiency of non-timber forest products (NTFPs) use and lack of demand from big processing enterprises has limited FMU interest in NTFPs and recreational forest use. As a result, the FMUs have focused on timber harvesting. NTFPs, particularly mushrooms and berries, are intensively harvested by local population for both personal subsistence and commercial purposes (Forest Management Certification Report 2005).

It is necessary to note positive trends related to development of forest recreation by the FMUs. In recent years, the Transcarpathian tourist route, connecting the most popular tourist areas in Transcarpathia, was established in a FMU-managed forest.

The Transcarpathian FMUs forest management practices do not comply with FSC certification standards in several other areas. First, the FMUs lack a system for data collection and monitoring of rare, threatened and endangered species (RTE species). These species are also not protected during on-site forest operations because forest workers have not been trained to identify them. In addition, under current practices, water streams, especially in mountainous regions are not sufficiently protected during forest operations resulting in degradation of water quality and soil erosion.

To address these issues the Transcarpathian FMUs are seeking to establish long-term monitoring programs. They are also undertaking analysis of forest quantity and quality; and introducing GIS technologies using ARC GIS software into forest management.

To reduce environmental impacts of logging, the FMUs have introduced new technologies for harvesting operations and timber transport. In particular, in recent years, caterpillars were changed on wheeled tractors, were bought some cable-cranes, timber-transport lorries with hydromanipulators.

Finally, there has been a massive dieback of spruce forests resulting from inappropriate management and the replacement of natural mixed spruce-fir-beech forests with plantations of spruce monocultures. Such spruce monocultures count in Transcarpathian region over 34,000 hectares. Most of clear spruce forests on area of natural mixed forests, which today wither intensively, are the example of wrong forest typological approach during planting forests in the past.

Withering of spruce begins when trees are between 20 and 30 years old. At 50 or 60 years, forests are fully withered, becoming hosts for forest pests and illnesses. Because the harvesting age for spruce is legislatively set at 80 years, infected spruce plantations are dead at harvest time.

Withering of ecologically unsustainable spruce forests, storms, strong winds, and other negative factors often result in wind throw. Table 14.7 provides data about damage to the forests of Thranscarpathia by strong wind.

Table 14.7 Damage to the forests of Transcarpathia by wind (Annual Statistical Report, 2007, 2008)

Years	***ha/thousands м3***			
	Remain of forests damaged by wind on the beginning of year	Forests damaged during the year	Forests harvested	Remain of forests damaged by wind on the end of year
2000	204.7 / 71	471.9 / 164	392.8 / 137	283.8 / 99
2001	283.8 / 99	112.4 / 36	224.1 / 82	172.1 / 63
2002	172.1 / 63	614.8 / 191	506.2 / 182	217.2 / 72
2003	217.2 / 72	82.8 / 17	113.4 / 49	121.3 / 40
2004	121.3 / 40	176.9 / 68	127.7 / 46	170.5 / 62
2005	170.5 / 62	407.4 / 135	422.0 / 145	155.1 / 51
2006	155.1 / 51	259.1 / 98	233.8 / 83	178.8 / 66
2007	178.8 / 66	1032.0 / 369	746.2 / 269	464.6 / 166
2008 (as of 01.07.08)	464.6 / 166	405.0 / 143	217.2 / 77	652.4 / 230

Intensive and unsustainable forest management in the past have resulted in landscapes dominated by single cohort and mono-specific forest stands. Multi-aged, mixed species forests do exist in the region but are mainly concentrated in protected areas.

The FMUs have initiated practical measures to remove existing problems. Recently, much work has been undertaken to replace spruce plantations to natural, pre-existing forest types. Work is also underway to create forests different age classes. There are also used complex kinds of cuttings, as progressive cutting and selective cutting, which can help to reduce environmental damage and minimize natural processes.

The measures taken by the FMUs of the Transcarpathian RFHA to address the mentioned non-conformities with the FSC standard are critical to passing annual certification audits. It is obvious that the efforts of the FMUs in forest management must focus on addressing all of the mentioned areas of noncompliance.

14.5 Conclusions

The forest certification process illuminated the strong and weak sides of FMU forest management in Transcarpathia. Generally, areas of noncompliance relate to activity, which before was not actual for the enterprises and was not strictly required by national forest legislation. Firstly, this touches social issues, related to the process of public consultations, social impact assessment, and process of conflicts resolution. Some other moments are related to the ecological issues, such as an environmental impact assessment, identification of key representative ecosystems, and identification of high conservation value forests. There are also issues, which are related to the improvement of administration, in particular, weak monitoring process and range of issues related to forest management planning.

By addressing the issues raised in annual audits, the FMUs of the Transcarpathian RFHA can successfully implement sustainable forest management and achieve forest certification.

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Актуальні проблеми запровадження ведення сталого лісового господарства в Закарпатській області у контексті вимог лісової сертифікації згідно зі стандартами FSC

Ковалишин В.Р. к. е. н., НЛТУ України,
Печер І.І., Закарпатське обласне управління лісового і мисливського господарства

Лісове господарство в Закарпатті належить до пріоритетних галузей економіки. Воно також виконує важливі природозахисні функції, пов'язані з підтриманням і примноженням природних багатств краю. Ведення лісового господарства тут здійснюють державні лісогосподарські підприємства, підпорядковані Закарпатському обласному управлінню лісового і мисливського господарства. Закарпатське обласне управління лісового і мисливського господарства є одним з найбільших в Україні (загальна площа 493,7 тис. га) і керує роботою 18 державних лісогосподарських підприємств. У 2005 р. Управління для покращення економічного, екологічного та соціального складників лісового господарства та з метою вдосконалення системи менеджменту розпочало процес сертифікування лісів. Це допомогло скласти уявлення про управління лісовим господарством у Закарпатті та вдосконалити його відповідно до вимог стандарту FSC.

Chapter 15

Estimation of forest ecosystems stability

Igor Neyko[1]

Abstract Analysis of the influence of ecological factors on forest ecosystems is complex. Changes in forest stand biodiversity are tracked as a result of deterioration in forest condition. This paper evaluates the application of Ukrainian and international techniques for assessing condition of forests. As an alternative, I offer a two-level estimation technique focusing on the forest and watershed levels.

15.1 Introduction

Forests in Ukraine were intensively used over the last 1,000 years but were most intensively managed during the last 200-300 years. As a result of extensive use, forest resources have been reduced to nearly one-third their original size. The remaining forest stands have been subject to repeated clear cuts. As a result of these cuts, which were common practice, forest regeneration has essentially changed. As a consequence of intensive economic use of forests resources, there was a reduction of the areas of natural (climax) forests. Over the last 60 years, forest plantations were created after stands were clear cut. As a result of reduction of natural forests and the creation of forest plantations, levels of biodiversity are reduced.

There is evidence that forest ecosystems have been influenced by abiotic and biotic factors over the last century. The influence of these factors is exacerbated by destruction of forests, emphasizing the need for sustainable forest management.

Today, sustainable management of forests is regulated by certain criteria and requirements which should support, not exhaust forest resources, and preserve their ecological and social role. Because past forest management has prized economic uses over social and ecological component, there is a need for the development of a sustainable forest management strategy, which should include preservation of ecological, economic and social function. The model sustainable management of forests should support an effective combination of these three components.

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Today, forest ecosystem condition reflects the influence of three types of environmental factors.: abiotic (climate, soil, geology), biotic (plants, animals) and anthropogenic (forest use, industry, transport, recreational). These factors may periodically influence the stability of forest ecosystems. We can examine and measure these factors to determine their influence on the development of forest ecosystems (Fig. 15.1).

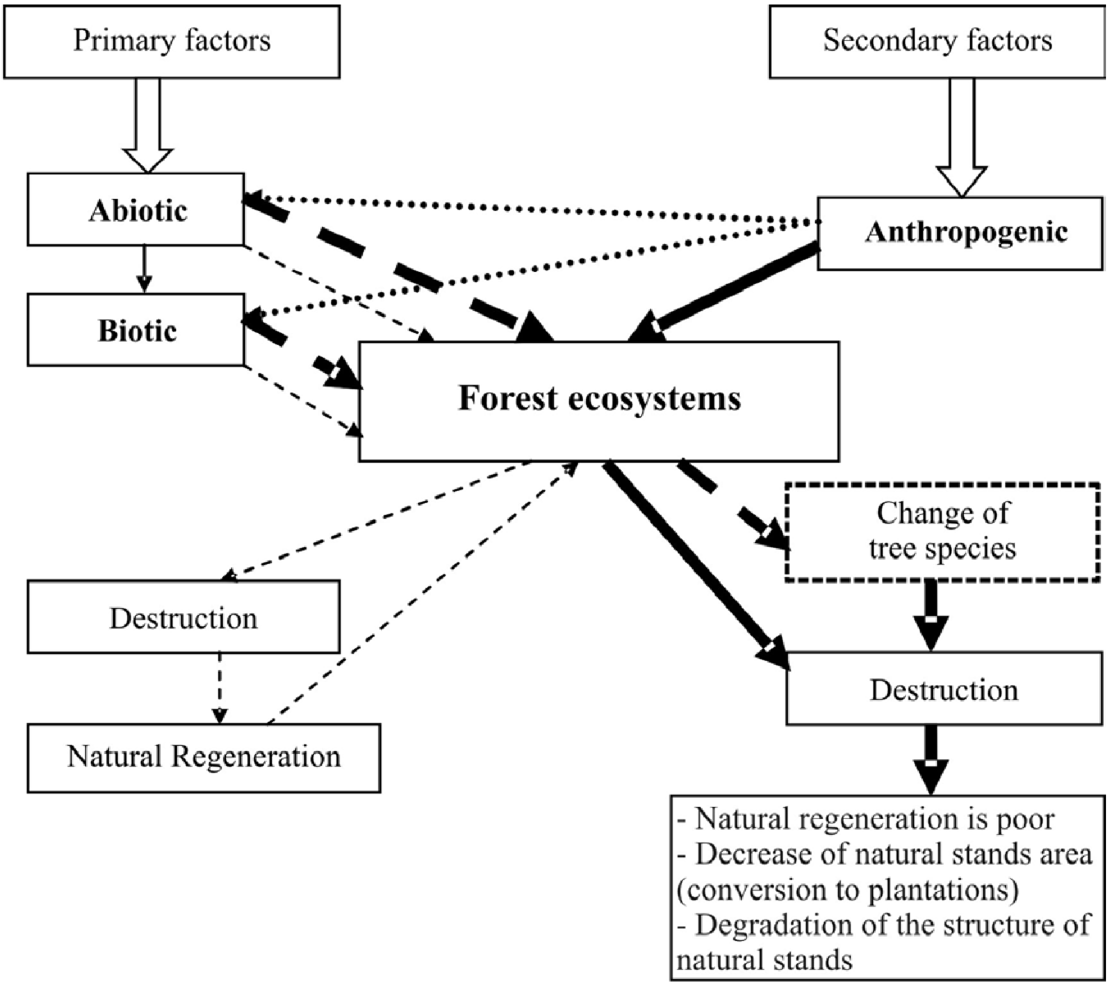

Fig. 15.1 Diagram of the influence of primary (dotted thin lines) and secondary (dotted and continuous thick lines) ecological factors on forest ecosystems

In the past, primary factors (climatic fluctuations, biotic damages) resulted in forest disturbances but also natural renewal, where old-age forest stands was replaced by young generation. Thus, a natural pattern of regeneration was intact. New influences of anthropogenic factors have been most significant over the last three or four centuries. These factors not only influenced forest ecosystems directly, as in forest harvest and use, but also indirectly, exacerbated the impact of abiotic changes, such as climate change, and biotic factors, such as forest insects and pathogens. As a consequence, anthropogenic influences led to changes in ecosystem structure and function.

Conditions of forests ecosystems are assessed by a number of criteria and parameters. Primary factors of estimation are specific (biodiversity) and reflect components forest stands. The first component is a forest's trees, usually measured by defoliation and dechromation. Of the existing techniques and recommendations monitoring forests and assessing condition, such as ICP-Forests, FHM, and the Sanitary Rules in Forests of Ukraine, there are no specific guidelines for criteria for assessing the condition of forest ecosystem. Most techniques include parameters which are difficult to measure and reveal little as to the precise conditions of the forest. For example, the common European parameters used for estimation of a forest ecosystem's condition, defoliation and dechromation, are not always are informative enough to characterize an ecosystem's condition, as such measures only assess the forest's trees.

Carrying out research of forest ecosystem conditions utilizing the existing techniques is insufficient for establishing cause and effect relationships related to the deterioration of forests. It is necessary to note that deterioration in the condition of forest stands can occur in combination with change in environmental components. In this case, it is not feasible to establish the reasons for deterioration of forest condition. For example, deterioration of forest stand condition can result from a decrease of forests lands in a watershed or degradation of a hydrology outside forest ecosystem.

For such situations, it is useful to apply an assessment of forests ecosystem condition at two levels: the watershed level and forest ecosystem level (Fig. 15.2). The watershed assessment should include an estimation of the degrees of degradation and, in particular, change of a hydrological function and erosion of soil cover.

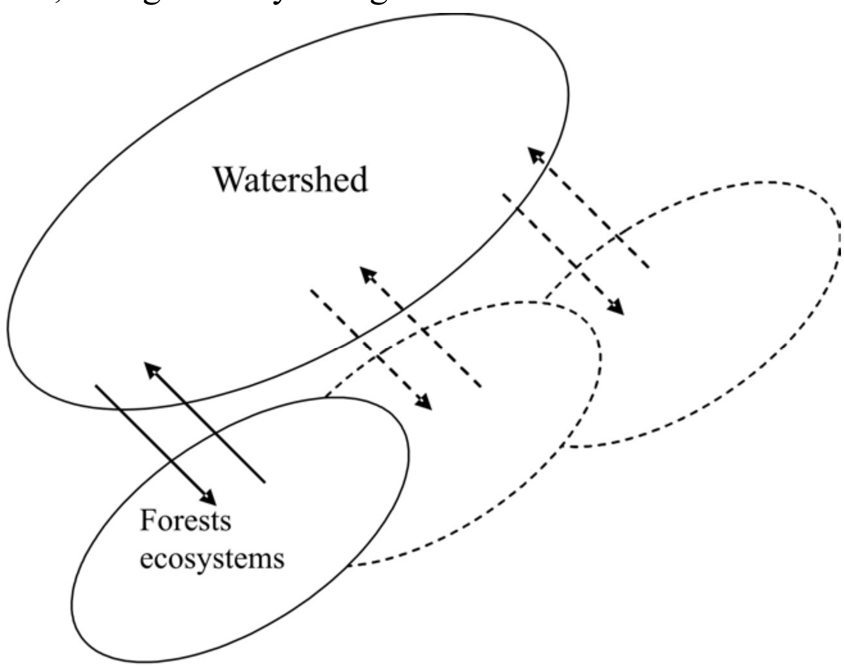

Fig. 15.2 The two-level estimation of forest ecosystem condition

To assess the condition of a forest ecosystem (level 2), one must assess levels of biodiversity and the condition of a forest's separate components such as the forest stand, the underbrush, regeneration, grassy cover and other elements. The basic approach for assessing the condition of forests is to look at the condition of trees in the main stands which characterize its development. As the main element of forest stands, it is necessary to consider the condition of the trees relative to the influence of external factors. At the forest stand level, condition is assessed by stand density, viability of trees, presence and condition of live crowns, which are characterized by a level defoliation and dechromation.

The vital condition of trees may not always reflect the condition of forest stand as a whole. So, the vital condition of trees can worsen, as a consequence of the influence negative factors, while overall stand condition may not change. Significant deterioration in stand condition can be observed through the viability of trees and mortality unrelated to biological ageing.

Recovery of trees, depending on the degree of their damage, can occur over one year or several years, but renewal of stand structure occurs over decades or centuries. It is necessary to note that deterioration of a forest ecosystem condition and the destruction of forest stands may not lead to mortality. Occurrence of the following generations of trees coincides with the dying of older forest trees. A schematic of the connection between tree condition and level of biodiversity of the forest stand is shown in Figure 15.3.

Condition a trees of the main stand	Degree of simplification a biodiversity of stand				
	1	2	3	4	5
1	1/1	2/1	3/1	4/1	5/1
2	1/2	2/2	3/2	4/2	5/2
3	1/3	2/3	3/3	4/3	5/3
4	1/4	2/4	3/4	4/4	5/4
5	1/5	2/5	3/5	4/5	5/5

Fig. 15.3 Relationship between tree condition and forest stands biodiversity

Figure 15.3 shows the processes of degradation and decrease in the level of biodiversity of forest stands as a result of tree mortality. On a vertical axis, there is an estimation of the condition of stand trees. On the horizontal axis, there is an estimation a biodiversity. The optimum forest ecosystem condition is estimated by an index of 1 to1. Arrows specify the basic changes of forest stand in response to the influence of external factors.

Simplification of biodiversity of forest stands is expressed in values 1 to 5 on the horizontal axis, and deterioration a condition trees – on a vertical from 1 to 6 degree classifications. In each cell, a fraction represents an estimation of biodiversity (in numerator) relative to tree condition (in denominator). The figure displays the deterioration or restoration of tree conditions which lead to changes in the level of biodiversity of forest stands. Thus, forest stands in the best condition have an index of 1/1. With insignificant damage to trees, an index of ½ suggests full renewal of their primary condition. Transitions 1/1 through 1/2 most are frequently observed in nature and do not lead to any degradation of forest stands. Greater deterioration of structure follows the transition of stages 1/1-1/3-2/3-3/3-3/1. It is necessary to note that with regeneration (indicated with a dashed line in Figure 3), forest stands can return to the former condition, with optimal biodiversity. However, more often, the destruction of part of a forest stand and structure can stimulate deterioration of the entire stand (transition of stages 3/1-3/4-4/4-4/1). At each stage, degradation of forest stands probably represents a partial returning of biodiversity to the preliminary condition. In the complete transition process, deterioration of tree condition can lead to full destruction of trees in the stand (represented as index 5/5). The full destruction of trees sometimes occurs during the short periods of vegetative growth (indexes 1/1-1/5). The maximum damage to trees, which is expressed by an average index of a condition of 5, leads to the maximum deterioration of condition, stand degradation and disintegration (an index 5/5).

Analysis of the criteria for assessing forest ecosystem condition suggests that the level of biodiversity within forest stands is a basic parameter. However, the vegetative biodiversity of forest stands may reflect certain changes in vital structural elements, such as forest stand, underbrush and regeneration. Thus, as discussed above, overall stand condition may reflect tree condition and regeneration, which respond to changes in environment.

Deterioration of forest condition, as well as the processes that influence plant mortality speak to the need to develop methods for evaluation of forest condition. In Ukraine, the "Sanitary rules in forests in Ukraine" and "Recommendations for complex oak forest protection against pest, disease damage"(Avramenko I. D., Lesovskiy A.V., Lokhmatov N., 1985) are used as guidelines for evaluation. In addition, the ICP and FHM Programs of forest monitoring in Ukraine are carried out by the Ukrainian Research Institute of Forests and Forest melioration (URIFFM) (Buksha I. F., 1998). In Europe, there is consensus on evaluation techniques codified in international programs of monitoring, such as the ICP Forests Monitoring (Manual of methods and criteria, 1998). In the USA, the Forest Health Monitoring Program (Forest Health Monitoring, Field Methods Guide, 1995) provides guidelines.

Comparing the URIFFM techniques for monitoring against the ICP Forests and FHM techniques revealed several principle differences, particularly in plant viability evaluations. In Europe using the ICP Forest Program, and the USA, using the HFM Program, tree condition is based on evaluation of crown features such as defoliation, dechromation, crown density, foliage transparency and peripheral crown extinction. In Ukraine, under the URIFFM recommendations, tree condition is evaluated by live crown relative to full crown potential. A live crown's photosynthetic apparatus is responsible for the plant obtaining the necessary quantity of nutrients. Dead and dry crown can reflect current or past tree deterioration (see Photo 1).

To understand methodical approaches, it is necessary to investigate the processes of deterioration and identify various stages in the deterioration process. The processes of deterioration and dying are discussed in detailed scientific reports produced in URIFFM (URIFFM, 1980). According to the methodical recommendations developed by URIFFM, oak trees are divided into six categories of condition according to the percentage of a saved crown part. The basic indices of tree condition characteristics are given in Table 1.

Table 15.1 Characteristics of oak tree condition according to URIFFM and ICP Forest Techniques

Recommendations of URIFFM			***ICP-Forest technique***		
category of viability	Characteristics of tree condition, %	percentage of saved live crown part	level of damage	characteristics of condition	level of defoliation and dechromation, %
1	healthy	100-75	1	not damaged	0-10
2	rather healthy	70-45	2	conditionally damaged	11-25
3	rather weak	40-20	3	with middle level of damage	26-60
4	very weak	15-5	4	strongly damaged	61-99
5	dying during the last year	0	-	-	-
6	dying during the last years	0	-	-	-

Dying begins with deterioration of the live crown (Fig. 15.3, Tree №1), affecting tree vigor. Initial stages of damage, as characterized by Tree №2 (URIFFM condition category 3), are expressed through crown reduction and die off. The process of tree recovery is the next stage of restoration, as shown by Tree №3. Near complete restoration of viability is observed in Tree №4. In oaks, restoration is characterized by secondary crown growth, such as sprouts and foliage. Such trees have attributes reflecting past deterioration and destruction of parts of a crown, such as in Tree № 4, shown in Fig. 15.3 in attachment). For a given time, these trees are provided with nutrients necessary for successful growth and development as the result of the formation of a new crown.

Using the basic indices of the ICP Forest technique in one-time assessements, it is not possible to determine the present condition of the trees or stages of restoration.

Table 15.2 Indices of viability of trees №2-№4 on URIFFM, ICP Forest, FHM techniques

Tree №	***Indices on techniques***				
	URIFFM		ICP Forest		
	Condition Category	Crown norm, %	Defoliation, %	Dechromation, %	Live Crown Ratio, %
2	1	95	5	0	50
3	3	40	75	0	55
4	3*	35	20	5	35
5	2*	75	15	0	85

According to methodical recommendations of URIFFM, Tree №3 belongs to condition category 3; according to the ICP Forest technique, this tree does not provide indications of deterioration on condition. Levels of defoliation and dechromation of 40 % for Tree №1 may not be crucial. However, for Tree №3, such crown loss may lead to mortality.

15.2 Methodology and Results

The experimental field work was carried out on 7 stationary sample plots, which were created between 1974 and1975 in damaged and dying oak stands. Sample plots were selected in the context of dominant forest types, age classes, structure, stand composition, and intensity of damage. The ICP Forests technique was applied as part of the visual evaluation of tree condition. Forest valuation characteristics of sample plots are given in Table 15.3.

Table 15.3 Forest assessment characteristics of sample plots

Sample plot №	*Structure (composition), %*			*A, age (years old)*	*Heigh t, m*	*DBH, cn*	*G, $м^2$/ha*	*N, units/ha*	*Growth class*
	oak	ash	maple						
1	30	70	-	70	25,4	29,1	45,02	740	I
2	50	50	-	80	24,2	28,0	45,09	615	II
3	50	40	10	120	29,6	42,2	48,40	321	I
4	100	-	-	160	23,5	56,0	20,31	82	III
5	100	-	-	60	19,8	22,3	27,00	575	II-III
6	100	-	-	60	18,0	26,0	31,98	408	III
7	100	-	-	70	18,6	27,4	24,36	360	III

While conducting field work on the sample plots, along with data collected using the techniques discussed above, the following tree data was also gathered: diameter at breast height, cohort, canopy class and relative crown height.

Statistical processing of field materials suggested a correlative relationship between the condition category and crown height. Indices of defoliation and dechromation, which are the principal measures of ICP Forests technique, are represented in Tables 15.4 and 15.5 and are compared with categories of viability under the URIFFM technique.

Table 15.4 Comparison of indices of defoliation and dechromation utilizing the ICP Forests technique and categories of viability using the RIFFM technique

Dechroma-tion, %	***Defoliation, %***										
	0/5	10/15	20/25	**30**/35	40/45	50/55	60/65	70/**75**	80/85	90/**95**	100
0	1/1	1,5/1,5	-/1,5	**2**/2	2/2	2/2,5	2,5/2,5	2,5/**3**	3/-	-/**4**	-
5	1/1	1,5/1,5	1,5/1,5	2/2	2/2		2,5/2,5	-		-	-
10	-/1,5	1,5/1,5	1,5/2	2/-	**-/2**	-/2	2,5/2,5	-	3/3	-	-
15	-/1,5	1,5/2	-	-	**-**	-	2,5/-	-	-	-	-
20	-	**2**/-	2/-	2/-	**2/-**	-	2,5/-	-	-	-	-
25	-	2/-	-	-	**-/2,5**	**-**	-	-	-	-	-
85	-/4	-	-	-	-	-	-	-	-	-	-
95	-/4	-	-	-	-	-	-	-	-	-	-
100	-	-	-	-	-	-	-	-	-	-	-

Trees in the initial stages of deterioration were included in calculations, as low index crowns or percentage of a live crown part, as shown in Photo 4, Tree №4. Levels of defoliation are displayed on the horizontal axis and dechromation is displayed on the vertical axis.

Table 15.5 Calculated percentage of a live crown part relative to defoliation and dechromation, utilizing the ICP Forests Technique

Dechromation, %	Defoliation, %																				
	0	5	**10**	15	20	**25**	30	35	40	45	50	55	**60**	65	70	75	80	85	90	**95**	100
0	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0
5	95	90	86	81	76	71	67	62	57	52	48	43	38	33	29	24	19	14	10	5	0
10	90	86	81	77	72	68	63	59	54	50	45	41	36	32	27	23	18	14	9	5	0
15	85	81	77	72	68	64	60	55	51	47	43	38	34	30	26	21	17	13	9	4	0
20	80	76	72	68	64	60	56	52	48	44	40	36	32	28	24	20	16	12	8	4	0
25	75	71	68	64	60	56	53	49	45	41	38	34	30	26	23	19	15	11	8	4	0
30	70	67	63	60	56	53	49	46	42	39	35	32	28	25	21	18	14	11	7	4	0
35	65	62	59	55	52	49	46	42	39	36	33	29	26	23	20	16	13	10	7	3	0
40	60	57	54	51	48	45	42	39	36	33	30	27	24	21	18	15	12	9	6	3	0
45	55	52	50	47	44	41	39	36	33	30	28	25	22	19	17	14	11	8	6	3	0
50	50	48	45	43	40	38	35	33	30	28	25	23	20	18	15	13	10	8	5	3	0
55	45	43	41	38	36	34	32	29	27	25	23	20	18	16	14	11	9	7	5	2	0
60	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2	0
65	35	33	32	30	28	26	25	23	21	19	18	16	14	12	11	9	7	5	4	2	0
70	30	29	27	26	24	23	21	20	18	17	15	14	12	11	9	8	6	5	3	2	0
75	25	24	23	21	20	19	18	16	15	14	13	11	10	9	8	6	5	4	3	1	0
80	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
85	15	14	14	13	12	11	11	10	9	8	8	7	6	5	5	4	3	2	2	1	0
90	10	10	9	9	8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1	0
95	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Dechromation levels of 30-80 % were not observed in registration trees. The tree condition category, as determined using the URIFFM technique in field study, is indicated in the center of cells. According to table, URIFFM viability shifts when defoliation values are between 30 % (Condition 1) and 75 % (Condition 2) or 75 % (Condition 2) and 95 % (Condition 3). Taking into account that indices of defoliation and dechromation characterize crown loss at the initial stages of damage, the percentage of live crown will equal the difference between the full crown and the percentage lost as a result of damages. Calculations are carried out under the formula:

$$Nkr = (100 - Dfl) - \frac{(100 - Dfl) * Dhr}{100}, \% \qquad (1)$$

where: *Nkr* – crown norm;
Dfl – defoliation;
Dhr – dechromation.

The theoretical values of a live crown part are represented in Table 15.5, where levels of defoliation are given on the horizontal axis and levels of dechromation are given on the vertical axis.

The levels of defoliation and dechromation are shown in relation to degrees of damage according to the ICP Forests technique. Using Formula 1, calculated percentages of live crown are provided in the center of cells.

Considering the processes of deterioration in condition and the destruction of crowns, stages of tree recovery should be more specifically delineated. After damage to the crown, a tree may realize some level of crown regrowth with the formation new branches and foliage. Thus, condition of the crown may not accurately reflect stages of restoration. Furthermore, trees at various stages of restoration may not have indications of defoliation, dechromation and reduction of crown density. Thus, when using the ICP Forests visual evaluation technique, it is important to also measure the percentage of live of crown, as compared to "crown norm." The "norm crown" is estimated by looking at the skeletal crown area of the tree. This technique is especially important in the stages of regeneration. Please refer to index in table 15.5.

15.3 Conclusions and Recommendations

Sustainable management of forests provides for the stability of forest ecosystems by accounting for external influences and balanced use. In most cases, it is not possible to establish cause and effect relations by looking only at the forest ecosystem level. Therefore, it is important to apply a two-level estimation and evaluate conditions at the forests ecosystem level and at the watershed level. The estimation of condition at the forest ecosystem level, Level 2, should is carried out by utilizing two criteria: criterion of stability of development and criterion of stability of a condition. The criterion of stability should include estimations of biodiversity, age classes and presence of natural regeneration. The criterion of stability should include an estimation of all components of the forest stand, such as underbrush and grassy cover. In an estimation of the condition of a forest stand, it is necessary to take into account the processes of deterioration of tree condition and subsequent renewal. At stages of tree and crown renewal, techniques for monitoring do not precisely identify condition. Therefore it is necessary to add an additional measure, percent of "crown norm".

Thus, in addition to a tree's categorization within the ICP Forests technique based on degree of damage, it is necessary to also classify the portion of the tree which is not damaged, the level of defoliation and dechromation.

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Оцінювання стабільності лісових екосистем

Ст. н. сп. І. Нейко, Вінницька лісодослідна станція, канд. с.-г. н

Аналіз впливу чинників середовища на стан лісових екосистем дає змогу за часом розподілити їх на дві групи: первинні (абіотичні, біотичні) та вторинні (антропогенні). Внаслідок зростання дії антропогенного тиску відбувається посилення негативного впливу біотичних та абіотичних чинників на лісові екосистеми. Це призводить до порушення генезису лісових формацій. Значне порушення та втрата здатності до відтворення компонентів лісостанів призводить до збіднення біорізноманіття.

Для з'ясування причин погіршання стану лісових екосистем запропоновано оцінювати його як на рівні ландшафту (водозбору), так і лісової формації. Враховуючи особливості розвитку лісових екосистем та періодичне відмирання компонентів лісу пропонують застосовувати критерії стабільності розвитку та критерії стану оцінки. Критерії стабільного розвитку лісових екосистем повинні враховувати показники біорізноманіття, різновіковості компонентів лісостанів, наявності природного поновлення (насамперед лісотвірних порід). Критерії оцінки стану мають характеризувати життєздатність окремих компонентів лісостану: деревостану, підліску, підросту, трав'яного покриву, інших компонентів.

Для оцінки стану лісових екосистем потрібно застосовувати показники, розроблені в рамках міжнародних систем моніторингу лісів (ICP-Forests, FHM) та у відомих настановах ("Санітарні правила в лісах України", Рекомендації із комплексного захисту дібров…"). Поряд із показниками дефоліації та дехромації, які характеризують втрату фотосинтетичного апарату деревних крон, доцільно застосовувати також додатковий показник - "відсоток живої частини крони стосовно норми".

Chapter 16

Classification of Functions Associated With European Beech Plain Forests in the Context of Sustainable Forest Management

Stepan Myklush[1]

Abstract Since the early 20^{th} century, scientists have studied different forest management approaches in terms of their ability to provide a range of ecosystem functions.. Considering the potential for forests to provide a range of resource uses and values, classification of forest functions and resources at the regional level will help inform sustainable forest management.

The most complete list of forest functions was developed by Y.Y. Tunycya, however different forest function classification systems have been developed. Common shortcomings in these are unclear differentiation and distinctions among individual functions.

I distinguished 52 functions of plain beech forests considering their ecological, economic, and social values. These functions satisfy a range of societal needs and require specific silvicultural practices to produce. The quantity and type of forest functions demanded over time changes as societal values change. Societal demands for forest services can influence their classification. This paper proposes a three-level system for classifying forest functions, consisting of (1) type, (2) group, and (3) function. Division into groups was performed according to their similarity, especially in terms of the corresponding silvicultural measures needed to produce them. The highest taxonomic unit in the classification system is function type, which describe the broad demand society places on forest resources.

Considering the current expansion in area and values provided by beech forests, their functions are aggregated into 14 groups at the middle classification level. These are recreational, sanitary, research, defensive, protective, environment forming, water-protective, soil-protective, atmosphere-protective, biota-protective,

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food, fodder, power, and industrial. At the top classification level (type), they are grouped as social, ecological, protective, and raw material.

Each function of beech forests is most important under specific conditions. For instance, forests provide function such as soil-formation, watershed and hydrologic regulation, wind breaks, harvestable and extractive materials, and recreational opportunities. Recently there is increasing interest in forest functions related to climate change, such as carbon sequestration, and production of drinking water. Societal demand for specific functions is achieved through different types of resource utilization. Providing a full range of utilization types forms the essence of multipurpose forest management.

At top levels of the classification system, different functions drive the general direction for multipurpose management. At lower levels, the desired functions influence choice of more specific multipurpose management approach, but these are often implemented over more limited time and space. To illustrate how the proposed classification can be applied in practical forest management, this paper presents a case study focusing on beech plain forests.

It should be noted that forest management cannot always consider the whole variety of forest functions. In reality only one or two main and 2 or 3 secondary functions are usually considered. However, sophisticated mathematical modelling methods can be applied to help achieve multipurpose forest management. According to location of beech forests and their meaning, there could be different main functions.

Type and intensity of forest management should be adapted according to the forest functions groups.

Класифікація функцій рівнинних букових лісів у контексті сталого лісового господарства

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16.1 Вступ

Функція лісу – об'єктивна властивість лісової екосистеми, яка проявляється через специфічний вплив на чинники середовища, явища природи і компоненти біосфери. Функцію лісу можна розглядати як сукупність наслідків його впливу на зміну абіотичних та біотичних чинників середовища та явищ природи, тобто як результат взаємозумовленого функціонування компонентів екосистеми в межах лісу у взаємозв'язку з зовнішнім середовищем (Щербина В.М.,1999).

Лісові ресурси – це не тільки сировина, але й багатогрstates корисності лісу, які не оцінені належно (Токмурзин Т.Х., 1978, Тупиця Ю.Ю., 1973, Шейнгауз А.С., Сапожников А.П., 1983). На потребу диференційованого ведення лісового господарства з урахуванням багатофункціональності лісів вказували М.М.Орлов

(1924), Г.Н. Висоцький (1950), М.Е. Ткаченко (1939), А.В. Побединський (1979), А.А. Молчанов (1973), С.А. Генсірук (1964), П.І. Лакида (2002) та ін.

Зважаючи на це організацію господарства доцільно починати з класифікації функцій лісових ресурсів району. О.С. Шейнгауз та А.П. Сапожников (1983) з метою належного проектування лісогосподарських заходів пропонують: 1) класифікувати функції лісових ресурсів; 2) для конкретного лісового масиву на основі класифікації встановити перелік використовуваних чи прогнозованих до використання функцій; 3) визначити у кожному конкретному випадку цінності різних видів функцій; 4) формувати цілі господарства з урахуванням усіх виявлених функцій і їхньої вагомості; 5) обгрунтувати режими використання лісових ресурсів, що забезпечують досягнення поставлених завдань; 6) вибрати системи та форми господарства, що відповідають режимам та цілям; 7) обгрунтувати рівень інтенсивності господарства, який забезпечує неперервність та невиснажливість використання лісових ресурсів.

16.2 Підходи до класифікації функцій лісів

Існують різні класифікації функцій лісових ресурсів (Тупиця Ю.Ю., 1973; Рубцов М.В. 1984; Шейнгауз А.С., Сапожников А.П. 1983; Papanek F. 1977), загалом їм притаманна недостатня диференціація окремих функцій чи відсутність відмінностей між окремими з них. В одній з перших концепцій (Papanek F. 1977) здійснено поділ функцій лісу на три основні: 1) продуктивну; 2) екологічну; 3) природоохоронну та введено поняття інтегральної функції.

Оскільки наслідком дії функцій лісу є зміна чинників середовища, явищ природи і компонентів біосфери, вплив на них лісу, за М.В. Рубцовим (1984), може проявлятись у вигляді запобігання, стимулювання, сповільнення, ліквідації чи відновлення функціонування у просторі та часі чинника середовища чи явища природи як у кількісному, так і в якісному аспекті. Будь-яку функцію лісу визначають природні та соціальні умови, характеристика лісових біогеоценозів, від поєднання котрих вона проявляється різною мірою. За масштабністю дії функція лісу може бути: локальною; регіональною чи зональною; глобальною (Рубцов М.В. 1984).

Поряд з функціями лісу М.В. Рубцов (1984) виділяє ролі лісу, виходячи з його значення для суспільства і економіки держави, що зумовлене функціями лісу. Він виділив дві суперролі лісу: середовищетвірну та соціальну. Вслід за М.В. Рубцовим пропонує розділяти функції та ролі лісу В.М. Щербина, який розробив детальну класифікацію ролей лісу (Щербина В.М. 1999). Основна відмінність між функціями та ролями лісу у тім, що останні не можуть існувати без відносин "людина – ліс". В.І. Парпан (1994), класифікуючи букові ліси за цільовим призначенням, у лісах екологічного та господарсько-сировинного призначення виділяє чотири підгрупи: заповідну, рекреаційно-оздоровчу, водоохоронно-захисну і господарсько-сировинну, яким відповідають чотири типи господарювання та антропогенного використання. Визначальними принципами екологічних основ використання лісових ресурсів

В.І. Парпан вважає: 1) ценоекологічний; 2) імітації природної структури; 3) максимального використання природної відновної здатності ценопопуляцій головних лісотвірних видів; 4) екологічної технології; 5) дотримання меж допустимих навантажень; 6) екомоніторингу. Їх диференційовано залежно від цільового призначення лісів (Парпан В.І. 1994).

Надання лісами економічних вигід (послуг) дало підстави Дейлі і Фарлей (H.E. Daly і J. Farley 2003) ототожнити їх з економічними активами. Для економічної оцінки лісових ресурсів А.Б. Горстко і П.А. Хайтер (1991) виділили економічні, екологічні та соціальні групи функцій лісу. Такі ж великі блоки функцій лісів виділили Я.В.Коваль та інші (Коваль Я.В., Мишенин Е.В., Царенко А.М. и др., 2002).

Класифікація лісових ресурсів, яку запропонували А.С. Шейнгауз та А.П. Сапожников, (1983) містить 4 класи, 14 підкласів, 29 груп, в які об'єднано 75 основних функцій. М.В. Рубцов (1984) виділяє суперфункцію – біосферотвірну, що поділяється на чотири загальні функції: клімато-, ґрунто-, гідросферо- біотоперетворювальну, які формують 4 одноіменні групи. В.М. Щербина (1999) виділив два типи функцій лісових екосистем (біогеоценозний та пертинентний), у кожному з них – ландшафто-стабілізувальний клас, які у першому випадку містять 6 підкласів, у котрі об'єднано 12 груп, а у другому – 4 підкласи з 11 групами функцій.

16.3 Класифікація функцій рівнинних букових лісів

Класифікація функцій лісових ресурсів має базуватись на системно-функціональній моделі лісового господарства як частини системи природокористування і враховувати можливості лісових екосистем та потреби суспільства. Враховуючи поширення рівнинних букових лісів, їх екологічне, господарське та соціальне значення, ми виділили 52 функції, які задовольняють відповідні потреби суспільства і потребують для їх забезпечення певних лісогосподарських заходів у конкретних лісорослинних умовах. Їх виділяють за явищем чи об'єктом, які реалізуються в процесі використання корисностей чи матеріальних ресурсів лісу. Кількість функцій та їх деталізація можуть змінюватись відповідно до розвитку суспільства, це може теж позначатись на їх класифікації. Для класифікації функцій лісових ресурсів пропонуємо трирівневу систему – **тип** – ***група*** **–** функція. У групи функції об'єднані за спорідненістю та потребою здійснення однотипних лісогосподарських заходів. Вищою таксономічною одиницею класифікації визначено тип функцій, який характеризує задоволення сукупності потреб суспільства в лісових ресурсах у процесі природокористування.

Враховуючи поширення та значення рівнинних букових лісів у кожному регіоні, їх функції об'єднано у 14 груп: рекреаційна, санітарно-гігієнічна, науково-дослідна, оборонна, захисна, середовищетвірна, водоохоронна, ґрунтозахисна, атмосфероохоронна, біотоохоронна, харчова, кормова, енергетична та промислова. Вони згруповані у такі типи функцій: соціальний, екологічний, охоронний та сировинний (табл. 16.1).

Пропонована класифікація може забезпечити обґрунтований підхід до організації багатоцільового використання лісових ресурсів у рівнинних букових лісах, а також до режимів господарства та інтенсивності лісогосподарських заходів у певних категоріях лісів.

Таблиця 16.1 Функції рівнинних букових лісів

Класифікаційні одиниці		
Тип	Група	Функція
Соціальний	*рекреаційна*	лісопаркова
		пансіонатна
		візитаційна
		туристична
		спортивно-мисливська
		ландшафтно-естетична
		колекційна
	санітарно-гігієнічна	оздоровча
		санаторно-курортна,
		киснепродукувальна
		вуглецедепонувальна
		пиловловлювальна
		шумопоглинальна
		мікрокліматотвірна
	науково-дослідна	заповідна
		дослідницька
		пізнавальна
		спеціалізовано-освітня
	оборонна	оборонна
		маскувальна
Екологічний	*захисна*	джерелозахисна
		агропротиерозійна полезахисна
		садозахисна
		дорожньозахисна
	середовищетвірна	лісорепродуктивна (насіннєва, поростева)
		лісоохоронна
		протипожежна
Охоронний	*водоохоронна*	кольматівна
		водотерморегулювальна
		водохімічна
		стокорегулювальна
		гідромеліоративна
	ґрунтоохоронна	ґрунтоформувальна
		ґрунтотерморегулювальна
		структуротвірна
		ґрунтохімічна
		гумусоакумулювальна
		ґрунтопокривноформувальна
		протиерозійна
	атмосфероохоронна	вітрорегулювальна
		пиловловлювальна
		газоуловлювальна
	біотоохоронна	популяцієохоронна
		ареалоохоронна

	Класифікаційні одиниці	
Сировинний	*харчова*	плодопромислова рибопромислова травопромислова мисливськопромислова
	кормова	гілкокормова плодокормова
	енергетична	продукування дров'яної деревини гілляпродукувальна, сучкопродукувальна
	промислова	продукування ділової деревини балансопродукувальна танідопродукувальна

Кожна із функцій букових лісів за певних умов є найважливішою. Загальновідомє значення грунтоформувальної, стокорегулятивної, вітрорегулятивної функцій, сировинних чи рекреаційних груп функцій. Значення окремих функцій зростає разом з розвитком промислового виробництва. Останнім часом щораз актуальнішою стає проблема зміни клімату та водозабезпечення регіонів, тому зростає значення вуглецедепонувальної та водоохоронної функцій рівнинних букових лісів.

Задоволення потреб суспільства в конкретній функції лісових ресурсів реалізується через конкретний вид їх використання, а поєднання видів формує багатоцільове використання лісових ресурсів, що є в основі організації сталого лісового господарства. Багатоцільове лісове господарство віддавна ведеться у букових лісах, хоча його організація переважно базувалась на використанні окремих функцій. тому важливо визначити можливість поєднання певних видів лісових ресурсів у конкретній організації господарства. Поділяємо думку О.С. Шейнгауза та А.П. Сапожникова (1983) про доцільність виділення чотирьох типів поєднання видів використання лісових ресурсів: 1) синергетичне, за якого види використання не тільки не заважають, але і посилюють одне одного; 2) нейтральне, за якого види використання несуттєво впливають одне на інше; 3) конкурентне, за якого види використання суттєво обмежують одне одного; 4) альтернативне, коли види використання лісових ресурсів не можуть поєднуватись на одній території. Поєднання функцій лісових ресурсів завжди має конкретний характер для певного часу та території і може змінюватись разом із зміною цілей, способів і технологій чи інших умов лісового господарства.

Прикладом синергетичного поєднання видів використання ресурсів є ефективне виконання буковими лісостанами заповідника "Розточчя" захисних, водоохоронних, середовищетвірних функцій. Водночас ці насадження не можуть бути джерелом заготівлі ділової деревини чи дров, тобто у такому випадку справу маємо з конкурентним поєднанням функцій. Букові масиви військових лісгоспів, виконуючи оборонні чи маскувальні функції, не призначаються для рекреації чи заготівлі деревини, тобто поєднання оборонної та рекреаційної чи сировинної функцій є альтернативним. Вони виконують санітарно-гігієнічну функцію (поєднання функцій нейтральне), охороняють грунти, атмосферу (синенергетичне поєднання). Експлуатаційні букові масиви Опілля забезпечують економіку держави високоякісною деревиною, дровами, тобто енергетичним ресурсом (поєднання функцій –синенергетичне), не призначаються для рекреації (поєднання функцій – альтернативне), і не слугують для заготівлі плодів (поєднання функцій –конкурентне).

Поєднання видів використання лісових ресурсів на різних класифікаційних рівнях визначає характер рішень багатоцільового лісового господарства. На нижчому рівні детальніше описано поєднання видів використання лісових ресурсів, точніше – може бути прийняте рішення щодо організації сталого багатоцільового лісового господарства, але воно буде обмежене часом і територією. Розроблено двомірну матрицю поєднання груп використання ресурсів рівнинних букових лісів станом на 01.01.2008 р. Зауважимо, що сучасні методи управління не дають змоги врахувати всю різноманітність функцій лісових ресурсів. Зазвичай розглядають одна-дві основних та дві-три додаткові. Для реального вирішення проблеми багатоцільового використання лісових ресурсів, врахування можливого поєднання видів використання лісових ресурсів потрібне залучення складних математичних методів. О.С. Шейнгауз, А.П. Сапожников (1983) пропонують для вирішення цієї проблеми методи оптимізації. Жодна організація лісового господарства, спрямована на багатоцільове використання лісів, не досягне бажаного результату, поки не буде визначено її мети.

Відповідно до розміщення рівнинних букових лісів, їхнього значення, основними функціями в певних регіонах можуть виступати різні з них (табл. 16.2).

Таблиця 16.2 Пріоритетні функції букових лісів за регіонами

Регіон	*Шифр панівного типу лісу*	*Тип функції*	*Основна функція*
Волинська височина	D_2 -гД	соціальна	пізнавальна
Розточчя	D_2 –д-гБк	охоронна	стокорегулятивна
	C_2 –г-дС	охоронна	ґрунтоформувальна
Опілля	D_2 –д-гБк	сировинна	продукування ділової деревини
	D_2 -гД	соціальна	вуглецедепонувальна
Західне Поділля	D_2 –д-гБк	екологічна	лісоохоронна
Східне Поділля	D_2 -гБк	охоронна	популяцієохоронна
Центральне Полісся	D_2 -гД	соціальна	дослідницька

Очевидно, що основними функціями букових лісів на Лівобережжі України є пізнавальна, середовищетвірна, в зелених зонах м. Львова, Тернополя, Чернівців – рекреаційна, вуглецедепонувальна, в експлуатаційних лісах Розточчя, Опілля та Поділля – перевагу надають заготівлі ділової деревини, але усі вони виконують санітарно-оздоровчу, охоронну, захисну функції тощо.

16.4 Висновок

Численні функції рівнинних букових лісів, які проявляються в системі "ліс-людина", мають важливе значення для забезпечення життєдіяльності людини та економіки держави. Класифікація функцій рівнинних букових лісів дасть змогу ефективно використовувати їхні ресурси. Для груп функцій мають бути опрацьовані заходи щодо режимів та інтенсивності ведення сталого лісового господарства.

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Chapter 17

Challenges and opportunities for the sustainable development of forest management on private lands in Ukraine

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Currently, the total area of private forestland in Ukraine consists of approximately 318,000 hectares – less than 3 % of the nation's total forest area. From an ecological and economic perspective, there is considerable agricultural land in private ownership that could be reforested. Land that is suitable for afforestation or reforestation includes: eroded pasture and cropland, non-productive or marginally productive farmland, mine spoils and tailings, open land contaminated by industrial waste, undeveloped urban or suburban land and other types of open lands. An undetermined number of acres are currently abandoned, underutilized or not in production because of the lack of economic investment, land-tenure and distribution patterns and lack of modern farm equipment. As opposed to adjoining countries in Eastern Europe, there are no plans for land restitution in Ukraine. Because there is such a small percentage of forested land, there is no serious consideration being given to privatization of forestland belonging to the State Committee of Forests of Ukraine. However, there has been, ongoing discussion of privatization of woodlands belonging to the former *kolhosps* or state collective farms. The State Committee of Forests

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of Ukraine has made it a priority to increase the percentage of forest area in the country from the current 15-16 % to 18 % in 2025 and up to as much as 20 % by 2050. State figures are unreliable but this will entail massive afforestation and reforestation of as much as five million hectares of land. These are ambitious goals and it is clear that, in order to succeed, there will have to be investment from the private sector and some form of private forest ownership in Ukraine will have to be introduced as an option in the near future. Any privatization of forests or large-scale afforestation of open land will require a sound, stable, and supportive legal environment, that will include a reasonable tax regime and a program of public forest regulations that will see to the protection of larger social interests. Obviously, this must build on the current situation based on the Land Code, the Forest Codex, and relevant tax and environmental legislation. Complex analyses of the private forestry perspectives and problems in Ukraine are discussed and the first steps to initiating a dialogue between society and public authorities are proposed.

Проблеми та перспективи сталого розвитку лісового господарства на землях приватної форми власності в Україні

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Загальна площа лісових земель приватної форми власності, згідно з офіційною статистикою, становить на сьогодні 318 тис. га або близько 3 % площі лісів Україні. Загалом, в Україні існують значні площі приватних сільськогосподарських земель, що мають бути залісені: еродовані, виснажені, забруднені тощо. Крім екологічних міркувань, існує багато інших стимулів для розвитку приватного лісівництва різних рівнів: від сімейних лісових ферм до великих лісопромислових господарств. Однією з головних умов успішного розвитку приватного лісівництва різних форм в Україні є добре розвинене законодавче поле, яке охоплює економічні та ринкові стимулювальні інструменти (наприклад зменшений податковий тиск) та програму суспільного регулювання приватного лісівництва в інтересах захисту ширших соціальних інтересів. Розроблення таких інструментів має будуватись на аналізі поточної ситуації у цьому секторі, відповідати Земельному, Лісовому кодексам, відповідному податковому та екологічному законодавству. Потрібно також здійснити комплексний аналіз перспектив та проблем приватного лісівництва та ініціювати діалог між потенційними лісовласниками, суспільством та державними органами управління.

У лісовому кодексі наголошує на тому, що ліси України "…за своїм призначенням та місцерозташуванням виконують переважно водоохоронні, захисні, санітарно-гігієнічні, оздоровчі, рекреаційні, естетичні, виховні, інші функції та є джерелом для задоволення потреб суспільства в лісових ресурсах" (Лісовий кодекс 2006). Пріоритетність екологічних функцій лісів зумовлена низькою лісистістю України та тим вирішальним значенням, які ліси мають для збереження екологічного та видового різноманіття у ландшафтах. Соціально-економічні та екологічні зміни, які відбулися за останні десятиріччя, показали, що існуючі ліси не в змозі компенсувати існуюче антропогенне навантаження на довкілля. Це стимулювало зміщення пріоритетів національної лісової політики в бік нарощування темпів лісорозведення.

Починаючи з кінця 90-х років Уряд на підставі об'єктивного аналізу стану наземних та водних екосистем затвердив цілу низку законів та програм спрямованих на покращення їх екологічного стану, важливою частиною яких було лісорозведення. Зокрема, це Національна програма екологічного відновлення басейну Дніпра та покращення якості питної води (27.02.97), Закон України про "Про Загальнодержавну програму формування національної екологічної мережі України на 2000-2015 роки" (29.12.99), Закон України "Про невідкладені заходи щодо створення захисних насаджень на виснажених землях та у басейнах річок" (28.02.01), Державна програма "Ліси України", 2002-2015. Загалом усі програми передбачали створення додаткових лісів на площі 2,339 мільйона га і збільшення лісистості України до 20 %.

Аналіз сучасного стану виконання цих програм переконує, що прийняті обсяги лісовідновлення були здебільшого намірами та планами. Частково це було пов'язано із заниженою вартістю створення гектара лісу, яку було закладена у програми. Зокрема, у програмі створення захисних насаджень вартість створення гектара лісу становила 964 гривні, у програмі "Ліси України" 1440 гривень, що було скориговано у 2007 році до 3500. Інша причина – скорочення обсягів фінансування робіт з державного бюджету. Аналіз переконав, що в існуючих соціально-економічних умовах повноцінна реалізація згаданих програм за рахунок державного бюджету дуже маловірогідна, що вимагає пошуку нових механізмів та підходів для реалізації зазначених вище національних пріоритетів.

У цьому контексті перспективним виглядає розвиток напряму, за якого можливо було б залучення коштів приватних та закордонних інвесторів для реалізації такої мети національної лісової політики як лісорозведення на приватних землях. Необхідними умовами реалізації такого сценарію є створення абсолютних гарантій прав власності на землі, що були залісені, широка підтримка його громадкістю, власниками непридатних для сільського господарства земель, а також створення сприятливого, чіткого та прозорого законодавчого поля, пільгових податкових умов, розроблення адаптованих технологій посадки, вирощування та догляду за лісом, розрахованих як на великих, так і на малих власників земель, створення системи державної підтримки лісорозведення на приватних землях.

Результати соціологічного опитування, яке здійснила компанія "TouchPall" на замовлення Державного Комітету лісового господарства України свідчать, що питаннями приватної власності на ліси вже опікується 11,6 % громадян.

Близько чверті опитаних (26,1 %) вважають, що потрібно розвивати інші, ніж державна, форми власності на ліси, а 34,9 % вважають, що приватна власність на ліси вже широко розповсюджена в Україні. При цьому більша частина громадян (84,9 %) вважає, що підсилення екологічної функції лісів має залишатись пріоритетним напрямком лісової політики в Україні.

Отже, на сьогодні існує потреба як з боку держави, так і суспільства, у здійсненні наукового аналізу передумов та потенціалу для розвитку лісівництва на приватних землях. Підготовку такої роботи здійснюють у межах співпраці Інституту лісового та садово-паркового господарства Національного університету біоресурсів та природокористування України та факультету лісівництва та екологічних досліджень Єльського університету за підтримки ряду неурядових організацій, таких як Асоціація фермерів та приватних власників України, Спілка орендарів та підприємців України та інших. Метою проекту є науковий супровід, юридичне та еколого-лісівниче забезпечення розвитку ефективної системи ведення лісового господарства на землях приватної форми власності, яке б охоплювало всі етапи лісовирощування, починаючи зі створення лісу, а також регламентувало можливі варіанти управління цими лісовими землями. У межах проекту планують розробити підходи до контролю за лісовласниками з боку державних органів управління, систему стимулювання приватних власників щодо розвитку екологічних корисностей лісу для регіону, врахування інтересів місцевої громади, а також інституційну систему, яка б забезпечувала справедливе ведення лісового господарства на землях всіх форм власності.

Chapter 18

Terms and Principles of Sustainable Forest Resource use Based on a Historical Review

Alexander Adamovsky[1]

Abstract This chapter analyzes the evolution of ideas and principles in sustainable forest resource use (or sustainable forestry). Terminology and principles developed over the last three hundred years are described based on the European experience. I review the history of forest management thinking, beginning with the first articles of Karlovich, Schwestka, Hartig; tracing the subsequent development and improvement of concepts by Judeikh, Wagner, Baader, Knuchel, Mantel, Richter, and Davis; then continuing to the present day meaning of sustainable forestry terms and principles. I argue for the concept of the "target forest" as an idea that facilitates decision making optimization by regulating the harvesting areas and time limits of forestry resource use in Ukraine.

18.1 Introduction

Modern economic development tendencies show positive changes in careful treatment of nature. But there are reasons to consider that during transitive period to market economic relations in Ukraine for some time past we obviously see negative, literally, merely consumer's influence of man on forest resource, which also unfavourably affects economy, environment and man himself.

Only preservation of natural resource potential may guarantee further economic progress for coming generation. Forests of Ukraine need and demand special care because they are the main component of landscapes and at the same time they meet the needs of forest and wood processing enterprises, building organizations and other timber users, local communities in particular.

Ukraine aims at integration to European Union. This fact puts before modern society new requirements to the quality of exported production, timber in particu-

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lar. Having entered European and world markets, Ukrainian timber products will get in strict competition. Uncertificated products world market sales has more and more barriers. Therefore forest certification becomes more actual.

One of the biggest forests certificating world organization is FSC (*Forest Stewardship Council)*. This organization has determined "FSC principles and criteria", which are used for all types of forests, and without keeping to which FSC certification is impossible. According to these principles forest management must be directed to effective multifunctional use of forest products and functions. Rising and keeping up economic vitality and also getting and consideration of wide range ecologic and social effects and expenses must become the purpose of such certificated forest management. Forest users must contribute to ecologic forest productivity maintenance.

Forest management and forest production marketing measures are necessary to promote different forest products optimal use and local processing. Forest management must facilitate cutting and processing waste decrease and prevent damage to other species of forest recourses. This activity leads to strengthening and diversification of local economy and helps not to be depended on the only type of forest product.

Forest management measures must support and contribute to water protecting, recreational and other useful forest functions improvement and help to increase its resources and their sustainable use. Forest exploitation volume cannot exceed unexhausting safety level of forest use.

18.2 Sustainable Forest Use Idea Evolution

Sustainable forest use idea evolution can be clearly seen in the history of forest management basis and principles appearance and improvement. It is obvious that even deferent methods of calculated wood cutting area determination for the last three hundred years take into account the idea of continuous forest use. First this concept meant uniformity, regularity and rationality. Later it extended to a certain direction of forest management. It was caused by transformation of social understanding of forest, general and forestry knowledge increase and industrial system development. There is understanding of negative influence on forest ecosystems because of unreasonable anthropogenic intrusion and the problem of continuous timber supply for public utility needs.

At the beginning scientific explanation of continuous forest use was made by Karlovich, who suggested the idea of the need for long lasting forest use in 1713. Hartig, the founder of a famous German forest biometry scientist dynasty, gave the concrete interpretation of this idea (Hartig 1975). He determined the principle of even annual forest use. It is a pity, but in his works we could not find real ways to reach the uniformity. Cotta grounded foundations of forest management methods according to the area. Aloiz Schwestka suggested to determine rating and value of every forestry, two of his books were published in Lviv (Malynovsky, Goroshko 1995).

The early period of improving forest management principles regardless of the theoretical arguments passive character or their practical realization possibilities, in our opinion, is valuable, because the researches concentrated their efforts on correction of their predecessors' mistakes. In the following two centuries the idea of continuous forest management had a very strong impact on saving forests of Europe from excessive cutting. The attempts of bringing the continuous forest management conception into life resulted in its inseparable combination with forest management. This fact is shown by famous scientists – the authors of books, which became classic – Judeikh, Wagner, Baader, Knuchel, Mantel, Richter and Davis. All of them, without exception, introduced the conception of continuity into the forestry organization system, which is prerogative of forest management. Judeikh, in particular, was the first to explain the continuity concept in scientific publications (Judeikh 1877). The development of public opinion, the change of aspects on the forest brought inevitable understanding of the continuous forest management idea on the state level. In several countries these ideas brought into life government resolutions (Switzerland 1876 and Austria-Hungary 1884). The last resolution had a favorable influence on the development of forestry organization in Galicia (western part of Ukraine).

An important contribution to idea of continuous forest management was made by scientists Schokke, Hundershagen and Heyer. In the opinion of these authors basic factors of continuous and even forest using are stand growth volume and cutting cycle, right territorial (spatial) placement and the same volume of uneven aged classes of trees. At the same time growth, reserve and calculated wood cutting area must be regular. Decisive condition for getting continuous even wood supply, according to Heyer, is normal space-age structure of forest stand, which depends on accepted regularity of cutting, spatial arrangement of forest stands and regular growth on a certain area. Such forest objects are classified by Heyer as continuous forest management objects.

Thus, Heyer added financial aspect to the continuous forest management concept. Beginning from 18-th century this aspect is reflected in the theories of land and forest rent by Bordreve and Grieb (Harrison, de Kluyver 1984). These theories are directed to form a certain forest management system.

Theories of land and forest rent according to the state of forest stand contributed to development of forest management methods. Judeikh develops assumption, that manifestation of continuous forest using for gaining the profit is choosing the best possible cutting age of forest stand regardless of the state of all region.

Further development of continuous forest management conception we can find in the works of Karsthofer, who adds a new aspect recommending to pay special attention on the need of keeping to the even annual forest using principle with unconditional forest stand. The author considered that any actions to grant the future growth of forest exploitation through temporary limitation, mainly for territorial forest management, are features of continuous forest management. Karsthofer made an important contribution to development of continuous forest management conception (Adamovsky 2000).

Scientific achievements in understanding forest productivity rules, development of their classification, forest typology in particular caused that potential productivity of forest conditions type and real state of forest groups were considered to be the most important factors of keeping continuous timber supply.

At the same time optimal age structure of forest stands was considered less important. Conviction prevailed that every decrease of productivity level leads to negative consequences for a long period. Different methodic regulating product output developed together with researchers of continuous forest management conditions.

Obtained results and realization methods of forest management conception resulted in it's separation into two composites: continuously material resource supply and continuous production in general. Weber, Landolt, Flury and other scientists made attempts to consider both aspects in continuous forest management principle interpretation. Definition of stability in forming timber resource conception belongs to Weber. He considered timber resource to be a condition of continuous forest management and connected it with even in time and space restoration of certain structure forest stand. Unfortunately, Weber did not define in details continuously unit and desirable forest structure characteristics, did not set production period length.

Landolt considers a certain state that is taken as normal as the most important characteristics during evaluation of existing forest (Garrod 1999). These characteristics are the following: correct structure of age classes and their reasonable placing at a certain territory, good quality forest stand condition (high thickness in particular) and forest stand species harmonization with environmental conditions.

Fluri also kept to similar conceptions. He considered that forest management evaluation must be made on the principle of existing forest comparison with normal state, which is a model and is taken as purpose of management. Nevertheless, Fluri did not define in details this normal state, did not formulate and determine its characteristics depending on forest management conditions. Wagner (Garrod 1999) confirmed Fluri's conception of continuous forest management as a purpose of management. He asserted that continuous forest management conception reflects persistency of desire to reach the state of forest formation balance with reserve structure with even reserve and growth division to separate years with necessary regularity of cutting. Wagner considered the first way of this desire direct, the second – mediated through constant income supply.

According to Baader, the continuality conception is aside of the main management theories and it must only define the resource renewing conditions, which come from forest management and development rules, without management purpose direct clarification. So we can consider that the conception gives certain freedom in the choice of purpose. Unfortunately, more often it is the purpose that rules the ways to reaching the desired state, formation of the forest in different aspects (economic or intangible functions).

Continuous forest management conception special modern interpretation depends on the requirement to take into account multitude intangible forest functions in forest management principles. In previous interpretations they were almost neglected. Intensive forest use causes that along with traditional continuous forest management notions (like reserve and growth, income, normal state etc.) appear new, for example, forest stand stability, social and protective tasks, recreational value, biologic sustainability, long productivity, landscape value.

Continuous forest management complex explanation is given by Dietrich and Leibungdgut (Adamovsky 2000). Dietrich states that continuous forest management is determined by stable and long lasting ability to carry out different functions. Leibungdgut considers that continuous forest management conception realization means formation and maintaining such forests, that could adapt to local environment and perform their productive and versatile environmental influence functions. We can notice that this definition has much in common with the previous one.

Leibungdgut expands the normal forest conception. He assumes the normal forest to have not only space-age structure and reserve, to grant the highest growth possibility, but also long lasting and maximum intangible functioning ability.

Kuhn, basing on time changing forest character conception, and dependence on regional situation recommends to separate the notion of high level continuous forest management, which includes general social economy functions, from the notion of continuous forestry production.

Trampler points out at the double meaning of this notion, at its importance for forestry policy and economy growing tasks for continuous forest management conception, especially in the first aspect (Adamovsky 2000).

Schrotter, who included continuous forest management principle into forest economy tasks system as a means of ruling and regulating, declared similar opinion.

18.3 Sustainable Forest Management Modern Meaning

European countries focus on the sustainable, understructure, unexhausting, self-restorable forest management principles is reflected in resolutions of International Ministers Conferences on European forests protection (Strasbourg – 1990, Helsinki – 1993, Lisbon – 1998, Vienna – 2003, Warsaw – 2006). Ukraine also joined to these resolutions. They provided for the forest cover stabilization necessity, biodiversity conservation, introducing scientifically argued forest management measures and multifunctional forestry (especially mountain territories).

Thirty years ago at the International United Nations Organization Conference in Stockholm the representatives of many countries agreed that urgent measurement must be taken to solve the problems of environmental degradation. At the United Nations Organization Environment and Development Conference in Rio de Janeiro (Rio-92) these countries came to the conclusion, that environmental protection and social-economic development are very important for sustainable development on the coordinated at the conference principles. The conference adopted "Agenda 21" and "Environment and Development Declaration" to ensure the development. These principles were confirmed by the countries-participants of the World Earth Summit (Johannesburg – 2002) as "Plan of actions". At the last Summit there were more than 20 thousand participants from 180 countries of the world (Johannesburg summit 2002). Analyzing the country activities for last ten years, the participants stated that only developed countries follow the main principles of forest management, declared at the Conference Rio-92. First of all it was caused by the suggestive and not directive character of the Conference resolutions and declarations. Accordingly, first of all, the countries that had sufficient financial resource realized those principles.

In our opinion the best modern definition of sustainability was given in the general Forest Protecting Ministers Conference Declaration in Helsinki (1995): "Sustainable forest management means regulating an managing forests and forested territories in such a way and with such intensiveness that could secure their biologic variety, productivity, restoration capability, vitality, and also ability to certain ecologic, economic and social functioning today and in future on local, national and global levels without damage to other ecosystems". Further it says, that "forest resources and forested territories must be managed according to the principle of sustainability to meet social, ecologic, cultural and spiritual needs of the present and future generations of mankind" (UNEP).

This definition obviously shows that sustainability conception has a very wide explanation. This idea is hard to realize completely, it may only serve as a social guideline for those who set forest management rules.

Actual problems of continuous forest management realization by forestry enterprises reveal an urgent need for decision making process optimization to regulate the forest management amounts.

In modern conditions keeping continuous forest management mostly depends on the way it is directed, that causes intensity and character of timber selection during main felling. Today scientists try to combine regulation of general use of different cutting systems with continuous forest management.

Evaluation of the state, necessary for restoration, and for Ukraine today – expanded reproduction of forest resource is still unsolved problem. It determines following the rule to accept timber in ideal condition. This was the reason to introduce the notion of target forest, which was made by Kurt (Adamovsky 2000, Anuchin 1978). This forest means social and economic balanced, able to restoration model, which fulfils continuous forest management conditions in complex.

Schrotter says that formation of "target forest" is constant, and its main criteria are the need to increase production and to crow forest material value.

Conception of "target forest" inspired many scientists to research forest productivity and development prognostication in different conditions of forest management intensification. These researches deal with optimization of species formation, age structure, forest amount and reserve structure, reconstruction process organization derivative and thin forest stands and forest stands of incompatible composition in the aspect of today's and future functions of forest and optimization of sanitary cuttings and main felling (Adamovsky 2000).

Improvement of forestry production organization taking into consideration continuous forest management conception in direction of its optimization includes the main trends of economic activity (the general use, restoration, care) with the purpose of forest systems stability in developed forest conditions.

These ideas are expressed in the researches of scientists from different countries of the world, and famous scientists came to conclusion that preservation and inexhaustibility of resources is possible only in joint orientation to sustainable forest management, its development, i.e. with governmental support in all the countries.

18.4 Conclusions

Forest management of Ukraine prospects must be based on the sustainable forestry principles. According to purpose forest resources divided to ecologic and resource-economic groups, which are subdivided into four subgroups: natural reserve, recreational and health-improving, protective and raw materials resources. In our opinion, because of urbanization in Ukraine in the nearest future besides timber using of forests the demand for its ecologic resource use will growth rapidly.

Today sustainable development and sustainable forest management, and also timber and other production is very important from the aspect of sustainable development providing and it is one of the most important instruments to overcome poverty, to minimize substantially deforestation range, to stop forest biodiversity losses, soil degradation and resource exhausting, to raise the level of food security and extend access to safe drinking water and reasonable priced energy; besides it visibly demonstrates multitude advantages connected with natural forests and forested territories and it is favorable to prosperity of mankind and the planet. Sustainable forest management on the national and global levels, on the principal of partnership between interested governments and economic entities, private sector including, indigenous and local communities, non-government organizations is the most important aim of sustainable development.

Today general model of multipurpose forest resource use management must cover balance of real and desired resources state problem. This balance must determine character and range of the problem that is revealed in evaluation of a certain forest ecosystem characteristic, which is ruling subject in forest management.

Composites of this balance will be of different complication scale, some of them are complex tasks (the necessity to take into consideration timber resource specific character, forest components stability).

After obtaining independence Ukraine started economic reforms in direction to industrial developed countries. That is why natural resource evaluation problem, adequate price standards for forest resource use in particular, scientifically substantiated economic forest evaluation methods become a problem of urgent importance. Complex integral forest evaluation is significant because any decision in forest economy has global influence and consequences which are far beyond local and national projects.

Transition to sustainable forest management first of all needs forest biologic variety preservation, that is why there is necessity in more exact and substantiated evaluation not only economic, but also ecologic and social factors of forming consumer cost of forest.

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Поняття і принципи сталого лісокористування: історична ретроспектива

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Еволюція ідеї сталого лісокористування наочно простежується в самій історії виникнення та вдосконалення основ і принципів організації лісового господарства. Навіть різні методи встановлення розрахункової лісосіки впродовж останніх трьохста років враховують ідею неперевності лісокористування. Спочатку поняття сталого лісокористування вживали для означення рівномірності, регулярності та раціональності використання деревних ресурсів. Поступово воно стало охоплювати певні конкретні напрями ведення лісового господарства на практиці.

Поняття "неперервність" різні автори трактують не однаково. Це зумовлено трансформацією соціального розуміння лісу, розвитком загальних природничих, економічних і лісівничих знань та розвитком промислового виробництва. Домінантними стають усвідомлення негативного впливу на лісові екосистеми внаслідок необґрунтованого антропогенного втручання і проблема забезпечення неперервного постачання деревини для господарських потреб суспільства.

У розділі проаналізовано еволюцію понять та принципів сталого лісокористування та подано європейський досвід втілення понять та принципів сталого лісокористування у історичній ретроспективі за останні триста років – починаючи з праць Краловіча, Швестки, Гартіга. Вказано на внесок у теоритичний розвиток цього поняття у працях Юдейха, Вагнера, Баедера, Кнухеля, Мантеля, Ріхтера та Дейвіса, проаналізоване сучасне розуміння сталого лісокористування. На думку автора, ідея "цільового лісу" вказує на потребу оптимізації процесу прийняття рішень шляхом регулювання обсягів та часових меж лісокористування в Україні.

PART III

EXPANDING THE SOCIO-ECONOMIC COMPONENT OF SUSTAINABLE FORESTRY

ЧАСТИНА III

РОЗШИРЕННЯ МОЖЛИВОСТЕЙ СОЦІАЛЬНО-ЕКОНОМІЧНОГО КОМПОНЕНТА СТАЛОГО ЛІСОВОГО ГОСПОДАРСТВА

Chapter 19

Forest Resource Planning for People – with People: Two-level Planning for Sustainable Natural Resource Management

Hilmar Foellmi and Raphael Schwitter[1]

Abstract Following the severe flood of 2001 in Transcarpathia, the Swiss-Ukrainian Forest Development Project in Transcarpathia (FORZA) was formulated with the objective to introduce and test new forest resource planning and management approaches in the Region. Among the new approaches is the two-level planning approach – consisting of a *strategic plan*, prepared by and for the community and an *operational forest management plan* prepared by the forestry authorities. Through this strategic plan, the communities are empowered to influence decision-making about and manage-

About FORZA

CONCEPT

The project is designed to support the government of Ukraine at the national and regional levels (through the State Forest Committee and regional agencies and stakeholders) in enhancing the protection of rural landscapes through sustainable forest management, biodiversity conservation and improvement of rural livelihoods through forest related economic activities. Particular attention is given to the crucial role forest can play in preventing and mitigating natural disasters and reducing vulnerability of local people to climate hazards. The project consists of the following components:

Multi-functional Forest Management:

To further develop and strengthen multi-functional forest management using means such as close-to-nature silviculture and low-impact harvesting to sustain forest functions and enhance production of forests goods and services.

Forest Economy and Market-orientation

To strengthen the viability of forest-based economic activities by introducing market–oriented approaches and employing sound economic methodologies to forest management and landscape protection.

Improved Livelihood of the Population

To improve the livelihood of local populations through better access to forest resources and the collaboration between forest service and local communities and through the involvement of the private sector.

Forest Policy, Law Enforcement and Lessons Learnt

Based on lessons learned from project activities, to facilitate and support the development of forest policies and law enforcement by providing relevant findings and justifications to policy makers at all levels.

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ment of the forests in the vicinity of their communities. The natural resource development priorities identified in the strategic plan are important guidelines for the foresters, who will have to consider these priorities for the formulation of the operational Forest Management Plan. The two-level planning approach represents a participatory process for coordinating the community development priorities with those of forest resource management. So far this approach has been applied in two communities, on an experimental basis, but the findings suggest that the wider application of this approach is only a matter of time. Amendments to the legal framework and general increase in capacities on part of the communities and the foresters would greatly accelerate the use of the two-level planning approach in the Carpathian region.

Keywords: FORZA, two-level planning, strategic community development plan, forest management plan, Carpathian region, capacity building.

19.1 Introduction

FORZA, the Swiss-Ukrainian Forest Development Project in Transcarpathia is a technical assistance project carried out under an umbrella agreement between the Ukrainian and Swiss governments. Funding is provided by the Swiss Agency for Development and Cooperation and Intercooperation, a Swiss Foundation, is implementing the project jointly with Ukrainian partners. The idea to introduce sustainable forest management practices in the Oblast of Transcarpathia stems from the serious floods that occurred in 1998 and 2001. Ukrainian forest authorities and Swiss Forestry experts jointly developed the concept of this forest development project.

The project was launched in October 2003 and is now completing the last year of Phase II (2006-2008). The main project activities center on sustainable management of forest resources and are guided by the overriding long-term goal to implement *"Sustainable, multi-functional forest management in the Carpathian region with particular emphasis on environmentally sound management and on improving the livelihoods of local people"*. To achieve the stated goal, FORZA pursues four project objectives, namely (i) multi-functional forest management; (ii) forest economy and market-orientation; (iii) improved livelihood of the population; and (iv) forest policy, law enforcement and lessons learnt, gender mainstreaming being an important cross-cutting theme for all the components. The period 2009-2010 will be the project completion phase which will focus on sustainability and on capitalization of project results.

For the duration of the project, operational focus of FORZA activities remains on Transcarpathia and on the pilot areas, Khust and Rakhiv lishosps[2], which have been granted an *experimental status* by the State Forest Committee for those FORZA activities that deal with forest management issues. This status permits the

[2] A lishosp is a state forest enterprise, which is a district office within the State Forest Committee of Ukraine. Currently, the lishosp carry out both regulatory and commercial functions. For the implementation of the project, the Khust and Rakhiv lishosps have been designated as "Experimental State Forestry Enterprises".

implementation of activities that go beyond the current legal framework, which is an essential precondition for the effectiveness of the project, given that the project introduces some, non-traditional approaches to forest resource planning and management. One such new approach is the two-level natural resource planning concept, which occupies a central position in the project and that will continue to receive much attention during the completion phase.

19.2 The Two-level Planning Concept

Public participation and community involvement in forest-management are not yet common practices in Ukraine. The traditional forestry planning concept anchored in the legislation is based on central planning[3] with little or no input from the people who live close to the forest and whose livelihood significantly depends on forest management.

However, the traditional planning and management practices in Ukraine are being increasingly challenged by public opinion and by new national and international legal requirements. In the aftermath of yet another serious flooding event in the Carpathian region (July 2008), forest management practices have come under heavy criticism from politicians and the affected population. Thus, calls for fundamental changes are getting louder and the government is taking steps in the direction of c-t-n silviculture and landscape/watershed management. There are also legally-binding international agreements such as the Carpathian Convention that clearly requires the consultation and participation of local population in the planning and management of natural resource. Thus, the traditional centralized approach to natural resource planning and management is in contradiction not only with public opinion but also with legal requirements.

Within the privileges of the experimental status granted to the Khust and Rakhiv lishosps, the rayon administrations and FORZA have agreed to develop and test a new approach of forest resources management planning in the Nyzhniy Bystryy model watershed and in Bogdan village. The planning concept tested in these villages is based on preparation of two separate plans:

(i) New: the higher-level strategic plan – the Community (Natural Resource) Development Plan (C(NR)DP)[4], and
(ii) and the second-level (subordinate) Forest Management Plan (FMP) which is a modification of the current operational plan – the Forest Management Plan (FMP)[5].

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[3] The Forest Management Planning Unit, which is a subsidiary of the SFCU, carries out forest management planning for the entire country.
[4] The Community (Natural Resource) Development Plan in Nyzhniy Bystryy has been called "Watershed Development Plan (WDP)" but the plan in Bogdan was renamed "Community Natural Resources Development Plan" to avoid misunderstandings.
[5] This plan corresponds to the current Forest Management Plan, with the important exceptions that it has to be fully consistent with the higher-level WDP and also needs to consider close-to-nature silviculture practices.

(i) Community Natural Resource Development Plan

Community (Natural Resource) Development Plan

Strategic Target:
The C(NR)DP ensures that the interests of the people living in the area will be taken into consideration while managing the forests

- What functions should the forest provide?
- Which are priority forests for the village and where are they Show all priority functions on a map! not very clear)

Procedure:
Participatory process that:

- takes into account the demands and interests of the local people
- Identifies resource use conflicts, and seeks solutions
- Introduces clear framework conditions for prioritizing forest management functions

The C(NR)DP is the participatory strategic plan, by which the population identifies the development priorities for the natural resource in the vicinity of the village. The important element in this planning process is that the population and individual stakeholder groups are directly involved in developing the plan and that the public has the opportunity to review the plan and to provide feed-back at various stages during the planning process. A special multi-sectoral working group, consisting of representatives of main local stakeholders such as the Transcarpathian Forest and Hunting Administration (TFHA), rayon administration, village council, lishosp and forest range, environmental agency, water management administration, private sector and NGOs, is responsible for the formulation and completion of the C(NR)DP. In order to capture all relevant stakeholders in the community, a stakeholders' analysis is carried out at the onset of the planning process. To assess needs and priorities in natural resources use at the household level, it is also beneficial to carry out a sociological survey. The data, information, findings and recommendations from the analyses and surveys will be available to the working group und will be an integral part of the C(NR)DP.

The C(NR)DP is to be approved by the village and rayon councils and submitted to the TFHA and to the appropriate lishosp. An important consideration of the two-level planning approach is that the strategic plan has priority over the subordinated FMP, thus the latter can only be finalized after the C(NR)DP has been approved.

Forest Management Plan

Operational Target:
An overview of activities that have to be carried out, which forests will be treated and how, and a schedule for activities :

- Map of the stands
- Annual allowable cut
- Map of intervention

Procedure (How to achieve the targets):
Inventory – map of the stands
- Annual allowable cut – firewood - NTFP
- Where and when silvicultural interventions are foreseen?
- What harvesting methods are available?
- Roads and tracks to build or improve
- Work- and budgetary planning
- Marketing of products

(ii) Forest Management Plan

The new-style operational plan is still referred to as the Forest Management Plan (FMP) and its functions are consistent with those of the traditional FMP. However, there is an important difference between the new and the traditional FMPs. While field work for the FMP can commence before the approval of the CNRDP, the preparation of the actual FMP, can only take place after the strategic plan is approved in order to ensure that all the community priorities contained in the C(NR)DP are adequately reflected and that there are no contradictions between the two plans. To guarantee effective coordination between the two plans, a representative each of the TFHA and the lishosp are members of the C(NR)DP working group.

Lisproekt, the National Forest Planning Unit in Irpin, has been responsible for preparing the FMPs for N.B. and also for the one in Shchaul forestry range in Bohdan, but lishosp and forest range specialists and other stakeholders are actively participating in the formulation of these two FMPs. An additional step for consultation is the requirement for the lishosps to submit the draft FMP to the community for review and feed-back. This review process ensures that people can verify that all the community priorities are adequately reflected in the FMP.

How this new two-level planning works in reality can best be illustrated on the basis of the process applied in the community of Nyzhniy Bystryy.

19.3 Case Study: Nyzhniy Bystryy

Community Natural Resource Development Plan: The village of Nyzhniy Bystryy (N.B.) in Khust rayon was selected to be the first model village to test the two-level planning approach. N.B. has 2400 inhabitants and the area of the selected watershed (Shirokyy River) covers some 5687 ha of which 4700 ha are covered by forests. The village is largely dependent on the wood resource, but there are other underdeveloped potentials such as eco-tourism and processing of timber and non-timber forest products.

Key aspects of participatory planning are transparency and timely dissemination of information among village community members and other stakeholders. From the beginning, the village council of N.B. has been well informed about the purpose and the procedure of the CNRDP, has been very supportive of the new planning process and participated in the planning activities of the working group. The fact that it proved much more difficult to motivate and involve the general public led to the recognition that the population needs to be better and more directly informed about the purpose and the procedure of the two-level planning approach. Thus, the importance of informing the community and stakeholders, by means of regular newsletters, technical meetings, reporting of the Working Group on the progress of the planning process, and articles in local newspapers, is an important lesson learnt. Consequently, in the new methodology for subsequent CNRDP (which has been modified based on the experience of N.B.), FORZA recommends a public information program as an integral part of the planning process.

For the preparation of the actual plan, an inter-sectoral working group was formed, under the leadership of the member of the Transcarpathian Forestry and Hunting administration (the composition of the group follows that outlined above). It was soon realized that the participatory approach with numerous information and consultation meetings is time consuming, especially when it is a totally new approach as was the case in N.B. Lasting almost 18 month, the participatory planning process took considerably longer than initially planned mainly due to the fact that it was a novel and non-traditional process for all stakeholders but particularly for the community. Because the inter-sectoral communication and collaboration among stakeholders is a prerequisite for participatory planning it is also important to have a clear picture about the number as well as the identity of the stakeholders. In N.B., FORZA relied on a 100 % sociological survey (more than 700 households were surveyed) to obtain relevant information. However, in retrospect it would have been easier and more efficient to get this information by means of a Stakeholder analysis. As a result of this experience, FORZA now recommends to carry out a stakeholder analysis and to collect a sample of sociological surveys (e.g. 20 % of households). The combined approach is effective for larger villages and, in addition, provides information from two different sources which can be compared.

But the process has paid off: as a result of the CNRDP the area of protective forests in the Shirokyy River watershed increased from 10 % to 40 % and an overall forest access road network was determined. Other development priority included the promotion of ecotourism and the establishment of three different hiking trails within the watershed. These hiking trails have now been marked. The focus on eco-tourism has resulted in the establishment of green tourism households and already 10 households have applied for ecological certification of which six households have received certification. The plan identifies the priority areas of river bank enforcement for protection against flooding. The plan also proposes several commercial opportunities such as areas for skiing, fish ponds and processing facilities for timber and non-timber forest products. Many of these aspects require a shift to close-to-nature silviculture practice, which the new FMP considers for the first time in Ukrainian forest management.

Forest Management Plan: The new FMP for the Shirokyy River watershed has now also been finalized and has been approved by the TFHA. 2008 is the first year of this new 10-year FMP, which is fully consistent with the requirements of the CNRDP. Implementation of the plan will face some operational and economic hurdles. For the first time in Ukraine, a FMP identifies areas to be harvested according to close-to-nature silvicultural practices. On some 20 % of the area final harvesting will not be permitted. Instead, these areas will be selectively harvested with the objective to convert the forest from even-aged/homogeneous to uneven-aged/heterogeneous forest stands. It is expected that the implementation of this new plan will be a big challenge for the Khust Lishosp because the current road access and the harvesting equipment are not yet adapted for c-t-n silviculture practices and there is little operational experience with c-t-n silviculture. All partners recognize that implementation of the new FMP will require a combination of road construction and acquisition of low-impact harvesting equipment, including suitable cable harvesting systems. Thus the implementation of the FMP will not only require financial resources, but also new operational and management skills. In order to facilitate implementation of the plan, the State Forest Committee of Ukraine has been asked to provide technical and financial support to the Experimental State Forestry Enterprises. Up to now, the 2008 c-t-n block in Khust have been harvested with horses but this is only a temporary solution, since there are many blocks that require other technologies primarily suitable cable crane systems that will both minimize the need for roads (long-haul cable systems) and that can be economically operated.

Challenges: The new two-level participatory process entails some real challenges for all participants. The lengthy consultation process has perhaps been most difficult for the forestry professionals, who have been used to forest management planning without any input from the local population. This can explain some initial reluctance and some skepticism towards this planning approach. However, through active participation in the development of the plan, the foresters have come to appreciate the merits of this approach, which has resulted in more productive working relations with the community and in a better image of the lishosp among the population.

The participatory process has also challenged the village council and the population. In the past, neither the community leadership nor the people had much opportunity to participate in natural resource planning. The initial hesitation among people to participate in the planning process was a clear sign that men and women found it difficult to define community development priorities, although most people knew the problems and needs of the community very well. In order to overcome the initial inertia, the project undertook large-scale public information efforts, conducted technical meetings and informed and surveyed every household in the watershed. But even after a very intensive information campaign many people still have a wait-and-see attitude towards this new planning method, which is understandable, given that the real impact of this planning process only shows after implementation of the plan. FORZA recognizes this and foresees to provide support to the model communities for the implementation of micro-projects that are part of the CNRDP. Similarly, FORZA also support the pilot lishosps during the implementation of the FMPs, particularly in questions of economic efficiency of the c-t-n silviculture practice and in determining suitable harvesting technologies for c-t-n silviculture.

Unfortunately, there is some risk of over-expectation on part of the community that could easily lead to disappointment. As the survey in N.B. showed, people have concerns and expectations that are only remotely related to forestry issues and that go far beyond the scope of the project. However, the project is maintaining links with the rayon and regional administrations and information about issues that cannot be addressed by the project are being forwarded to these authorities. Successful implementation of the two plans will ultimately depend on the availability of funding and also on the villages' ability to attract investment for the realization of the commercial opportunities.

19.4 Steps to Secure Long-term Prospects of Two-level Planning

The move towards participatory planning for natural resources will undoubtedly continue and the two-level approach, tested in the Transcarpathian model villages Nyzhniy Bystryy and Bohdan provide a suitable approach. For this reason, FORZA and the Ukrainian partners are optimistic about the merit of two-level planning in the Ukrainian context. The initial methodology that was applied in N.B. has already been modified and improved for application in Bohdan village (Rakhiv rayon) where the second test plan – the C(NR)DP is being developed. Besides the increased public information and the results from surveys and stakeholders analysis, the new methodology includes a different sequence of activities, a bigger size of the planning area (includes the whole village area, three forest ranges and two forest units of Carpathian Biosphere Reserve) and the streamlining of the approval procedure. All these changes have been introduced in response to the lessons learnt from the WDP in Nyzhniy Bystryy.

An essential step is the continuation of capacity building for forest professionals and for the communities. Even for the model communities, this process has just started and partners and stakeholders need to improve the communication, managerial and technical skills to allow effective interaction. Forestry specialists need to improve their ability to communicate with communities and learn how to incorporate community needs into their operational plans. Communities need to learn how to identify priorities and how to present these during the planning process; they need to feel empowered so that their needs are properly reflected in the both the strategic as well as the operational plans. This is a process that will take some time and that will require concerted efforts on the part of all stakeholders and government authorities on all levels.

Institutionalization of the two-level planning approach

With the development and partial implementation of two model 2-level plans, the wider application of this planning approach is not at all guaranteed. The longer-term objective of testing and modifying the two-level planning approach is of course to promote and secure application of this approach throughout the Carpathian region. The two strategic plans and the two corresponding operational plans prepared by this approach in N.B. and Bogdan are still experimental – outside the normal planning procedures. In order for this approach to become the standard planning approach, several important developments are required:

- At the moment forest resource management is based on the FMP alone. Forest resources are not subject to the strategic plan prepared by and for the community. From the perspective of the forester, the FMP is the only valid plan, and although some lishosps and communities may voluntarily choose to follow the proposed procedure, there is no legal requirement to do so. Thus, it is essential to create the legal framework that provides the legal status for the strategic as well as for the new-style operational plans. Only if the strategic plan is an integral part of forest resources planning will it be possible to consistently apply the 2-level planning approach.
- The implementation of the strategic plan is very difficult, mainly because there is generally very little budgetary resources at the disposal of communities for development activities. By providing a legal basis for the strategic plan, other issues, such as community participation, community empowerment and budget al.locations, would also need to be re-defined. As a result, the overall reform process would be accelerated.
- Virtually all forests in Ukraine are currently under State ownership, and there are no examples of community ownership or management of forest resources. Given

the fact that communities are so strongly dependent on forests, it raises the question if community forest management could not be an effective alternative to the current forest utilization approach, which sees most of the benefits from wood products bypass the communities. To correct this, more community forest ownership and direct involvement in forest resource management – as promoted in other countries – should also be considered for the Carpathian region.

The FORZA activities are only a first step towards sustainable, multi-stakeholder forest management. To maintain the momentum that has been created by the project, and to accelerate the reform process that has been started, local foresters and communities, regional and national authorities need to further develop and promote new approaches. Jointly all stakeholders need to amend and create legal conditions which will facilitate the application of new planning and management concepts.

Дворівневе планування управління природними ресурсами

Хілмар Фіольмі, Швейцарсько-український проект FORZA;
Рафаель Швіттер, Навчальний центр менеджменту гірських лісів, Мейнфельд, Швейцарія

FORZA, Швейцарсько-український проект розвитку лісового господарства в Закарпатті, започатковано в рамках угоди між урядами України та Швейцарії. Його фінансування здійснює Швейцарська агенція розвитку та співпраці. Швейцарський фонд Інтеркооперейшн зреалізовує задум спільно з українськими партнерами. Ідея запровадити методи сталого лісового господарства в Закарпатті виникла через руйнівні провені в 1998 та 2001 рр. Органи лісової служби України та експерти зі Швейцарії спільно розробили концепцію цього проекту.

Впродовж підготовчої стадії І, що розпочалася у жовтні 2003 р. (2003-2005 рр.), було створено партнерську мережу, покращено потенціал та спроможність партнерів і розроблено концепцію проекту та програми його реалізації. Впродовж стадії ІІ (2006-2008 рр.) увагу приділено сталому управлінню лісовими ресурсами на тривалу перспективу. У Карпатському регіоні започатковано ведення сталого багатофункціонального лісового господарства, з акцентуванням на належному управлінні довкіллям та поліпшенні життєвого рівня місцевих громад. Проект FORZA має чотири мети, зокрема (i) багатофункціональне ведення лісового господарства; (ii) економіка лісового господарства та ринкова орієнтація; (iii) покращення добробуту громадян; і (iv) лісова політика, дотримання закону та набуття досвіду; також важливою наскрізною темою в усіх компонентах є ґендерна інтеграція.

У центрі уваги діяльності проекту FORZA залишається Закарпаття, зокрема дві пробні території – Хустський та Рахівський лісгоспи[6], яким Державний комітет лісового господарства України надав *статус дослідних* для реа-

[6] Лісгосп - це державне лісове господарське підприємство, підпорядковане Державному комітету лісового господарства України. Лісгоспи виконують регулятивну (розпорядчу, нормативну) і комерційну функції.

лізації заходів проекту FORZA, пов'язаних зі сталим господарюванням. Цей статус зобов'язує вживати заходів, які виходять за межі чинної законодавчої бази, що є важливою передумовою ефективності проекту, з огляду на те, що у ньому передбачено багато нетрадиційних підходів до планування і управління лісовими ресурсами. Це, зокрема – концепція дворівневого планування використання природних ресурсів.

Про проект FORZA

КОНЦЕПЦІЯ

Проект започатковано з метою сприяння уряду України на національному та обласному рівнях (через Державний комітет лісового господарства України, обласні управління та зацікавлені сторони) у посиленні захисту сільських ландшафтів на основі ведення сталого лісового господарства, збереження біорізноманіття та покращення добробуту сільських громад через економічні заходи, пов'язані з лісовими ресурсами. Окремо приділено увагу значенню лісів у запобіганні стихійним лихам та зменшенню загроженості місцевих мешканців.

КОМПОНЕНТИ
Проект FORZA має чітко сформульовані чотири мети та шляхи їх реалізації:

Багатофункціональне ведення лісового господарства
Подальший розвиток і посилення багатофункціонального ведення лісового господарства з використанням таких засобів, як наближене до природи лісівництво та лісозаготівля зменшеного тиску, з метою підтримання функцій лісу і збільшення виробництва лісових товарів і послуг

Економіка лісового господарства та ринкова орієнтація
Підсилення вмотивованості економічних заходів, що базуються на лісових ресурсах, шляхом запровадження ринково-орієнтова-них підходів та належних економічних мето-дик ведення лісового господарства і захисту ландшафту.

Поліпшення добробуту громадян
Поліпшення добробуту місцевих мешканців завдяки кращому доступу до лісових ресурсів, співпраці між лісовою службою і місцевими громадами – шляхом залучення приватного сектора.

Лісова політика, дотримання закону та набутий досвід
На основі досвіду, набутого в процесі вико-нання заходів проекту, сприяти та підтримувати розвиток лісової політики і застосування закону шляхом надання відповідних ре-зультатів і обґрунтувань тим, хто формує політику на всіх рівнях.

Концепція дворівневого планування

Залучення громад до ведення лісового господарства наразі незвичне для України. Законодавчо закріплена традиційна концепція планування лісового господарства базується на централізованому управлінні[7] і фактично ігнорує участь у ньому людей, які живуть у лісистій місцевості та чий добробут залежить від стану лісів.

Однак традиційні методи планування і управління в Україні дедалі більше трансформуються на вимогу національного та міжнародного законодавства. Карпатська конвенція, до прикладу, вимагає обов'язкових консультацій і участі місцевих громад з питань планування та управління природними ресурсами.

[7] ВО "Укрдержліспроект", підпорядковане ДКЛГУ, здійснює планування ведення лісового господарства для усієї держави.

План розвитку громади на основі природних ресурсів

Стратегічна мета:

ПРГ/ПР гарантує врахування інтересів людей, які проживають на визначеній території, в питаннях управління лісовими ресурсами

Громада вирішує:

- які функції лісу є пріоритетними для неї
- які ліси є найважливішими для села і де вони розташовані (вказавши ці ліси на мапі)

Процедури:

процес участі багатьох сторін що:
- враховує потреби та інтереси місцевих громад
- передбачає оцінку ресурсів і конфлікти інтересів та шукає рішення
- передбачає чіткі рамкові умови для пріоритезації функцій ведення лісового господарства.

Таким чином, ця конвенція, що має для України юридичну силу, не збігається з чинним законодавством. З метою усунення цієї правової колізії потрібно розробити та застосовувати підходи, що передбачають участь багатьох зацікавлених сторін у плануванні та управлінні природними ресурсами в Карпатському регіоні. Скориставшись преференціями, наданими Хустському і Рахівському лісгоспам, районні адміністрації та учасники проекту FORZA узгодили вироблення та апробацію нового підходу до управління лісовими ресурсами у пілотному водозборі села Нижній Бистрий та у селі Богдан. Концепція планування, апробовувана у цих двох селах, базується на двох рівнях планування:

(i) цілком новий стратегічний план – План розвитку громади на основі природних ресурсів (ПРГ/ПР)[8], та

(ii) модифікований операційний план – План ведення лісового господарства (ПЛГ)[9].

ПРГ/ПР – це стратегічний план, розроблений за участі багатьох сторін, у якому громада визначає пріоритети розвитку природних ресурсів навколо села. Важливо те, що громади та окремі зацікавлені сторони безпосередньо залучено до розроблення і громадськість має право коригувати план та вносити зміни до нього на різних етапах процесу планування. Спеціальна багатогалузева робоча група, до складу якої входять представники основних місцевих зацікавлених сторін, таких як Закарпатське обласне управління лісового та мисливського господарства (ЗОУЛМГ), районна рада та адміністрація, сільські ради, лісгосп та лісництво, управління охорони навколишнього природного середовища, управління водного господарства, приватний сектор та громадські організації, відповідає за написання та остаточне оформлення ПРГ/ПР. Маючи на меті охопити всі зацікавлені сторони, що мають стосунок до природних ресурсів, на початку процесу планування було здійснено їх аналіз, а також з метою вивчення пріоритетів використання природних ресурсів на рівні домогосподарств – соціологічне опитування, висновки якого надано робочій групі і введено до ПРГ/ПР.

ПРГ/ПР, затверджений сільською та районною радами, повинен бути переданий ЗОУЛМГ та керівництву відповідного лісгоспу. Важливим принципом дворівневого планування є те, що стратегічний план має перевагу над під-

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[8] План розвитку громади на основі природних ресурсів у селі Нижній Бистрий мав назву "План розвитку водозбору (ПРВ)", проте назву плану в с. Богдан було змінено з метою уніфікації.

[9] Цей план відповідає чинному Плану ведення лісового господарства за винятком того, що він повинен повністю відповідати ПРВ вищого рівня і також враховувати методи наближеного до природи лісівництва.

порядкованим йому ПЛГ, таким чином розроблення останнього може бути завершене тільки після затвердження ПРГ/ПР.

Польові роботи за планом ведення лісового господарства можуть здійснюватися незалежно від ПРГ/ПР. Проте для відображення та врахування усіх пріоритетів ПРГ/ПР під час розроблення самого ПЛГ вкрай важливою є узгодженість цих планів, тому до складу робочої групи з розроблення ПРГ/ПР увійшли представники ЗОУЛМГ та лісгоспу.

ВО "Укрдержліспроект" все ще несе основну відповідальність за розроблення ПЛГ, але спеціалісти лісгоспу та лісництва, поряд з іншими зацікавленими особами, вже беруть активну участь у його формуванні. На додаток до цього, проект ПЛГ має пройти громадське обговорення з метою врахування у ПЛГ усіх пріоритетів ПРГ/ПР.

План ведення лісового господарства

Операційна мета:

Прелік та мотивація лісогосподарських заходів та засобів їх виконання.
Графік виконання заходів:

- мапа деревостанів;
- річний обсяг рубань;
- мапи втручання

Процедура (шляхи реалізації):
- інвентаризація – мапа деревостанів;
- річні обсяги рубань – паливна деревина – НДЛП;
- виконання передбачених лісівничих втручань;
- оптимізація заготівельних методів;
- перелік доріг і шляхів, які треба прокласти або покращити;
- планування робіт і бюджету;
- маркетинг продукції.

Практичний приклад: с. Нижній Бистрий

План розвитку громади на основі природних ресурсів

Н.Бистрий (далі – Н.Б.) Хустського району було обрано першим модельним селом для апробації підходу дворівневого планування. У Н.Б. проживає 2400 мешканців, територія обраного водозбору (р.Широкий) сягає 5687 га, з яких 4700 га вкрито лісами. Добробут села значною мірою залежить від лісових ресурсів, але існують й інші потенційні сфери, які слід розвивати: екотуризм та переробка деревинних і недеревинних лісових продуктів.

Ключові аспекти процесу планування із залученням зацікавлених сторін – відвертість та вчасна поінформованість. Від самого початку голова сільської ради Н.Б. підтримав процес нового планування, але висновок з досвіду, набутого у ході роботи у Н.Б., такий: мешканців села потрібно краще поінформовати про мету та процедуру дворівневого планування. Інформування громади та інших зацікавлених сторін варто здійснювати за допомогою інформлистків, проведення технічних зустрічей, звітування робочої групи щодо процесу планування, а також опублікування статей у місцевих газетах. У новій методології для наступного ПРГ(ПР) (яку було змінено на досвіді Н.Б.) FORZA рекомендує програму інформування громадськості як невід'ємну частину процесу планування.

Залучення зацікавлених сторін потребує тривалого часу, особливо якщо йдеться про цілком новий підхід, як у випадку з Н.Б. Але зусилля виявилися не марними: ПРГ(ПР) територію захисних лісів водозбору р. Широкий збільшено з 10 % до 40 %, окреслено загальну мережу лісових доріг. Інший пріоритет розвитку – сприяння розвиткові екотуризму та облаштування трьох різних туристичних шляхів у межах водозбору. Ці шляхи вже промарковано. Вислідом заходів з екотуризму стало створення сільських садиб, 10 з яких подали заявки на екологічну сертифікацію, і шість з них вже отримали сертифікат. У плані визначено найвразливіші зони, які потребують укріплення берегів з метою запобігання паводкам. Деякі комерційні проекти, як, до прикладу, лижні траси, рибні ставки та перероблянння деревинної та недеревної лісової продукції, також передбачено у плані.

Оскільки міжсекторні зв'язки та співпраця зацікавлених сторін є передумовою планування, потрібно чітко окреслити їхнє коло. У Н.Б. проект покладався на стовідсоткове соціологічне опитування (опитано більше ніж 700 домогосподарств) з метою отримання достовірних даних. Завдяки набутому досвіду FORZA радить використовувати вибіркові соціологічні дослідження (напр., 20 % домогосподарств). Такий комбінований підхід є ефективним у великих селах, до того ж він дає змогу порівняти інформацію, яка надходить з двох різних джерел.

План розвитку лісового господарства

Розроблення нового ПЛГ для водозбору р. Широкий вже також завершено, його затвердило ЗОУЛМГ. 2008 рік є першим роком цього 10-річного ПЛГ, який цілковито відповідає вимогам ПРГ(ПР). На шляху до реалізації плану постають різноманітні господарські та економічні перепони. ПЛГ вперше в Україні визначає території, де заготівлю здійснюватимуть відповідно до принципів наближеного до природи лісівництва. Головні рубання заборонено на 20 % території. Натомість на цій території буде здійснено вибіркове рубання з метою переформування насаджень з одновікових/однорідних у різновікові/неоднорідні. Очікується, що запровадження цього нового плану стане викликом для Хустського лісгоспу, оскільки існуюча шляхова мережа та лісозаготівельне обладнання ще не адаптовані до вимог наближеного до природи лісівництва, також бракує практичного досвіду. Усі партнери визнають, що запровадження нового ПЛГ потребуватиме прокладання доріг та придбання природоощадливого обладнання для заготівлі, зокрема линвових заготівельних систем. Отже, для реалізації плану потрібні не тільки фінансові ресурси, а й нові господарські та управлінські підходи, тому партнерам слід співпрацювати під час реалізації плану та задля підтримки Хустського лісгоспу.

Виклики

Процес нового дворівневого планування ставить реальні виклики перед усіма його учасниками. Тривалі консультації для працівників лісової галузі були, напевно, найважчими, оскільки раніше вони планували ведення лісового господарства без участі місцевої громади. Цей факт може пояснити початкове небажання та скептицизм щодо самого підходу до планування. Але згодом, завдяки активній участі в розроблянні плану, лісівники позитивно оцінили його переваги, йдеться, зокрема, про налагодження конструктивних партнерських стосунків з громадою та покращення іміджу лісгоспу серед місцевих жителів.

Залучення до планування зацікавлених сторін застало зненацька голову сільради та й громаду на загал. Адже у минулому вони не мали важелів впливу на процес планування природокористування. Спочатку вагання щодо участі у плануванні було зумовлено тим, що у мешканців виникли труднощі з визначенням пріоритетів розвитку громади, хоча більшість з них були добре обізнані з проблемами та потребами села. Для подолання початкової інертності було вжито заходів широкомасштабного інформування селян, проведено ознайомчі зустрічі, поінформовано та опитано кожне домогосподарство у територіальних межах водозбору. Але навіть після інтенсивної інформаційної кампанії багато людей не визначилися стосовно доцільності нового методу планування.

На жаль, існує ризик несправдження сподівань громади, що може призвести до розчарування. Як показало опитування у Н.Б., громадяни мають різні думки очікування, не завжди пов'язані з лісогосподарськими питаннями і компетенцією проекту FORZA. Позаяк керівники проекту підтримують зв'язки з районною та обласною адміністраціями, усі сторонні питання переадресовують владним структурам. Успішна реалізація обох планів у підсумку буде залежати від наявності фінансування, а також від спроможності сіл привабити інвесторів для реалізації комерційних задумів.

Подальші дії та довготривала перспектива дворівневого планування

Вимоги до планування з залученням багатьох зацікавлених сторін зростатимуть надалі, дворівневий підхід до планування управління природними ресурсами довів свою перспективність. Тому учасники проекту FORZA та українські партнери з оптимізмом дивляться у майбутнє. Методологію, використану у Нижньому Бистрому, надалі було вдосконалено, і на сьогодні в селі Богдан Рахівського району запроваджують новий план розвитку громади на основі природних ресурсів. Окрім якомога повнішого інформування громади, та узагальнення інформації, отриманої від зацікавлених сторін, нова методологія передбачає іншу послідовність заходів, більший обшир території планування (зокрема територію цілого села, 3 лісництва та 2 ПНД-відділення в Карпатському біосферному заповіднику) та спрощену процедуру затвердження.

Дворівневий підхід до планування в с. Н.Б. та с. Богдан є експериментальним та потребує подальшої апробації і модифікації. Однак завдяки вдосконаленню методології дворівневий підхід, який передбачає планування розвитку громади на основі природних ресурсів та планування лісового господарства, повинен враховувати потреби та пріоритети розвитку громади та забезпечити дедалі ширше залучення громадськості до сталого управління ресурсами. У межах заходів FORZA у 2008 р. буде розроблено та розповсюджено серед зацікавлених сторін методологічні поради для складання багатофункціональних ПЛГ.

У разі, якщо апробовану модель буде вдало адаптовано до умов Карпатського регіону, потрібно буде внести поправки до нормативних документів, політичних та нормативно-правових актів, які регулюють планування та управління природними ресурсами. Зі зміною законодавчих засад Карпатський регіон зробить вагомий крок, насамперед, до євроатлантичної інтеграції.

Chapter 20

Challenges of Carpathians' Forest Resources Economic Valuation and their Integration in Forest Enterprises' Accounting and Reporting

Ludmyla Maksymiv[1]

Abstract In conditions of rapid development of globalization processes which significantly impact each country of the world accompanied by environmental threats one can note a change in the requirements to natural resource accounting and reporting and to their usage. Traditional accounting is aimed on maximizing profit in short-term period. Hence natural resources are treated only as a raw material. An economic value of these resources essential for human surviving is neglected. Forest ecosystem services serve as a good illustration for these considerations. Carpathian Mountains due to their geographical location play an important social, economic, resource, and ecological role (hydrological regimes regulation, climate forming, and biodiversity conservation) which is crucial for all the Central Europe and that is why they obtained the name of "green heart of Europe". Therefore it is very important to take into account all these forests ecosystem functions (from environmental quality to human safety and cultural needs) in the conditions of Ukrainian Carpathians, where main Ukrainian forest resources are located. Recent findings of international scientific community toward covering aroused gaps in practice and methodology of forest assets accounting are considered in the paper, both challenges and efforts for their tackling are analyzed. Proposals for extension of forest assets accounting and reporting are developed and illustrated for Ukrainian Carpathians case study.

20.1 Introduction

In conditions of rapidly changing environment both scientists and practitioners need precise and comprehensive information on changes in nature capital, particularly in forest assets that is value of the growing stock. There is no need to explain

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how these data are important. Incomplete comparison of forest enterprises assets and liabilities may finally result in misinterpretations and even wrong decisions (Matthies 1984). But in the same time there is no a significant improvement in the field of forest accounting practice anymore.

Indeed, some recent findings of international scientific community made some important steps toward covering aroused gaps in practice and methodology of forest accounting and this paper deals both with challenges and efforts for their tackling.

20.2 Gaps in Financial Accounting

Traditional accounting from many points of view is not suitable for the complete reflection of enterprise's environmental impacts and environmental management and control implementation. Its main shortcoming lies in the accounting methodology, which still is strongly oriented on the management of costs and incomes, focuses its attention on production processes in a narrow sense, on productivity, process and production.

Lacks of managerial accounting from an environment point of view induce from insufficient information of market prices. Non-adequate character of market prices drives enterprise to sub-optimal decisions from long-term perspective. These lacks arise because of "market blindness", market failures, asymmetric and unclear environmental information, and also complications of valuing the environment.

Forests generate a lot of services. But significant part of them is quasi-private (as recreation or recreational fishing) or pure public goods (like gas and climate regulation, waste absorption capacity etc.). Nonexcludability, nonrevealness of demand and difficulties with these services accountability and valuation result in suboptimal decisions and mismanagement of forest resources. In the same time in most countries of the world the marketed values of forest ecosystems services associated with commonly measured economic values are less than a one third of the total economic values, including non-marketed values (Table 20.1).

Table 20.1 Values associated with forests ecosystems (adopted from Millennium Ecosystem Assessment, 2005, p. 8)

Marketed values	*Non-marketed values*
• Timber • Fuel wood production • Grazing	• Carbon sequestration, • Watershed protection • Non-timber forest products • Recreation

20.3 Environmental Accounting as a New Accounting Instrument

Unlike the financial reporting, which purpose, targets and principles are clearly regulated by the proper international standards (Commission Recommendation 2001), nowadays-common standards of the environmental accounting are not well identified. Discussion about standardization of the environmentally oriented accounting has been taking place among experts. At the same time, work at development of relevant models of account goes ahead, in particular, due to efforts made by Federation of European Experts (FEE). Also guides for identification, measurement and inclusion of environmental costs into annual reports of companies are developed for Europe (Gray 1990).

In our opinion, optional character of recommended forms and methods used in environmental accounting, as well as voluntariness of its procedure makes less tangible benefits but more labor and time consuming from the enterprises point of view. On the other side, absence of any requirements results in volumes of positive information about enterprise's nature protection activity and zero attentions to negative environmental impacts.

The EU countries' experience provides us with a good example of scientific substantiation and robust recommendations in regard to environmental accounting system shaping.

Taking into account that environmental accounting still has been forming, there is no single, common approach to the scope definition. This term is used both at the level of statistical accounting and of bookkeeping. In particular, Environmental Protection Agency proposes approach presented in Table 20.2.

Table 20.2 Modified system of environmental accounting (EPA, 1995, p. 166)

Type of accounting	*Object of calculation*	*Address*	*Measure*
National income accounting	Nation	External	Quantitative Monetary
Financial accounting	Company	External	Monetary
Managerial accounting	Company, department, channel of service, production line or system	Internal	Quantitative Monetary

As one can see from the Table 20.2, at an enterprise level the environmental accounting is considered in the context of methods of managerial and financial accounting with the aim of external use, and also for analysis of inputs and outputs of real activity.

Further development of conceptual principles of environmental accounting requires inclusion of qualitative indicators. ISAR and Financial Accounting Standards Board (FASB) offered such indicators for environmental accounting: importance, objectivity, timeliness, accuracy, and validity.

20.4 Extended Scope of Forest Accounting

Enterprises, which aspire to proactive management, run their business in environmentally responsible way and design relevant comprehensive environmental accounting system (Maksymiv and Podobyedova 2001). This system should, on the one side, provide with relevant information about environmental impacts for external bodies (function of documenting). What is moreover, this system should support decision-making in strategic, tactical and operation planning (function of planning). Finally the system should be confirmed *ex-post* (function of control).

Therefore the traditional accounting system should be extended to reflect not only financial results of the enterprises activity, but environmental impacts of this activity too. Austrian economists H. Jöbstl and J. Hogg present this extension by Fig. 20.1.

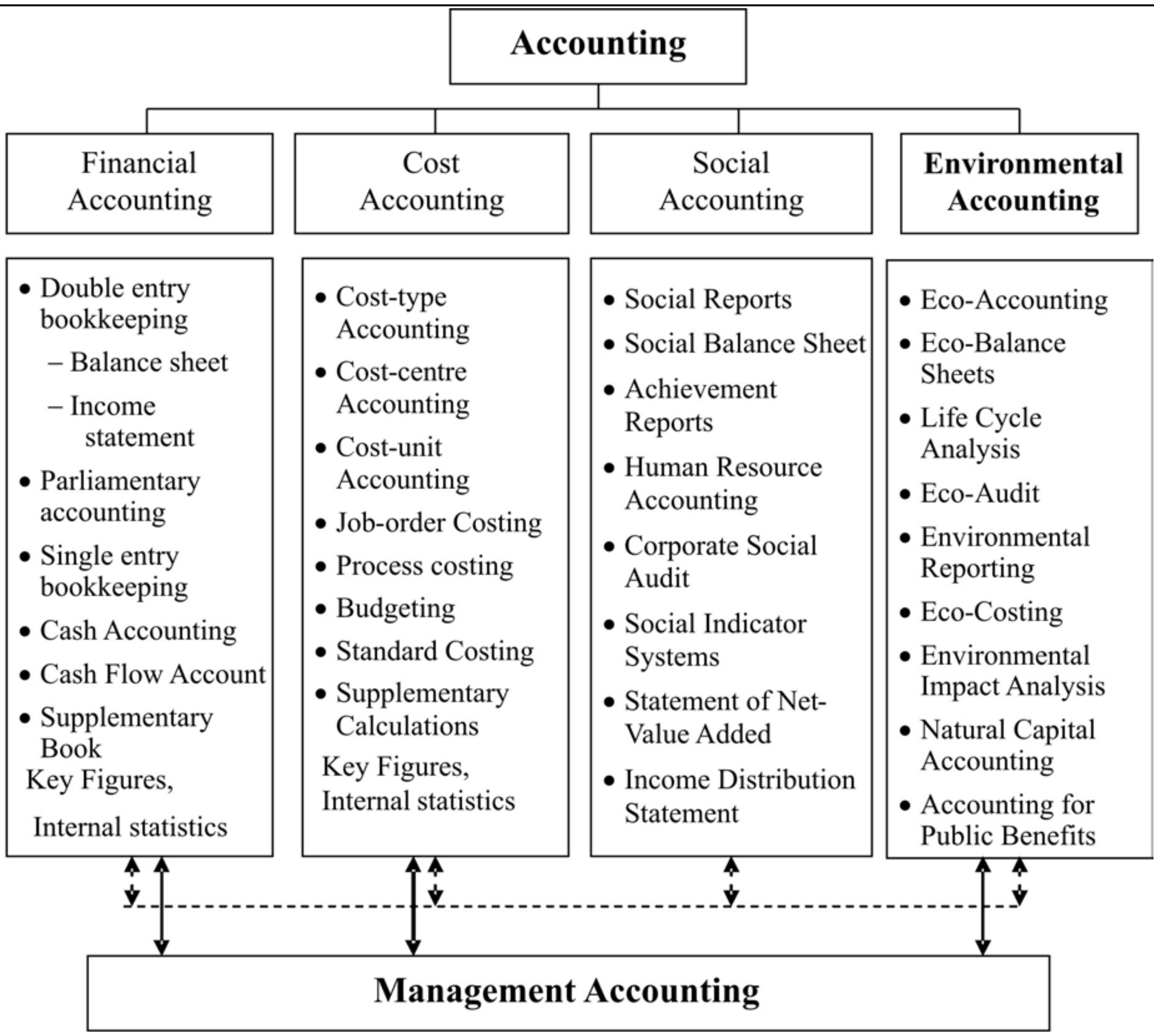

Fig. 20.1 Branches of forestry accounting (Jöbstl and Hogg, 1998, p. 397)

Negative externalities, which feature a particular enterprise activity, should be appraised and declared. Hence, initially oriented for the financial indexes accounting system should be complemented by eco-balances, material flow analysis, and other environmentally oriented instruments, that will give possibility to make clear the environmental impacts of an enterprise activity.

Such extension of traditional accounting system induces making decisions not only from narrowly financial and often short-term perspective (in interests of shareholders), but also taking into account the long-term use of enterprise capacity and risk avoiding for benefits of all stakeholders. Raw material scarcity and limitations of carrying capacity have increasing influence on both strategic factors. In other words we talk about new quality of strategic planning and control with the purpose of gradual orientation of an enterprise on the course of "sustainable development", that ensure eco-efficiency and eco-justice. There are three components of environmental accounting (Maksymiv and Podobyedova 2001):

a) collection and preparation environmentally relevant data by such means:

- differentiation and extension of traditional accounting system (for instance, structuring accounting of different types of expenses and places of their origin,

extended accounting of investments, analysis of financial results, calculation of external expenses specific for a particular enterprise);
- extension of financial accounting through material balances design and calculation, by means of an enterprise, process or product eco-balance (Table 20.3);
- development of environmental indicators system for planning and controlling of enterprise eco-efficiency;

b) *system of eco-controlling* with the permanent planning, management, control within the framework of general controlling (in close relations with the strategic planning and control);

c) *eco-audit* as internal and external revision with purpose of supervision of functional capacity and effectiveness of environmental management system (accordingly to ISO 14001).

Table 20.3. Methodological approach to forest recourses accounting on macro level

Forest related assets	*Nonrenewable resources: Lands of forest fund, tha ha*	*Renewable resources: Forest as financial asset, m^3, tons*
On the beginning Economic usage	Forest covered land	Forest stock Harvesting Deforestation
Other accumulation	Changes in land use: Transfer of land use category from non-economic to economic Increment of forest area	Natural ingrowth Natural mortality Afforestation Transfer of resource category from environmental to economic
Other changes	Changes in land use induced by natural, political and other non-economic reasons	Decline provoked by natural disasters or other non-economic reasons (floods, windbreaks, fires). Transfer of resource category from economic to environmental one
On the end of period Changes in the resource quality	Forest covered lands Negative: soil erosion, lost of nutriments, land contamination, salty soils formation	Forest stock Negative: qualitative changes related to diseases of forests, acidification, Positive: carbon sequestration, oxygen production

Accounting and preparation of data about the environment create basis of eco-controlling, supports environmentally and socially responsible management of an enterprise. Simultaneously the background for certification of enterprise environmental management system accordingly to ISO 14001 is created. Eventually scope, intensity and purpose of environmentally oriented accounting is shaped due to enterprise environmental policy.

Main instruments of environmental accounting:

1. Differentiation and extension of managerial accounting (немає далі п. 2, для чого перший чи щось загублено)

On the first stage of costs and revenues accounting it is possible to determine **primary environmental costs** related to nature protection. It is easy to find relevant primary costs for different types and places of origin (for example, relevant equipment depreciation, payment for wastes utilization, effluent discharge, cost of environmental accounting reporting, environmental researches, monitoring, payment of proper personnel).

These costs are known as abatement cost of environment protection, often they arise at the end of pipe and part of them could be voluntarily. Nowadays, statistical registers reflect mainly these primary environmental costs, which are expressly definite in costs calculation. However environmental costs arise not only on the "end of pipe", in form of easily determined filters depreciation, or on the "begin of pipe" in form of environmental investigation costs. They are hidden as **secondary environmental costs** behind the value creation process both as direct and overhead expenses. Additional expenses for cleaner or certified raw materials are good example of such costs.

Hence, it is suggested to identify environmental costs of inputs, outputs and semi-finished products by means of **material flow analysis.**

Thus we extend a notion of **enterprise environmental costs** and consider them **as *internalized environmental costs, which arise due to voluntarily, or compulsory measures aimed to avoid, diminish or mitigate environmental impacts and also due to losses of productivity and irreversible losses of energy, materials and raw materials.***

If an enterprise fulfills an environmental policy and takes measures aimed to reduce environmental impacts and implements environmental accounting, then one can expect, that natural capital losses will decrease and greater part of all costs (from wider economic instead of narrow financial point of view) will remain on the previous level (Fig. 20.2). Hence, we create more value with less cost that corresponds with aims of environmental economics.

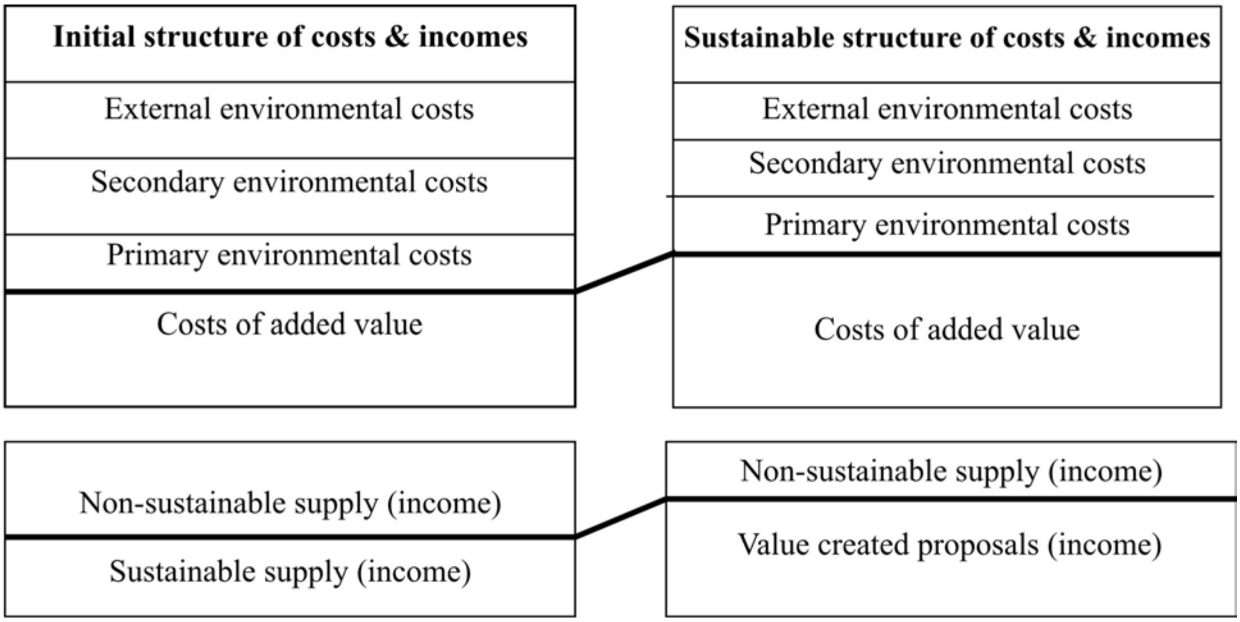

Fig. 20.2 Development of sustainable oriented costs and incomes (Stahlman, p. 169)

By means of such differentiation and extension of financial accounting it is possible to obtain an idea about key points that illustrate environmental profile of an enterprise's activity. It all takes place within a framework of monetary evaluation and must be complemented by the analysis of the real commodity flows. It will give a possibility to apprise quantitative indicators which are used in costs and income accounting.

2. Financial accounting extending

Reasonable background for a sound analysis of costs and real economic valuation of environmental impacts seem to be **eco-balances**. They enable us to explore both objects (for example, tools, package materials, machinery and equipment) and processes (for example, transporting) or various organizational units (like enterprises, production, products) in relation to their impacts on the environment, including possible impacts on human health.

Application of eco-balances enables to extend boundaries of balance (research horizon: balance scope, timing), and also limits of a system in question (research depth: choice of environmental impacts, environmental criteria of evaluation).

The approach of environmental accounting to the natural resources valuation demands simultaneous investigation of forest resources by land area and volume of wood. According to the general principles of accounting in cases when it is complicated to distribute the value of closely interrelated assets it is necessary to consider which of assets has major value. In this relation an approach of integrated valuation of land and forest recommended by some authors according to which for countries rich on forests the value of forest cover can be evaluated as zero value. In this case it is assumed that there are no other alternative uses of forest lands for other purposes. Obviously, a total value of land and forest on which it grows will be linked to the value of timber. In real practical cases the transportation costs, disposition of forest areas, and other expenses play an important part.

As some authors recommend other approach should be applied in cases when monetary valuation gives too complicated results because of high level of production costs (with a negative rent) or because of high conservation value of forests. Formally, in such cases the land value is equal zero. At the same time in the cases of forests with important conservational functions the wood value can be treated as a minimal value if it has positive meaning, or other substitute of this value can be proposed. In cases we presented in tables 20.1 and 20. 2 where in forests the felling are not allowed because of different reasons these forests can be treated as noneconomic resources. Any illegal felling should be considered as an exhaustion of resources.

Analysis of the data of table 20.4 shows the only quantitative dynamics of wood as resource. The qualitative changes are shown though dynamics of forest destruction processes because of different factors influences (in ha, cubic meters depending from age). But more detailed analysis requires much expended picture of qualitative changes of forest resources. Besides that, indicated dynamics is related indistinctly with the forest areas only. This circumstance does not look essential because young forests transfer into other categories (middle aged, matured). And biological processes in general are not determined by formal division of land on categories of use for specific purposes.

Table 20.4 Dynamics of forest as natural asset which produce wood in the framework of extended conception of ecological economic assets

Characteristics of forest resources significant for the ecological adjustment of macroeconomic indexes	Index which can be used as information source for the approximate calculation, thousand cubic meters	Year	
		2001	2002
The growing stock of wood on the beginning of period	Forest growing stock,		
	• including in matured and over-matured forests	1740000[1]	1738589
	• including in commercial forests	251000[1]	
Harvesting	Prescribed (annually allowable) cut	15000	15000
	Timber harvested from main felling, totally,		
	Including commercially valuable timber	5507[2]	5833[2]
	Timber harvested from intermediate felling, totally,	6515[2]	
	Including commercially valuable timber		
	Illegal logging	2977	
	Totally	14999	6994[2]
Natural growth	Average wood increment (changes of stock), thousand cubic meter /year	24000	24000
	Self thinning		
Transition from environment in to the category of economic use			
Reduction of natural capital caused by natural and other non-economic factors (fires, floods, windfalls)	Natural disasters (windfalls, glazed frost, snowbreakages)	10411[3]	
	Forest fires (loss of standing wood)		
The growing stock of wood on the end of period	Forest growing stock, totally, Incl. - growing stock of commercial forests	1738590	
Qualitative changes caused by forest deceases, acid rains	(Forest dieback dynamics, totally, thousand ha. Qualitative approach). Damage by insects' invasion and damage by wild animals. Damage by forest deceases. Damage by anthropogenic influences. Damage by unfavorable weather condition.		

It should be noted that at present objective criteria of forest plot designation to some of the category (groups of forests established by a Forest Act, 2006) in Ukraine are not developed. The most important indicator of dynamic changes of wood resources is forest covered area with separation of areas with different types of felling.

The data about natural self thinning of forests (quantity in cubic meters) and therefore data about transition from environment to economic use are not available. It is important to take into account all forests where cuttings allowed from the point of view of process of "transition from environment to economic use".

[1] "State Forest Cadastre", 01.01.1996.
[2] Yearly Statistics of Ukraine, 2002, State Committee of Ukraine, p. 216
[3] The National Report about the State of Environment in Ukraine in 2001., p. 92

During the last decade the positive dynamics of the forest area in Ukraine have been observed. Annually at the state enterprises plant forests on area more than 48 000 ha which is 20 -30 % more than area of cut (State Forest Committee 2008). In 2003 timber reserves are assessed in national equivalent approximately at the value of 3.4 billion USD, and according to the international markets prices their value is 27 billion USD (National Report 2003). It should be stressed that such evaluation does not take into account forest ecosystem services and functions.

The spatial aspect should be taken into account when it is analyzed where (on which area) and how much (intensity) of timber should be harvested. Usually, it is supposed that if wood increment is higher than harvesting a forest resource use is sustainable. But a concentration of clear cuts on areas with better access, unsound logging practices (see Chapter 13) can cause the diminishing of forest ecosystem services and timber quality worsening also. In the context of extended understanding of the national welfare such loses should be considered with ecological adjustment of GDP. The conception of extended environmental accounting – or bettr to define it as ecological economic accounting – makes possible such consideration.

20.5 Conclusions

Implementation of enterprises environmental accounting requires a new type of experts, which are able to make decisions taking into account economic efficiency, social justice and environment integrity.

Summarizing above-stated, we make such conclusion:

Environmental challenges, which are inalienable constituent of modern economic models development, require forming environmentally conscious activity of enterprises.

A bookkeeping as a base of an enterprise's information system must provide relevant data to enterprise managers to ensure environmental risk avoiding in long-term perspective.

Enterprises, which decide to accomplish their activity, following principles of offensive environmental business style, need more precise information about impacts caused by their activity, processes and products on the environment. These needs predetermine the necessity of differentiation, more precisely extension of both financial and managerial accounting.

Extension of forestry accounting by the most substantial environmental aspects will give possibility to external users to obtain more complete information about outcomes of enterprise activity, representing not only financial results but also level of environmental quality of production.

Development of standards (requirements) of environmental accounting in addition to financial reporting of enterprises, which take part in the system of environmental management, will ensure that their accounts are objective and complete from the environment point of view.

Differentiation of managerial accounting with a special stress on environmental costs in places of their origin, and for all bearers and types will make these costs transparent and, thanks to it, guided, that, in their turn will promote search of roots of backlogs, ways and instruments of their environmental impact reducing and lightening.

Application of recent tools of environmental accounting, such as eco-balances, lifecycle analysis, environmental indicators will improve efficiency of enterprises management owing to adjusting of eco-controlling and eco-audit systems.

Development of environmental accounting system needs well-educated and trained accountants, which have a good grasp of theory of sustainable development and are able to realize decision-making according to imperatives of sustainable development.

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Проблема економічної оцінки лісових ресурсів Карпат та їх відображення в бухгалтерському обліку та звітності лісових підприємств

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В умовах активного розгортання глобалізаційних процесів, які відчутно впливають на економіку кожної окремої країни, а також посилення загроз екологічного характеру змінюються вимоги до систем обліку природних ресурсів та звітності щодо їх використання.

Традиційний підхід до обліку ресурсів та подання звітності щодо них орієнтований на отримання суб'єктами господарювання максимального фінансового результату у якомога коротшому часовому проміжку. З огляду на це природні ресурси підприємства розглядають виключно як ресурсну базу для забезпечення виробничих завдань. При цьому реальну вартість природних ресурсів і благ з огляду на інші функції, які вони виконують у процесах життєзабезпечення і підтримання належної якості довкілля, залишають поза увагою.

Вагому роль у забезпеченні функцій екосистем відіграють лісові ресурси, які виконують, окрім ресурсних, не менш важливі та незамінні біохімічні (поглинання рослинами техногенних газів і аерозолів з атмосферного повітря), фізіологічні (фотосинтез) та інші функції. Загалом, завдяки географічному розташуванню, Карпати відіграють виключно важливу соціальну, економічну, ресурсну, кліматотвірну, гідрологічну й екологічну роль для усієї Центральної Європи, через що вони отримали назву зеленого серця Європи. Особливо важливо враховувати ці чисельні функції для Українських Карпат, де зосереджені основні лісові масиви держави, зокрема букові праліси, які, завдяки їхній унікальності занесено ЮНЕСКО до світової природної спадщини. Лісові ресурси мають значний вплив на формування промисловості Карпатського регіону, де розташовані основні деревопереробні потужності. Особливо важливе значення для розвитку промислового виробництва має концентрація тут запасів експлуатаційних лісів твердих листяних порід (дуба, бука, ясена), які є основною сировиною для виготовлення меблів, паркету, фанери, шпону тощо.

Проаналізовано зарубіжний досвід щодо економічної оцінки лісових ресурсів у складі природного капіталу, а також вимоги міжнародних стандартів обліку (МСБО), міжнародних стандартів фінансової звітності (МСФЗ), національних положень з бухгалтерського обліку (ПСБО) та міжнародних стандартів аудиту щодо вартісного відображення природних ресурсів, зокрема, лісових щодо обліку та звітності підприємств. Розглянуто також можливості застосування рекомендацій, розроблених за участю Міжнародної Федерації бухгалтерів (МФБ) і викладених у міжнародних настановних матеріалах з питань обліку екологічних витрат.

Умовою сталого менеджменту лісових ресурсів є їх усебічний облік і адекватне відображення у звітності суб'єктів господарювання. На сьогодні лісові підприємства ведуть достатньо повний облік лісових ресурсів у натуральних вимірниках. Для цього передбачено облікові реєстри і форми звітності, аналіз яких здійснено у розділі. Водночас, невирішеним залишається питання відображення запасів лісових ресурсів як складника природного капіталу у фінансовій звітності лісових підприємств. У розділі подано пропозиції щодо розширення фінансової звітності підприємств, зокрема балансу щодо залучення до складу активів запасів лісових ресурсів, а пасивів – природного капіталу, як джерела утворення цих активів. Наголошено, що основною завадою на шляху до цього є відсутність економічної оцінки лісових ресурсів (піддається вимірюванню лише вартість ресурсів як сировини для виробничих потреб).

Chapter 21

Role of Traditional Village Systems for Sustainable Forest Landscapes: a Case Study in the Ukrainian Carpathian Mountains

Marine Elbakidze[1] and Per Angelstam[2]

Abstract Maintenance of socio-cultural values and biodiversity at local and regional levels are new and important criteria for the implementation of sustainable forest management. Ukraine's forest sector is in transition from a planned socialist to a market economy. We evaluated the role of the traditional village system, which was successful for centuries at achieving both common economic as well as these new dimensions of sustainable forest management in Ukraine's Carpathian Mountains. We used the Skole district as a case study that represents one of the most forested areas in western Ukraine, and an integral part of Boiko people's ethnographic area. The village is a traditional social – ecological system defined by the traditional land use of pre-industrial cultural landscapes, and a spatial structure with land use zones satisfying different needs. Using documents on regional environmental history, analysis of socio-economic statistics, and interviews with local land users, we evaluated the extent to which the traditional village system supports socio-cultural dimensions of sustainable forest management. Our review of environmental history indicates that after different phases of cultural landscape development over several hundred years, the traditional village system has remained intact as a basic unit of the Skole district's forest landscapes. However, collected socio-economic and demographic data and interviews show that the traditional village system is endangered. Making use of the total economic value of forest landscape resources, including wood and non-wood products and services based on cultural values and biodiversity, is an urgent task. Support of traditional village

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socio-cultural functions and land use systems including fields, wooded grasslands, and forests, should be central to regional sustainable forest management. Traditional village system zoning and land use systems would be good indicators of sustainable forest landscapes.

21.1 Introduction

According to numerous international resolutions and regional programs for sustainable land use, cultural heritage and traditional knowledge should be maintained. To promote sustainability on national as well as regional and local levels Ukraine has joined the process of developing forest management ideas and principles oriented towards sustainable forest management (SFM), maintenance of forest biodiversity and socio-cultural values (Balashenko et al. 2005). The Carpathian Mountain ecoregion which is represented in the western part of Ukraine is a good example (Turnock 2002, Angelstam 2006). While the Ukrainian Carpathians represent only 3.5 % of Ukraine's area and 10.3 % of the mountain range's total area, nevertheless, this region has forest resources of high economic value and has retained an exceptional level of biodiversity and many of European's last great wilderness areas. The ecoregion is also home to several ethnographic groups of Ukrainians – Lemko, Boiko and Hutzul – who have been shaping mountain landscapes for centuries and have maintained a rich cultural heritage (Hajda 1998, Anon. 1983).

Nowadays people in many parts of the Ukrainian Carpathians are experiencing decreased standards of living. This is due to disintegration of the planned economy developed during socialism, and ongoing transition to a market economy under a climate of acute political and economic crisis. The picture is, however, very complex, especially as most of the Carpathian ecoregion has been part of Austria-Hungary, Poland and the Soviet Union during the past centuries. On one hand the Carpathian ecoregion is under severe threat from unsustainable logging methods, past replacement of native genetic tree species with introduced Norway spruce (*Picea abies*), habitat destruction, and fragmentation caused by changing land use practices and infrastructure development (Gensiruk 1964, Trokhimchuk 1968). On the other hand, local people are returning to their traditional land use practices, due to economic reasons and the need to develop local livelihoods. These were commonly practised before socialism and played an important role in maintaining biodiversity and cultural heritage, and thus rural development in the Ukrainian Carpathians. Recent land privatisation in the village communities by local people, beginning after the collapse of the socialist system in 1991, has led to a revival of the social and cultural value of land in western Ukraine, which often were unbroken part of families' cultural and natural heritage for generations (Huntingdon 1996).

The aim of this study was to evaluate the traditional village system as a framework for identifying ways of integrating the best practices of traditional land use into rural development. This would help achieve SFM objectives, including sustainable economic development, social stability, protection of cultural diversity, and maintenance of biodiversity in the region. We collected quantitative data describing economic, ecological, and socio-cultural dimensions of landscape sustainability and interviewed different actors to understand the role of traditional villages for sustainable development of forest landscapes in the Ukrainian Carpathians. The study is part of a transdisciplinary research network using multiple case studies located in regions with different biophysical conditions, economic histories, and governance systems in Europe's East and West (Angelstam and Törnblom 2004, Angelstam et al. 2007). In our study we focus on two questions: (1) what does sustainable co-existence of man and nature mean in forest and woodland landscapes; and (2) could traditional land use practice and traditional villages as integrated social-ecological systems be an example of successful rural development and sustainability?

21.2 Research Methodology and Study Area

Studying a complex concept, such as sustainable forest management (SFM), requires a common theoretical platform for analyses of ecological, economic, socio-cultural values (e.g., Sastamoinen 2005). We use the landscape concept as a theoretical platform of our applied interdisciplinary research integrating several related scientific disciplines (e.g., Tress et al. 2006). Landscape is an important concept within humanities (history), social sciences (human geography) as well as in natural sciences (ecology and physical geography) (e.g., Forman 1995; Angelstam 1997; Grodzinski 2005; Angelstam and Elbakidze 2006a, Elbakidze and Angelstam 2007). The landscape concept can thus be used as an interface for improving communication between social and natural sciences, as well as between policy makers and stakeholders, to increase the understanding of the dependencies between social and ecological systems that make up landscapes.

Under the European Landscape Convention, "landscape" is defined as a zone or area as perceived by local people or visitors, where the visual features and characters of the landscape are the result of the action of natural and/or cultural factors (Anon 2000). This definition reflects the idea that landscapes evolve through time. Individual landscapes can be viewed as units that offer a sense of place to stakeholders, thus representing a wide range of issues of concern and solutions. The landscape approaches requires expanding the spatial scale of management, for instance by moving from smaller spatial units to landscape and regional scales. Additionally, all social organisational scales must be considered, from individual, household or family, to community, county, nation, and global.

To study implementation policies for sustainable forest management in actual landscapes, we must view natural and socio-cultural components in a temporally and spatially expanded context, and one less restricted by administrative and political boundaries. Thus, we consider that a forest landscape forms a whole entity, where natural and cultural components are intermingled and cannot be viewed as separate entities or processes. A landscape is thus a social-ecological system that includes both tangible and intangible values, which can be described using variables that represent the different dimensions of SFM (Andersson et al. 2005;

Berkes et al. 2003). In an increasingly globalised world, it is essential to understand how factors at local, regional, national, and international levels affect the future sustainable development of forest landscapes. This must satisfy ecological, economic, and socio-cultural dimensions at different levels in rural landscapes with a long history of traditional land use (Innes et al. 2005). There are many views concerning the role of traditional land use in rural development (Syroechkovskyy, 1974; Klokov 1997; Yamskov 2000; Ramakrishnan 2001; Korytnyy et al. 2004).

The Skole district (147,100 ha) in the Ukrainian Carpathians was chosen as a case study landscape. The area is situated on the north-eastern side of Eastern Carpathian Mountains in the upper part of the Dnister river basin. Forests occupy 71 %, agricultural land 25 % and urban areas 2 %. All forests belong to the state. There are five state forestry enterprises (SFE), which are responsible for forest management and conduct commercial activities, and one national natural park 'Skolivsky Beskydy' (SBNNP). The proportion of forest under the management of the SFEs is 78 % and 22 % of the SBNNP. The number of inhabitants in the Skole district in 2005 was 49,438, with 13 and 87 % in urban and rural settlements, respectively, with an average population density of 33 persons/km (Anon. 2005a, b). There are 56 settlements including 55 villages and 1 town in this district. The oldest village was founded in 1100 and the youngest one in 1842. All villages are located in the forest zones (fir-beech and spruce-beech) at altitudes from 400 to 1000 m above sea level.

The Skole district has a rich history. Most people inhabiting the Skole district belongs to the Boikos (the Boikians), an ethnographic group of Ukrainian highlanders who have shaped both slopes of the middle Carpathians for centuries. The Boikos are believed to be descendants of the ancient Slavic tribe of White Croatians that came under the rule of the Kievan state during the reign of Prince Volodymyr I the Great (10th century) (Kyrchiv 1978; Utrysko 1980; Hoshko 1983). The Boikos have kept their ancient customs and rites and much of their material culture, architecture and costume. The Skole district preserves the old type of wooden houses under the same roof as the farm buildings, the old agricultural implements, typical old churches (from 17th century), characteristic forms of costume and ornaments, as well as some old customs and terminology (Kyrchiv 1978; Utrysko 1980; Hoshko 1983). Certain legends, such the story of Prince Svyatoslav's gave (10th century) and the stories about King Danylo (a famous Ukrainian King of Halychina in 13th century), indicate that the area of the Skole district played an important role in Ukrainian history (Anon. 1983). The restoration and protection of historic sites of regional and national value have been increasing since 1991, and the Skole district has been recognized as an integral part of Boyko's area in the Carpathians. The spatial structures of villages in the area still have traditional zones including: (1) built-up area, (2) gardens, (3) fields, (4) meadows and (5) forests and pasture commons, all of which satisfy different needs of land users.

There are many views concerning the role of traditional land use in rural development (Syroechkovskyy 1974; Klokov 1997; Yamskov 2000; Ramakrishnan, 2001; Korytnyy et al. 2004). Nevertheless, the village with its traditional zoning to satisfy the need of goods and services is a characteristic feature of the Skole district (e.g., Sporrong 1998). We regard the traditional village system (TVS) in the Ukrainian Carpathians as an integral socio-cultural component (a sub-system) of forest landscapes. To evaluate the role of the traditional village system for implementation of SFM we: (1) analysed the land use history, especially historical development of rural landscapes using published historic information, (2) gathered demographic and socio-economic data describing present economic, ecological and socio-cultural development, and (3) analysed landscape actors' needs and interests as well as their land use practices. To understand the level of compliance with the Pan-European Sustainable Forest Management discourse (e.g., Rametsteiner and Mayer, 2004) we also analysed the national forest legislation, and the regional program for rural development and forestry in the Ukrainian Carpathians. To assess the current landscape's match with the TVS we used two main attributes as proxies for assessing sustainability, (1) spatial traditional village zoning structure (i.e. domus, hortus, ager, saltus and silva), and (2) the traditional land use associated with cultural landscapes. As evidence for application of traditional land use at the present time, we applied the following main criteria: (1) types of natural resources are used by local people, (2) types of land use activity are employed, and (3) the main goods and services are produced by local land users (Yamskov 2000; Elbakidze 2005).

Analyses of published statistical data and recent original statistics were used to quantify the status and trends of economic and socio-cultural development of the region. To understand the real life of villages, 23 expert interviews were conducted with local land users in five villages in May – August, 2006. A standardised interview manual was used that contained several groups of questions including personal data of the respondents, data about household economy, sources of income, expenses, use of natural resources, farming, public work and meetings, traditions and mobility. Statements from the interviews made with local land users in summer 2006 were then compared with the State and trends derived from public statistical data.

21.3 Results

21.3.1 Historical Development of the Rural Landscape

The Skole district has a land use history extending back ten centuries. Continuous external political, economic, and social influences have modified land use practices conducted by local people. In the pre-agricultural period lasting until the 13th century, the Skole area was populated predominantly by Slavic tribes, who had engaged in hunting, fishing and gathering since the mid-Neolithic period (Portenko 1958). In Kyivan Rus times (10-11th centuries) and during the Halych-Volyn' Principality (13-14th centuries), agricultural activity in Skole was small scale. It was centered around the fortified towns and monasteries, which appeared along the trade routes that went through the Stryj-San Highland at the divide between the

Black and Baltic Sea catchments. During that time 8 villages were founded, representing 13 % of the total number of villages in Skole (Anon 1983, Hrushevsky 1995a, 1995b, Trokhimchuk 1968).

An era of profound human influence on the biophysical landscape started in the fifteenth century, when Boikos began to settle the area. The Boikos are an ethnographic group of Ukrainian highlanders who inhabit both slopes of the middle Carpathians. Since then they have shaped landscapes for 500 to 600 years. They introduced their own land cultivation traditions (Anon. 1983). Agricultural land development went side by side with the appearance of new permanent settlements. From the 15th to the end of 18th century 44 villages, or 80 % of the total number, were founded. The traditional land use practice of that time conducted by local people was to a certain extent a prototype of a sustainable use of natural resources. It depended completely on the availability of local natural resources and maintenance of an ecologically balanced environment with minimal use of outside resources and energy. Chief characteristics of the land use were: (1) using a two field rotation system; (2) combining tillage and livestock production within one farmstead; (3) dividing land into interchangeable plots and sowing by shifts; (4) using mechanical devices to cultivate the land and to exterminate weeds; and (5) protecting the soil from erosion by means of special plowing methods.

The character and intensity of natural resource use in Skole began to change in the 19th century. One of the main reasons was the emancipation of serfs in 1848, which in its turn led to the development of capitalism in the Halychyna. The agricultural cultivation of land intensified and became more widespread (Trokhimchuk 1968, Hajda 1998, Anon 1983). The role of livestock production increased, especially for meat, milk, cattle hides, and wool, since these products were in high demand on the Austrian market. As a result of high demand for wood in Western Europe, forest industry began to develop during the 19th century. Forests were cleared mostly to export wood. Only a small quantity of wood was processed locally (Anon. 1966). The demand for spruce timber on the world market and the rapid decrease of its supplies prompted the owners of the forests to replace beech and fir forests with Norway spruce forests. In 1882, this tendency was legalised by the Austrian government (Gensiruk 1964). Thus, during this period there was a significant increase in the use of forests for wood production. Nevertheless, the majority of the population in the Skole continued to use traditional methods of agriculture. Only three new villages (or 5 % of the total number) were founded during the 19th century (Anon 2005).

A complete change of political, social, and economic relations was initiated in 1939 when the western regions of Ukraine became part of the Soviet Union. This had a profound influence on the ways in which natural resources were used. The Soviet regime (1939-1991) had an especially disastrous impact on the local people's traditional way of life and land use. Private land was expropriated, people were forced to emigrate, arable lands increased at the expense of wooded grasslands, and forestry became more intensive (Trokhimchuk 1968). The land tenure and forest properties were changed. Forests were now owned by the State and private plots of land were joined into collective farms (kolkhozes). Collectivisation and mechanisation left limited space for the traditional way of life (Trokhimchuk 1968). Natural resource uses were thus shifted towards industrial forestry practices characterized by spruce reforestation, which was caused by the growing importance of forestry in the Carpathians in general, and within the Skole district in particular. This was accompanied by increased harvesting and reforestation rates, the latter using artificial regeneration (i.e. planting).

Since Ukraine became an independent state in 1991, economic crisis has made rural livelihoods directly dependent on the local natural resource use. They have had to come back to their traditional agricultural land use practices due to hard economic conditions. Non-wood forest products (NWFP) such as mushrooms, berries, honey, medicinal herbs, floral greenery, birch sap, resin and wild game, began again a part of the social fabric and livelihood of Ukrainian culture (Bihun 2005). This was especially true in communities dependent on forest landscape resources for rural development, like the Skole district.

Based on this review of the land use history of the Skole district, we define five phases of cultural landscape integration of land use activities under the different governance systems. These are: (1) pre-agricultural period (until the end of 13th century); (2) period of traditional extensive land use (14–18th centuries); (3) period of intensified traditional land use (19th to early 20th centuries); (4) intensive (socialist) land use period (mid to end 20th century); (5) period of extensive land use (present time) (Elbakidze and Angelstam 2006). To understand if present land use practices in the Skole district could be characterised as that of a traditional village system, we compared the main characteristics of land use activity during the period of extensive traditional land use (phases 2,3) with those at present time (Table 21.1). The present land use was studied through the field work and interviews which were conducted in summer 2006. Analysis of Table 21.1 clearly indicates that the present type of land use activity is similar to the traditional, with some reductions in diversity of land use characteristics, which is a result of evolutionary processes in land use practices.

Table 21.1 Comparison of the main components of traditional land use activity in the past and at the present time in the Skole district, Ukrainian Carpathians

Main components of land use	Past/Historical	Present Time
Type of natural resources in use	Arable land, meadows, non-wood products, wood, wildlife	Arable land, meadows, non-wood products, wood
Type of land use activity	Animal husbandry, plant growing, useful arts, forestry	Animal husbandry, plant growing
Tools of land use activity	Hands, ox, horse, plough, scythe, axe, pitchfork	Hands, horse, plough, scythe, axe, pitchfork
Main products of farming	Meat, milk, meal, cheese, vegetables, potato, wool, cloth	Meat, milk, cheese, vegetables, potato

21.3.2 Comparing Quantitative and Qualitative Data

In our interview survey, the most common statement of local land users was "our grandparents' land and houses are becoming empty." The field observations in the

Skole district showed that marginal lands on former collective farms, which are not used anymore for grazing or crop production, are being reclaimed by forests due to natural secondary succession, by pioneer species such as alder and juniper. Decreasing amounts of open land after the collapse of collective farms is a natural result of the transition from intensive agriculture during the socialism time to the extensive land use practice conducted by local farmers at present time. Privatisation of arable land by local people began after the collapse of the socialist system. However, the "new" agricultural land distributed among local people after 1991 has not taken into account pre-Soviet ownership patterns. This past legacy is of exceptionally high significance for people in western Ukraine, where the older generation still has strong feelings of ownership and memories about unjust political and social events, which brought them to ruin. This is still the main subject of conversation when meeting the old generation in the villages. However, at present time it is not profitable for the local people to manage their land, and they are escaping abroad to find jobs. Consequently, abandoned land is currently increasingly in area in the Skole district. According to official statistics (Anon. 2005), seasonal and empty house numbers have increased during the last decade. In 2005 9.6 % of villages in the district had empty houses and 36.5 % of villages had seasonal houses. Although the total numbers of empty (585, or 5 % of total number of houses in the district) and seasonal (55, or 0.5 % of total number) are still quite low, local people perceive this trend in village development as very painful. The total number of villages has not changed during the last 200 years. However analysis of official statistic data for the last 50 years shows that the size of villages according to the number of inhabitants has varied considerably during that time. Groups of villages with inhabitants less the 100, 100-199, and 200-499 people were the most stable. Their numbers have only slightly changed (less then 2 %) since 1959. The most noticeable changes happened with the groups of villages having 200-499 (positive dynamic, 11 % more in comparison with1959), and 1000-1999 inhabitants (negative dynamic, 9 % less in comparison with their number in 1959), respectively.

The second most common statement we found was: "young people are escaping abroad; it is so hard for us to take care of our land." Our review of official statistics shows that the total number of inhabitants has been decreased by 15 % from 1970 (the socialism period) to 2005 (the transition period). At the same time a comparison of urban and rural population dynamics shows two opposite trends. The size of the urban population has been growing since 1970 (16 % more in 2005 then in 1970), and the rural population has been decreasing during that period (19 % less in 2005 then in 1970). According to demographic data, the largest groups are working people (28-53 years of age, 35 % of total number of people) and retired (more than 55 years old, 27 % of total). In reality, however, the number of working people is considerably lower. The reason is that while all people have permanent residence registrations in their home settlements, at the same time many of them are working abroad.

The third most prevalent statement of local people was: "the government forgot about us – no jobs, no market for our farming products, high prices for wood;

without financial support from children abroad we would die." The number of employed people in the district is 17,600 (66 % of people 28-53 years of age and 49 % of total population), including 6,043 employees of state enterprises (22.8 % of those in work-able age or 12.4 % of the total population) (Anon. 2005). The main individual employers are educational foundations (6.5 % employed people from total number in workable age), forestry sector (3.6 %), and health service (3.2 %). The main sources of income for local people are pensions and salary and financial support from relatives living abroad. Very low incomes are gained from farming activities (mostly selling meat) and private businesses.

21.4. Discussion

21.4.1 Role of Traditional Village Systems for Sustainable Forest Management

Previous international publications on sustainable forest management in Ukraine have focused on the attempts to reform State forest management during the first decade of the country's independence (e.g., Nijnik and van Kooten 2000; Nijnik and Oskam 2004). Nordberg (2007) used an interesting comparative political science approach and concluded that the slow reform process was due to a combination of (1) interest group struggles between involved governmental institutions, (2) that politicians appeared to have been reluctant to take decisions that might threaten employment or the environment, and (3) that various economic interests have had significant importance, because control over the forest resource means control over an important economic asset. However, to our knowledge few if any studies have evaluated the forest policy implementation process using a bottom-up approach, founded in empirical studies of local and regional social-ecological systems, or landscapes, which is the approach taken in our study.

The combined use of qualitative and quantitative methods made it possible to evaluate the current dynamic of socio-cultural dimensions of the sustainable forest management concept, and to assess the extent to which this dimension of the traditional villages system has been retained in the selected case study region. After centuries of continuous coexistence between man and nature, followed by intensified management of landscapes during Austro-Hungarian and Soviet influence, the ongoing transition from planned to market economy has led to a revival of the traditional village system in support of rural development. Whether this trend will be sustained, however, is uncertain. Understanding the total economic value of forest landscape resources, including wood and non-wood products and services based on cultural values and biodiversity, is an urgent task (cf. Innes and Hoen 2005, Merlo and Croitoru 2005).

The Ukrainian Carpathians are a good example of the complex historical development of Europe's rural landscapes (cf. Whyte 1998). Our results indicate that the cultural landscape associated with the traditional village system in the Skole district belongs to the second category – the organically evolved landscape – of cultural landscapes adopted the World Heritage Committee in 1992, and included in the associated Operational Guidelines (UNESCO 1997). This "results from an initial social, economic, administrative, and/or religious imperative and has developed into its present form by association with and in response to its natural environment. Such landscapes reflect that process of evolution in their form and component features" (UNESCO 1997). In the context of contemporary European Union, Pan-European, and many national policies (e.g., the EU Common Agricultural Policy; Anon. 2000; MCPFE 2003), the cultural landscape of the Skole district has a high value due to its long history of development, beginning in the 10th century or earlier. This landscape reflects the ancient cultural and land use traditions of the Ukrainian highlanders. The traditional village system with its characteristic zones of different land use from the centre to the periphery is, still, a basic unit of the cultural landscape. The spatial structure of the village system has not been changed considerable since the end of 18th century. There are also many cultural artifacts (like wood churches from the 17th and 18th centuries, traditional wooded houses, vow crosses, etc.), and which are carefully maintained. At the same time the diversity of landscape pattern of the different village zones is decreasing in the Carpathian Mountains (Angelstam et al. 2003; Kuemmerle et al. 2006).

The organically evolved landscape concept falls into two sub-categories (UNESCO 1997). The first is the relict (or fossil) landscape in which an evolutionary process came to an end at some time in the past, either abruptly or over a period of time. Its' significant distinguishing features are, however, still visible in a material form. The second category is the continuing landscape. Here the landscape has an active social role in contemporary society, which is closely associated with the traditional way of life, and in which the evolutionary process of development is still in progress. At the same time, it exhibits significant material and cultural evidence of this evolution over time.

These two sub-categories are relevant in countries that have been developing without cataclysmic periods in their evolution. In the post-socialist countries, like Ukraine, however, rapid and fundamental changes in political and socio-economic spheres happened at the end of the 20th century, and without a protecting social welfare system. This has resulted in the appearance of a new type of rural landscapes that we call a "revived cultural landscape." A revived cultural landscape is one which resumes an active social role in contemporary society which still keeping alive their traditional knowledge in spite of political cataclysms, and in which the evolutionary process is unpredictable due to unstable land use activity. The revived landscape could be a third sub-category of an organically evolved landscape.

For several reasons the maintenance of traditional village systems in the forest landscapes of the Ukrainian Carpathians is a very important prerequisite for developing sustainable forest management as defined, for example, by the Ministerial Conference on the Protection Forests in Europe (MCPFE) process (Rametsteiner and Mayer 2004; Ilavsky 2006). Particularly important dimensions are represented by the existence of traditional villages as a base for preservation of cultural heritage and diversity, and traditional land use as a means of maintaining ecological sustainability, including species, structures and processes (Stoyko 1991; Angelstam 2006) on the one hand, as an embryo for developing effective local governance arrangements supporting rural development.

The forest landscape configuration and traditional management systems in different zones of the traditional village system, which most Europeans understand as a part of their history, is an everyday reality for people in this part of the world. This landscape is characteristic not only in parts of the Carpathian Mountains, and further to the southeast in the Balkan and Rodopi Mountains, but was common in many other European regions in the past (Angelstam 2006; Sporrong 1998; Vos and Meekes 1999). Thus, loss of the authentic pre-industrial village structure characterised by a fine-grained landscape pattern of arable land and wooded grasslands is a threat to both cultural heritage and biodiversity in many rural landscapes (e.g., Ramakrishnan 2001; Angelstam 2006). However, reviving the social capital of traditional villages systems remains an important challenge.

21.4.2 The Ukrainian Carpathian Villages in an European Context

The expansion of the European Union (EU) to the western border of Ukraine could bring advantages as well as disadvantages to the Ukrainian Carpathian ecoregion, now bordering four new members of the EU, namely Poland, Slovakia, Hungary and Romania. Closer integration into the EU's Common Market and some EU policies and funding will lead to the intensification of a number of threats to the natural values and long-term sustainability of the Carpathian ecoregion as a whole (cf. Angelstam 2006). These include development of mass tourism facilities, transportation infrastructure, and agricultural intensification as well as abandonment of traditionally farmed areas (Anon. 2006). At the same time, however, increasing EU integration is also driving the adoption and implementation of a number of progressive EU laws and policies. Even if Ukraine has not been presented with the perspective of future membership in the EU, still, the country has been aligning its national laws and policies to important pieces of the EU legislation. This harmonisation process presents potentially powerful tools for nature conservation and sustainable development (Anon. 2006).

Comparing the development of cultural landscapes in the western European countries and in the Ukrainian Carpathians shows that there are many similarities and considerable differences in rural development. In the past, traditional low intensity agriculture was the norm in Western European countries (Vos and Meekes, 1999), and the maintenance of biodiversity was an unplanned by-product (von Haaren 2002).

This phase is comparable with phases one, two, and three in cultural landscape development defined for the Skole district. Subsequently this was followed by a transition from primary to secondary economics in the West, and industrialised agriculture led to loss of biodiversity and other values (Höll and Nilsson 1999). This is similar to the period of intensive land use during socialism (phase 4), which had a destructive impact on cultural landscapes in our case study landscape. However, the political and socio-economic systems during that phase were completely different in Europe's West and East, and created opposite initial conditions for the next phase of rural development. For example, intensification of natural resources use and disappearing cultural landscapes in the West were the result of the development of democratic societies with increased economic welfare. By contrast, in Ukraine the consequences of economic and political development during the socialist period was linked to deep political and economic crises, collapse of economy and undeveloped civil society. The present post-industrial society of the western European countries represents a third phase: a desire to maintain 'the grandparents' landscape,' which seems like a luxury for developed nations. At the present time rural development in remote areas in Ukraine like the Carpathian region, restoring and maintaining such landscapes as integrated social-ecological systems is an absolute necessity for local villages to survive during the transition period from planned socialism to market economy (Angelstam 2006; Elbakidze and Angelstam 2006).

Financial, social, and cultural support for traditional village systems should be a milestone in a regional program of sustainable forest management designated for keeping cultural diversity and social stability of forest landscapes. Village system "intactness" would be a good partial indicator of success. However, the extent to which the land management in traditional village systems do maintain biodiversity also needs to be evaluated.

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Значення системи традиційних сільських поселень для сталих лісових ландшафтів: на прикладі Українських Карпат

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Підтримка соціально-культурних цінностей та біорізноманіття на локальному та регіональному рівнях є важливим критерієм запровадження сталого лісокористування та лісоуправління. Лісовий сектор в Україні перебуває на стадії від планового соціалістичного управління до ринкової економіки. Ми оцінили роль системи традиційних сільських поселень у підтримці сталого розвитку лісових ландшафтів в Українських Карпатах. Сколівський район було обрано як територію досліджень. Він є частиною Бойківщини і одним із найзалісненіших регіонів Карпат. Сільські поселення – це усталені соціально-екологічні системи, які характеризуються традиційним землекористуванням і мають просторову структуру із різними функціональними зонами для задоволення різних потреб. На основі аналізу документів щодо історії природокористування, аналізу соціально-економічних даних та інтерв'ю із місцевими землекористувачами ми оцінили роль традиційної системи сільських поселень для підтримки соціально-культурного складника сталого розвитку лісових ландшафтів. Наш аналіз засвідчує, що пройшовши різні етапи соціально-політичного розвитку, система традиційних сільських поселень досі є базовим утвором для розвитку і підтримки культурних ландшафтів. Але ми виявили, що існує багато загроз для їх сталого існування. Тому підтримка соціально-культурних функцій та традиційної системи природокористування має бути наріжним каменем програм регіонального сталого розвитку. Життєздатність системи традиційних поселень може бути важливим критерієм сталого менеджменту лісових ландшафтів.

Chapter 22

Ecological Economic Principles of Integrated Process Management for Forestry and Agriculture

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Abstract The main directions of managing the environmentally oriented integration of forestry and agriculture were proposed from the perspective of increase in the environmental and economic efficiency, decrease in environmental costs. It is argued that in the current environment the integration processes require governmental regulation. Theoretical and methodical approaches to the development of the expanded system of indicators on the level of integration processes development and cooperation level were proposed. Assessment of the economic and environmental effect of tree planting in agricultural areas should take into account the effects of the quality of farming products increase and opportunities for the pesticides use decrease and other environmental threats minimizing.

In terms of the economic assessment of the social and environmental functions of forestry, the following methods are distinguished: direct counting, normative methods, as well as the ways, which allow taking into account the environmental functions of forests relatively to the stock of raw materials. Coefficients for assessment of the annually counted social and environmental functions of forestry relatively to the value of wood were developed.

Two main approaches to the forests restoration planning are discussed taking into account the regional specific features of forestry. The target function of environmentally oriented forestry reproduction optimization may be expressed by a complex indicator of forestry social and environmental functions.

The essence of the system of environmental management in forestry from the perspective of sustainable social and economic development of this sector and system management of forestry is considered. The main elements of the environmental management system are considered: environmental and economic assess-

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ment of forestry; greening of labor and stimulation; forest certification; insurance mechanisms.

22.1. Principles of Integration Processes in Forestry and Agriculture Sectors

Environmentally sustainable development of forestry and agro-industrial sectors requires achievement of target and optimal use of environmental, agricultural and resource functions of forestry for the purposes of intensive and environmentally safe development of agriculture. Environmental interdependences of land uses, water resources and forestry stipulates the need to create highly productive, environmentally balanced agro-forestry landscapes, wide scale and justified agro-forestry development, further deepening and expansion of economic and environmental links between forestry and the agro-industrial sector. Ultimately, we mean the environmentally oriented integration of forestry and agriculture, wide scale cooperation between industries regarding agricultural forestry.

There is no just economic but also environmental importance of forestry for agriculture in terms of the following directions: efficiency increase of agricultural forestry; complex use of wood and by-products of forestry (food and fodder); agricultural use of forestry and transformation of low productivity agricultural lands into forestry. An important step regarding better interaction (integration) of forestry and farms is represented by creation of interfarm forestry's part of regional agro-industrial sectors.

Environmentally oriented integration of forestry and the agro-industrial sector is an organizational and economic form of comprehensive and deep greening of forestry and agriculture, implementation of agricultural, environmental and forest policies. It includes complex of agricultural and forestry activities that means interaction and intertwining of reproduction processes in forestry and various agro-industrial sectors, taking into account the importance of environmental and agricultural functions of forestry for other industries. This should be a planned process (taking into account various trends) of harmonization of environmental and economic interests of forestry and agro-industrial sector, as well as relevant economic relationships, division (specialization) of environmentally oriented labor and production development based on accounting for the forestry factor, expansion of material, technical, research, financial and economic cooperation between economic agents for timely resolution of interindustry economic and environmental issues.

Environmentally oriented integration processes in forestry and the agro-industrial sector have interindustry and regional importance in optimization of natural resource management. Environmental degradation and pollution are the result of overuse of land resources, increase in industrial impacts up to critical levels, as well as disruptions in regional ecosystem balances. Purely technocratic concept of the agro-industrial sector development caused the destruction of environmentally acceptable balances between the so called "wild nature" and agricultural lands as well as between agricultural lands, natural areas and perennial plantations, and, finally, between forestry and agricultural lands (Tregobchuk 1997).

Environmentally oriented integration of forestry and agriculture is described by natural, biologic, economic and environmental basis which includes the following main aspects: interlinks and interdependencies between conditions of forestry and agricultural ecosystems, taking into account specifics of their location; certain similarity of economic processes of natural resource management from the perspective of the land resource potential; environmental and economic importance of agricultural and environmental functions of forestry; close resource economic relations; common infrastructure etc. (Mishenin 2000).

The need to develop environmentally oriented integration of forestry and agro-industrial sector is based on the following aspects:

- critical environmental situation in all sectors, as well as the need and expediency for economic agents to move towards the model of sustainable, environmentally safe and balanced social and economic development;
- issues of environmental development of forestry and agro-industrial sector regarding optimal use and reproduction of forest and other natural resources. It's worth to mention, that the domestic agro-industrial sector is one of the most resource intensive sectors, while its environmental impact makes it one of the most powerful negative factors. Integration of environmental and economic interests, environmentally safe intensification of agriculture includes organization and implementation of wide scale environmental activities in the area of forestry reproduction. The main directions of agricultural greening must include timely agricultural forestry activities. At the same time agriculture generates negative impact on the forestry ecosystems, as well as efficiency of forestry in general. For example, the use of agricultural chemicals destroys forests, decreases the quality of forestry food and fodder resources, while the forests resistance to various diseases and pests falls;
- expediency and efficiency of integrated multipurpose forestry;
- regional aspects of preserving the naturally pure agricultural environment, biological diversity of natural organisms, as well as ensuring of food quality. Creation of highly productive, environmentally safe, balanced and socially important agricultural forestry landscapes requires a close coordination and economic interconnection between forestry and agricultural activities.

Therefore, the main goal of environmentally oriented integration of forestry and agriculture includes a wide scale development of agricultural forestry, thus deepening environmentally oriented economic relations regarding optimal use and reproduction of forestry.

The main principle of integration processes in forestry and agriculture should be represented by optimal use of forest and agricultural lands with the environmentally and economically grounded quantity of varied forestry and agricultural products. Environmental orientation of economic relations of forestry and agriculture includes more comprehensive, deeper and interlinked considering of nature protection factors, considerable decrease in economic, social and environmental costs.

The main tasks of environmentally oriented integration of forestry and agriculture include: achievement of optimal balance of natural components and biodiversity in the agricultural forestry ecosystems; creation of environmentally favorable environment for production of forestry and agricultural crops, side products of forestry given the use of chemicals in and agro-industrial and forestry sector (decrease in agricultural impacts on forest ecosystems and decrease of use of chemicals in the agricultural ecosystems); integral multipurpose use of forestry; creation of powerful information and analytical monitoring systems for agricultural forestry landscape, efficiency of agricultural and forestry factors.

Environmentally oriented cooperation of forestry and agriculture represents closer economic, including financial and economic ones, for the purposes of joint use and reproduction of agro-forestry ecosystems ensuring of high quality of the multipurpose forestry and use of agricultural natural resources. It includes direct association (cooperation) of forestry and farms for the purposes of joint fulfilment of economic and environmental tasks (for example, production of quality food and fodder, processing of raw materials, agricultural forestry etc.).

Traditional market orientation of businesses leading to decrease in production costs and prices, relatively constant focusing on certain market segments can undergo certain changes in the conditions of greening and agricultural forestryuse and complete considering for economically important environmental factors. Creation of strategic alliances between forestry and agricultural enterprises on economic and environmental basis should become an important component of regional forestry and agricultural policies, the necessary basis for strategic expansion of investments into environmental friendly use and reproduction of forestry, agricultural and biological resources, as well as the natural resources. Strategic alliances usually constitute of joint efforts of several companies regarding sales and division of the distribution network. Strategic alliances within business in the field of natural resource management can provide a higher degree of the use of natural and innovative capacities in order to improve the environmental and economic level and quality of products.

Main directions of environmentally oriented integration and cooperation of forestry in the field of optimization of natural resource management are as follows:

1. Wide scale development of agricultural forestry to fight water and wind erosion in order to improve productivity and environmental friendliness of agricultural lands and forestry. Creation of optimized agricultural forestry' landscapes should ensure better protection, as well as environmental friendliness of agricultural and water resources, taking into account recreational, and aesthetic functions of forestry.
2. Development of agricultural forestry in order to improve protective functions of forests which are important for the agro-industrial sector.
3. Integrated multipurpose use of state and agricultural forestry, based on sustainability principles and taking into account their environmental functions, includes: production of raw wood; better use of food and fodder resources; production of fodder and vitamins from the forestry' by-products; development of forestry plantations along with agricultural crops; production of planting materials for forestry etc.
4. Cooperation for the purpose of lands use systems development based on environmentally safe agricultural technologies, as well as taking care of tree plantations state and functions improvement. The following infrastructure elements are being developed: roads, communications, warehouses, nurseries etc.

5. Environmentally safe use of chemicals in forestry and agriculture, wider use of biotechnological intensification of reproduction processes, protection of forest and agriculture ecosystems.
6. Development of state programs on optimal use of land and water resources in agricultural forestry, as well as improvement in the environmental and economic efficiency of forestry and agriculture sectors as a source fo rural economies development. This should be facilitated by systemic structuring of lands and forestry, approval of agricultural forestry projects.
7. Development and maintenance of various information and analytical monitoring systems for forestry and quality of food and fodder products.

Therefore, environmentally oriented integration processes in forestry and agriculture may include various aspects: organization, technological, environmental, economic, financial, research, technical, social, information.

Environmentally oriented integration of forestry and agro-industrial sector in the market environment, full financial autonomy of companies requires various types of government regulation of this process, including:

1. Interconnection, arrangement and coordination of purposes and tasks, as well as directions of regional forestry and environmental policies; ecosystem based management of forestry and farms.
2. Development of organization and economic mechanisms, as well as the legal (institutional) basis for environmentally oriented integration processes. Due to financial and economic critical situation of forestry and farms, we need to recognize an expediency of barter transactions. Complex and joint use of resource assets of forestry enterprises and farms becomes a critical issue. There is a need for efficient and reliable economic instruments and levers (payments systems for natural resources, environmental taxes, fair and efficient distribution of rent, environmental costs etc.) of stimulating the integration processes, as well as for an effective system of governmental control over compliance of environmental requirements, regulations, standards, limitations, laws (which requires enhancements and reforms). It is worth mentioning that the efficiency of integration processes in forestry and the agro-industrial sector is affected by ownership on land and natural resources, as well as by management forms.
3. Development of national and regional programs of the environmental integration of forestry enterprises and farms, which would ensure protection and optimal use of agricultural and forestry resources.
4. Environmental assessment of joint agricultural and forestry projects, state programs, environmental cooperation of forestry and agro-industrial sector, and various initiatives.
5. Development of an efficient mechanism of economic responsibility for optimal use and reproduction of forest and agricultural resources, as well as compliance with contractual relationships between forestry and the agro-industrial sector.

We consider that the project for organization and maintenance of forestry may become one of the main documents for long term planning, setting up main directions and activities of environmentally oriented cooperation between forestry and farms. In this project certain directions and activities, related to integration processes of forestry and agro-industrial sector are justified and reflected by the system of organizational, technological, economic and social indicators. Integration level for cooperation between forestry and agriculture can be measured by the following indicators:

- percentage of the forest area, which are important for agriculture, in the total area of agricultural forestry;
- importance of forestry in the protection of fields, water resources and soils in the agricultural landscapes;
- integration (cooperation) ratios for various types of use of forest resource use and their reproduction, development of agricultural forestry, which are measured based on the relevant ratios of physical and monetary indicators;
- rent for the use of forests, paid by farms, in the total revenue of forestry:

$$Kif = \frac{Vf}{Vais}, \tag{1}$$

where Kif – integration (cooperation) ratio of forestry or use of forests by forestry and agro-industrial enterprises;

Vf – volume of forestry reproduction or resource use activities (physical or monetary indicators) executed by forestry enterprices in the forests, which are important for the agro-industrial sector;

$Vais$ – total volume of reproductive forestry activities or utilization of forests (physical or monetary indicators) in the agro-industrial sector or forestry.

Therefore, these indicators describe the level of economic and environmental links between forestry and farms, and they could be the basis for optimal decision making in the management of natural resources. Forestry project can initiate new organizational forms of forestry businesses, which will provide more efficient interaction with farms and their associations. They nay include cooperatives, small, family and other types of businesses. It makes sense to determine the impact of forestry and new organizations in the field of environmental cooperation upon improvement of the environmental situation in the region, lands and efficiency of the management of natural resources.

Therefore, environmentally oriented integration, cooperation between forestry and farms for the purpose of optimization of the multipurpose use and reproduction of forestry should be better reflected in various projects, instructions and forecasts related to the environmentally sustainable regional development, agricultural forestry landscapes, as well as the agro-industrial sector. In terms of greening of various industries and the agro-industrial sector, forestry are the basis for increase in the environmental friendliness level of agriculture, decrease in the environmental impact of agriculture, which ultimately can facilitate considerable improvement in the environmental safety for the population and natural ecosystems, as well as the products' quality.

Consideration of the above mentioned aspects of greening of reproduction processed in forestry and agro-industrial sector point a need to optimize an economic mechanism of increase in the agricultural forestry' efficiency, which is important for sustainable regional development.

22.2 Reproduction Efficiency for Environment Protecting Plantations: Methodical Approaches

Environmentally sustainable development of agricultural landscapes generates the need to preserve agricultural lands, as well as to fight erosion by means of protective afforestation. Further development of agricultural forestry in order to ensure environmentally sustainable development of agricultural landscapes and the agro-industrial sector, requires further research in order to improve the assessment of environmental and economic efficiency of protective plantations in agricultural areas, taking into account the quality of crops. That is why along with the economic assessment of increase the crops yield, prevention of soil fertility deterioration due to plantations it is necessary to take into account certain circumstances. For example, increased content of the main component (protein, fat, sugar) in crops can provide higher income (decrease in costs) during production, storage and processing of crops; decrease in chemicals contents in the agricultural lands will allow to reduce costs, related to fertilizers and other chemicals, thus improving the quality of products. Besides, the risk of loss of winter crops may decrease, along with the risk of deterioration and erosion of fertile soil in vulnerable areas due to increase in the area of ravines.

Taking into account environmental and economic effect of field protecting plantations (forest shelterbelts systems) the crops yield (Ey), can be calculated as follows:

$$Ey=((Pc-Pn)\times(Y+\Delta Y)+(Pn-Cy)\times\Delta Y)\times S, \quad (2)$$

Where Pc – price per 100 kg of agricultural crops in the area affected by the field protecting plantations, UAH;

Pn – price of 100 kg of agricultural crops in the area which is not affected by the field protecting plantations, UAH;

Y – yields of agricultural crops outside the area, which is affected by protecting plantations, 100 kg/hectare;

ΔY – additional yield obtained because of the plantations, 100 kg/hectare;

Cy – harvesting and transportation costs per 100 kg of crop UAH;

S – agricultural area protected by shelterbelts, ha.

On the contrary, agricultural forestry can ensure sustainable development of agricultural landscapes and the agro-industrial sector in general during economic and environmental crisis because it is a less costly as compared to other processes. Improvement of the crops yield due to agricultural forestry is explained both by increased moister, especially in the spring, and evaporation during the vegetation period, and also by a better effect of fertilizers due to their better solubility in the soil and absorption by well developed root system. From these perspectives, agricultural forestry can decrease the agrochemical impact upon the agricultural landscape, facilitating natural improvement in quality of agricultural products. Due to decrease in the impact of agrochemicals on agricultural ecosystems environmental and economic efficiency (Ech) can be calculated as follows:

$$Ech = \left(1 - \frac{Y}{Y + \Delta Y}\right) \times (Cch + EL) \times V \times S\ , \qquad (3)$$

Where V – volume of fertilizers and pesticides, kg/hectare;
Cch – costs of fertilizers and pesticides, UAH/kg;
EL – prevented economic loss due to contamination of food, water sources and other negative impacts due to use of agricultural chemicals per unit of fertilizers and pesticides, UAH/kg.

Besides, while calculating the environmental and economic effect of field protecting plantation it is necessary to take into account decrease in the risk of loss of agricultural crops. For example, in the Crimean State Agricultural Research Center, where each field has forest shelterbelts every 500-600 meters (covering 3,2 % o agricultural area), the survival level of winter crops (even during the years of dust storms) reached 92-95 %. There was no need to have one extra sowing during the past 30 years (Titova 1982).

Based on the data on the impact of the field protecting tree plantations on the survival of winter crops, we calculated the relative indicator – percentage of loss of the winter crops in the total area of crops;, this percentage fluctuated in the interval 0.037-0.503 depending on periods and farms, and the weighed average level of this indicator in the studied regions equals 0.383 (Pashkov and Kovalov 1988).

Economic and environmental risk of loss of winter crops (R) can be obtained from the following formula:

$$R = p \times S \times Crwc, \qquad (4)$$

where p – loss probability for winter crops;
S – agricultural area of winter crops which is not protected by tree plantations;
Crwc – costs of re-sowing of the winter crops.

It is important to determine the environmental and economic risk for other destructive aspects of agriculture as well: increase in erosion vulnerability for agricultural lands, decrease in the quality for agricultural products etc.

Economic assessment of environmental and recreational (social) functions of forest ecosystems is a complicated task both from the methodological and methodical (technical) perspective. Economic assessment of environmental and social (recreational) functions of forests by the means of direct calculation method is a labor consuming process, which requires a considerable volume of information (and, therefore, relevant forestry and environmental research) based on the social and environmental results of implementation of certain functions of forestry's ecosystems within a certain area (for example, increase in the groundwater seepage per hectare of forest area, additional yield of agricultural crops in the area of tree plantations, decrease in the air pollution levels, water sources etc.).

Normative method of economic assessment of environmental and social functions of forestry's ecosystems includes use of average physical and monetary indicators per 1 hectare of the forestry's area, depending on the geographical territory, conditions and soil quality. It is worthwhile to use the express (relative) method for the economic assessment of the social and environmental functions of the forestry' ecosystems, which is used for quick calculation process with the minimum volume of input information regarding the forest productivity.

For the purpose of economic assessment of the social and environmental functions of forests, this method can be used as follows:

$$\mathrm{EAi}= \mathrm{EA}_i^{ws}\left(\sum_{j=1}^{n} Kij\right)\times Si, \tag{5}$$

Where EAi – current economic assessment of the social and environmental functions of the forest in area i;

k_{ij} – ratio of the economically assessed social and environmental functions of the forest of type j as compared to the value of wood stock in the area i (annualized);

EA_i^{ws} – economic assessment of the wood stock per unit of area i;

S_i – forestry area i.

This approach can be used for quick economic assessment of forest resource use as raw materials.

Numerous data on the economic assessment of intermediate products and by-products of forestry protecting and recreational functions of the ecosystems create a certain variability range for the k_{ij} ratio due to different quality of forestry, as well as methodological approaches to evaluation of various utilities of forestry. Assessment of k_{ij} ratios can be done for various geographical areas, according to the type of local conditions or the soil quality. We can use productivity ratio of a forest area, based on the environmental function of the forestry depending on the soil's quality (Nelzin 1988).

The Table 22.1 below gives approximate ratios of the economically assessed social and environmental functions of forests (annual) as compared to the value of the timber stock, which were calculated by us based on the rent focused approach for geographical areas of Polissya and Lisostep (Mishenin 2007).

In a general case, the expected economic assessment of the social and environmental functions of the protecting tree plantations (EA exp) can be made according to the approach, specified in (Bobruyko 1996):

$$\mathrm{EA\ exp} = \lambda \times EA^{\max} + (1-\lambda)\times EA^{\min}, \tag{6}$$

Where $EA^{\max} EA^{\min}$ – maximum and minimum (potential) social and environmental functions of forests;

λ – special criterion for taking into account of the uncertainty of the environmental and economic effect, reflecting the system of preferences for the relevant social and environmental functions of forestry. By analogy, we can assume that it equals 0.3.

Table 22.1 Approximate ratios of economically assessed social and environmental functions of forests (annuly) as compared to the value of the timber growing stock in matured age. Based on investigations ((Bobruyko 1980; Golovashchenko, P, P.Plyuta 1990; Dmitrienko 1993; Ilyev, L, R.Gordienko 1973; Koval, Y, I.Antonenko 2004; Kokin 1981; Methodical recommendations, 1981; Paulyukyavichus 1989; Pristupa 1981; Tarasov 1986; Turkevich 1977; Environmental and economic role of forests 1986) in the field of economic assessment of environmental and social functions of forest resources, data of Ukraine forestry productivity and also expert assessment.

Contents of economic assessment	***As compared to the rent based assessment of the wood stock***		***Notes***
	Polissya	Lisostep	
Protection and regulation of water resources			
Assessment in the increase in the subsurface runoff	0,028 – 0,085	0,015 – 0,056	
Runoff cleaning effect	0,020 – 0,070	0,012 – 0,042	Shelterbelts 10 meters wide and 1000 meters long
	0,048 – 0,155	0,027 – 0,097	
Anti-erosion and field protecting functions			
Prevention of soil deterioration	0,003	0,006	
Increase in agricultural yields	0,645	0,938	Sheltervelts 10 meters wide and 1000 meters long
	0,648	0,944	
Air purification function			
Based on industrial waste management	up to 0,120		
Recreational function			
Based on differential rent	0,015 – 0,060		

Therefore, the proposed formula is based on the probability approach to the assessment of potential value of social and environmental functions of forestry.

It seems reasonable to assess social and environmental functions of forest per 1 cubic meter of produced timber. As an acceptable economic criterion for justifying the economic efficiency of forestry in the market environment we can use net income generated from use of forest resources (per forest area).

Currently reproduction and growing of forests are regarded as a top priority. This is caused by peculiarities of modern forestry, as well as forestry maintenance processes: increased scale of using of forestry' resources (dynamics of forestry' areas on Earth); deficit of forestry' products (both wood and non-wood products), social and environmental functions of forestry(in certain regions); considerable increase in the multifunctional role of environmental utilities of forestry' ecosystems in resolving of environmental issues; ensuring of environmentally sustainable development of territories; environmentally based reproduction of forestry, which requires knowledge on biological peculiarities of ecosystems, their specifics in certain economic conditions, taking into account development of market based relationships; considerable impact on the forestry reproduction processes of man made factors (i.e. pollution, fires, deforestation and forest degradation, use of environmentally unfriendly machinery).

For areas, which are to be used for forestry purposes, the target function of optimization of the environmentally oriented reproduction of forestry resource, can be presented as follows:

$$\sum_{i=1}^{n} EAi \longrightarrow \max , \tag{7}$$

with the following limitations:

$$\sum_{i=1}^{n} Si \leq Sf \ , \ \sum_{i=1}^{n} SiCi \leq FR , \tag{8}$$

Where EAi – comprehensive indicator of the forestry' environmental functions in the area *i*;

S_i – area *i* of lands, which are to be used for the forestry purpose;

Sf – total area, which is to be used for forestry;

Ci – costs of planting trees in area *i* up to the age when tree crowns makes a shelter;

FR – the amount of required financial resources.

Peculiarities and advantages of this model are as follows:

1. Priority is given to environmental functions of forestry' ecosystems, while the efficiency of use of forests for raw materials is disregarded. Preference is given to those areas, which, given certain costs for forestry, will yield the largest environmental and economic effect due to the forestry environmental protection and transformation functions.
2. The economic assessment of the social and economic functions of forestry resources is determined based on average (normative) indicators, environmental impact of forestry or economic value ratios for environmental forestry relative to the value of the timber. It's also possible to use a points based assessment of the forest's environmental functions, and the comparative rating based assessment of the environmental friendliness of forestry' areas.
3. Planting costs for the unit of area are measured taking into account the probability of successful growth.

Therefore, the abovementioned theoretical and methodical approaches to the environmental and economic assessment of man caused changes in forestry reflect and develop contemporary ideas of the ecosystem based management of forestry.

22.3 Main Directions for Creation of the Environmental Management System in Forestry

Implementation of the model of the environmentally sustainable development of forestry requires creation of the environmental management system. Environmentally sustainable social and economic development of forestry is the process of harmonization and growth of their economic and environmental development regarding use, preservation and reproduction of the forestry ecosystems, ensuring satisfaction of the necessary needs for various functions and services of forestry resources of current and future generations given preservation and gradual improvement in the environmental quality and nature's capacity, based on certain structured principles (Mishenin 1998).

Ecosystem based management of forestry is intended to ensure normal functioning of all components of forestry' ecosystems and their ability to reproduction based on interconnection with environmental situation. Forestry management in terms of ecosystems is based on optimal balance of sustainability and forestry' productivity, as well as environmental quality. Time is important factor in forestry since it determines forestry reproduction and utilization system. Most of mistakes committed at the early stages of reproduction processes can not be corrected and can cause considerable environmental and economic losses in the future. Therefore, there is the violation of the sustainable development concept – current generation must ensure for the next generations a high quality of the environment and adequate natural resource capacity (Yarovaya 2008).

During cource of implementation of the environmental management system it is necessary to take into account such interconnected principles of environmental, forestry, institutional, economic and social fundamentals of sustainable forestry development:

- maximazing and prioritizing of forestry protective and transforming functions from the perspectives of national and international interests;
- optimal maintenance of homeostasis of forestry' ecosystems based on spatial and temporal balance of their components;
- preservation of the gene pool of crops as the basis for biodiversity and reproduction of forests;
- integrated use of forestry on the principles of sustainability;
- considerable decrease in the levels and scale of various man made impact on the forest ecosystems;
- consecutive and comprehensive greening of forestry based on proactive and wide use of environmentally friendly technologies;
- development of environmentally oriented economic mechanism of market based forestry, as well as the ecosystem-based management of forestry;
- environmental certification of the forests and forestry;
- development of the organizational, economic and legal mechanism of responsibility;
- development of environmental entrepreneurship;
- development of the environmental insurance system;
- stimulation of public participation in harmonization of economic and environmental goals of forestry.

There is a need for the environmentally oriented management of forestry sector employees, increase in their environmental and economic performance, improvement in relative criteria and measures of employees' work, material and moral incentives for their activities taking into account nature protecting factors. Ultimately, forestry' specialists and managers must ensure implementation of the goals and tasks of environmentally oriented economic strategies.

Efficiency of environmentally oriented forest resource uses and reproduction is determined through compliance and ensuring of certain logics, forest and environmental management: actions of managers from the perspective of greening of managerial decisions – environmentally responsible economic behavior or certain employees – environmentally oriented economic operations of a team – environmental and economic performance, production and labor efficiency.

Environmental management in forestry is a process of efficient managerial decision making for the purposes of greening of use and restoration of forest areas; it is the system of managerial levers, which provides environmental and economic effect of coordinated actions of forestry sector employees in the field of environmentally oriented forest resource use and restoration. Close interconnections of all components of forestry, as well as environmental and economic parameters explains the elements of environmental management in all forest management fields. Environmental management in forestry is based on initiatives and entrepreneurship, and also includes voluntary environmental activities. Environmental management in forestry is a set of principles, forms, methods and instruments, which determine the environmental management of forests and forestry' employees in order to increase the environmental friendliness of forestry' uses.

Implementation of environmental management for forestry includes environmental and economic assessment of forestry based on various directions of forestry' use and reproduction. Comprehensive analysis of forestry' management can be based on the use of the system of economic and environmental indicators. The fundamentals of the environmental and economic level of the forestry' management should reflect: principles and criteria; mechanisms of ecosystem based forestry' management; patterns of socially responsible forestry' use and certified forestry' management processes.

It iss worth mentioning that forest certification is limited by the lack of national certified auditing firms, which are autorised to certify forest products according to international standards, as well as regionally adapted assessment criteria. There is a need for state support in the process of certification, particularly through proactive participation of state agencies in development of regulations and preparation for a voluntary certification. Regional programs of forestry' certification should be developed and funded.

State agencies, responsible for forestry' management, should implement insurance mechanisms in forestry: insurance of forests as a property; insurance of forested areas (which are leased, for example); insurance of civil liability for the economic and environmental losses to the forests. Insured risks include: fire; pests; diseases; blowdowns; flooding; emergency pollution; unauthorized tree cutting.

Therefore, creation of the system (or elements) of environmental management regarding use and restoration of forests demonstrates the level economic relations greening in certain area. This can be interpreted as follows: forest products and services include forest's goods, which possess environmental and social value for various sectors of the economy, society and individuals.

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Еколого-економічні основи управління процесом інтеграції лісового та сільського господарств

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Розроблено та запропоновано засадничі принципи управління екологічно зорієнтованою інтеграцією лісового та сільського господарства з метою підвищення еколого-економічної ефективності виробництва, зниження екологічних витрат за основними напрямками господарювання. Наголошено, що в сучасних умовах інтеграційні процеси потребують державного регулювання. Запропоновано теоретико-методичні підходи до формування розширеної системи показників рівня інтеграційних процесів, коперування. Оцінка еколого-економічного ефекту від створення полезахисних лісових смуг у процесі їх проектування має враховувати можливості підвищення якості продукції рослинництва, зниження агрохімічного навантаження та зменшення ризику виникнення несприятливих екологічних ситуацій.

Стосовно економічної оцінки соціально-екологічних функцій лісових ресурсів виділяють метод прямого рахунку, нормативний метод, а також способи, які дають змогу враховувати середовищезахисні функції лісу стосовно вартості запасу сировини.

Запропоновано орієнтовані коефіцієнти для оцінки соціально-екологічних функцій лісу в річному вимірі стосовно вартості деревини у стиглому віці.

Схарактеризовано підходи до постановки завдання планування лісовідновлення та специфіку регіонального (територіального) відтворення лісових ресурсів. Цільову функцію оптимізації екологічно зорієнтованого лісовідновлення можна відобразити за допомогою комплексного показника виконання лісовими насадженнями соціально-екологічних функцій.

Визначено сутнісно-змістову основу системи екологічного менеджменту у лісовому господарстві з погляду екологічно сталого соціально-економічного розвитку галузі та екосистемного управління лісами.

Окреслено основні складники системи екологічного менеджменту: еколого-економічну оцінку лісогосподарської діяльності; екологізацію організації праці та її стимулювання; лісову сертифікацію; страхові механізми.

Chapter 23

Discovering Values and Stakeholders' Preferences Regarding Forest Ecosystem Services

Lyudmyla Zahvoyska and Tetyana Bas[1]

Abstract Sustainable forest management initiatives depend on societal acceptance and support. However conflicting stakeholder preferences need to be explored because they profoundly shape and drive forest management planning and decisions. In this paper we generated a forest values universe using Conceptual Content Cognitive Mapping and used non-parametric statistical methods to evaluate stakeholder preferences and perceptions regarding forest ecosystems services. Cognitive maps of individual and group preferences are presented, providing comprehensive information for comparison of value systems identified by respondents. The paper represents maps illustrating statistically significant behavioral and value-based reasons for particular forest management decisions.

Keywords: forest ecosystem services, stakeholders, Conceptual Content Cognitive Mapping, non-parametric statistical analysis, cognitive map, co-management.

23.1 Introduction

The origin of the post-normal scientific paradigm strongly highlighted the synergetic nature of ecological-economic systems. Non-linearity, self-organization, complexity, and co-evolutionarity are the main features of synergetic systems (Haken 1983, Daly and Farley 2004, Prigogyne 2003). Conventional 'objective' science becomes inappropriate in these circumstances, where stakes are high and facts are uncertain, but decisions are vital and urgent. To tackle epistemological tensions in post- normal science it was necessary to recognize such alternative premises as an evolutional nature of systems in question, the value dependency of decision-making, subjectivity, uniqueness, contextualism, and multi-directional

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causation (Söderbaum 2001). Therefore, post-normal science moves away from searching for optimal solutions and disseminating relevant knowledge to illumination of complexity and possible consequences of different scenarios of development. It seeks consensus and conflict resolution through dialog, co-operative learning, and co-management.

Sustainable forest management (SFM) is focused on providing an array of ecosystem services, rather than just industrial forest products, in a way and at a rate that maintains relevant environmental, economic and social functions both at local and global scales. There are two main requirements of the economics of SFM: 1) the economics of multiple equilibriums and 2) a consumer choice theory that incorporates context specific and dynamic preferences, heterogeneous agents, distinction between needs and wants, and subordinations of needs (Kant 2003). They provide a theoretical background for extending boundaries of forest economics to economics of SFM and challenge investigations of multifunctional forest and land use for the purpose of effective collaborative decision-making (Nijnik *et al.* 2009).

Thus stakeholder values do matter. Different stakeholders have their own systems of values that create a values universe. To ensure sustainable forest resources use for the common benefits it is important to identify these sets of values. A number of questions should be raised, including what are the most important forest ecosystem services for stakeholders; do stakeholders have any kind of preferences regarding these services, and are these differences statistically significant?

Our goals here are: (1) to assist Ukrainian decision-makers in understanding relevant stakeholders' perceptions in a transitional economy and (2) to provide decision-makers with relevant statistically significant cognitive maps to support SFM in Ukraine.

Investigations of stakeholders' perspectives on SFM in the U.S. Pacific Northwest (Kearney et al. 1999) and northwestern Ontario in Canada (Kant and Lee 2004) provide insight into North American stakeholder perceptions concerning forest ecosystem values, which they term "a forest values universe". A forest values universe consists of ten dominant value themes and was developed applying hierarchical clustering (Kant and Lee 2004). In this paper we test the assumption that this concept can be applied with only minor modifications reflecting the lesser role of forest industry in the Ukrainian economy.

The paper is divided into four sections. An overview of methodology is provided in Section 2. The study area, subject of study, and methods used for data collection and analysis are examined there as well. The forest values universe and its dominant themes and sub-themes are presented in Section 3. Section 4 provides a comparison of the forest values universes as well as final conclusions.

23.2 Methodology

Ecosystems as natural systems that include all variety of interactions between living organisms and the components of non-living environment within which the organisms are found, are highly complex and dynamic entities. They sustain economic systems, providing them with renewable resources, the elements of ecosystem structure, ecosystem services, which can be defined as 'the ecosystem functions of value to humans and generated as emergent phenomena by the interacting elements of ecosystem structure' as well as waste absorption capacity (Daly and Farley 2004). Quoting Costanza *et al.* (1997) we can say that ecosystem services are 'conditions and processes through which natural ecosystems and the species that make them up, sustain and fulfill human life'. Exhaustive list of seventeen different goods and services generated by ecosystems are described in the mentioned paper (Table 23.2).

Forest ecosystems play the crucial role in functioning of the global ecosystem. They provide almost all of these goods and services. H. Daly and J. Farley give a comprehensive list of relevant examples of services provided by forest ecosystems (Daly and Farley 2004, Table 6.1). Wide range of the services – from environmental quality to human safety and cultural needs –covers this list: gas, climate, water and disturbance regulation, water supply, waste absorption, erosion control, soil formation, nutrient cycling, pollination, biological control, refugia, genetic resources, recreation and cultural values.

Rational *homo economicus* tries to measure all elements of natural capital, to attach them monetary equivalent and, at the end, to deal with them in decision-making like with ordinary elements of man-made capital. In our opinion the root of such intention to measure all environmental benefits in monetary equivalent lies in an inappropriate interpretation of a role individual plays in an aggregate man-nature system. In dominate economic theory we consider a *homo economicus* as an individual who is integrated into the man-nature system in a fragmentary way. Perhaps, it is vital to develop new knowledge about complex real-world human-measured systems (Tarasevych 2004) in which both human and nature are self-valuable and equal-valuable principles, where a man is integrated in an aggregated in this system in a quite and continuously-infinite way. Realizing it, we shall rethink both evaluation methodology and obtained results.

To achieve an efficient allocation economists have suggested two approaches which now became large sets of techniques: (1) extending market to catch non-market goods and services through valuation and (2) position analysis through numerous methods of elicitation and prioritization preferences regarding assets in question.

Both revealed and stated preference valuation techniques are in a sense an extension of a market valuation aimed to assign a monetary measure to all components of total economic value – use and existence values. A variety of valuation techniques, which have been proposed for today, and measurement studies (Arrow *et al.* 1993, Bateman *et al.* 2002, Bishop and Romano 1998, Dixon *et al.* 1994, Hanley and Spash, 1998, Jacobsson and Dragun 1996) and a huge amount of sober reflections on them (Arrow *et al.* 1993, Carson *et al.* 2002, Freeman 2003, Hausman, 1993, Kriström 1990, Portney 1994) signify that valuing nature is very important and complicated task at the same time. These studies give us numerous examples of careful investigation of willingness to pay for the environmental goods and services. However it is hard to ever develop a holistic perspective from this picturesque mosaic of relevant studies. Obtained results are sensitive to developed questionnaires (Callan and Thomas 1996), to techniques applied for gathering data and collected data analysis, and to general socio-economic environment (Sisak 1999, Kriström 1990). Although they provide useful information for environmentalists and decision-makers particularly in a case of absence of market for some private and public goods (Bishop and Romano 1998, Jacobsson and Dragun 1996), questions of their methodological validity and interpretation are strongly discussed in modern economic and philosophical literature (Kant 2003, Daly and Farley 2004, Etzioni 1988).

Another way to get a strong insight of value universe to conduct a position analysis is an application of social choice approach which involves both quantitative and qualitative techniques of public attitude examination. Multi-attribute utility analysis, Q-method, focus group, non-parametric statistical methods help to avoid market analogies and integration of non-meaningful monetary estimations into decision-making, which could lead us to wrong decisions from inter- and intra-generation perspectives. Kant and Lee (2004) ground the use of multi-group social choice method in order to determine stakeholders' preferences. This method features such peculiarities of multifunctional forest management as joint production of goods and environmental services, inter- and intra-generational distributional issues. Moreover, this approach deals much better with a continuum of use and non-use values because it considers an individual as a rational and responsible citizen that does not follow only their own profit and pleasure (Etzioni 1988). Such position in post-Brundtland society is more realistic and acceptable than a position of an aloof and indifferent observer.

To identify values which stakeholders associate with forest ecosystem services under social choice approach we use the technique known as a Conceptual Content Cognitive Mapping (3CM) (Kearney and Kaplan 1997, Kant and Lee 2004, Zahvoyska 2008). This method does not bring respondents and scientists to a dead end corner of a monetary valuation of non-market goods and services. On the contrary it provides a respondent with a space to verbalize his own preferences and considerations concerning his own and other stakeholders' interests related to multifunctional role of forest ecosystems services. Thus a researcher can capture the breath of preferences and perceptions concerning an object or a process in question.

In terms of 3CM respondents are supposed to identify all relevant aspects (values associated with forest ecosystems services), to group (organize) them, to name and to range them according to their own views and feelings. As an open-ended card sorting technique 3CM enables a researcher to make an assessment of somebody's/group's knowledge structure or attitudes related to a particular object or process. Cognitive maps of preferences as 3CM findings offer a values universe and individual or group priorities towards the values identified by respondents.

Eight steps for the 3CM exercise are well described by Kant and Lee (2004). They are: 1) introduction to the 3CM task, 2) visualization exercise, 3) identification of own preferences (values) regarding topic in question, 4) grouping (organization) of verbalized preferences, 5) labeling organized groups, 6) ranking the groups, 7) identification of own perceptions regarding own group and other stakeholders' values and finally 8) completing the task.

The 3CM task was performed for such stakeholders – local population, forest industry, environmental non-governmental organizations (ENGOs), and city population. These stakeholders were identified using such criteria as responsibility, impact, relationship, dependence, representation, and relevance (Hotulyeva *et al.* 2006).

Carrying out 3CM task respondents assigned values like '1' – 'the first' (the most important forest value), '2' – the second (less important then the first one but more important then rest and so on). Therefore data, collected and organized using 3CM, were considered as ordinal data and were examined by non-parametric statistical methods. To test the statistical significance of similarities and differences in the generated cognitive maps we used the Friedman and the sign tests (Newbold 2003).

The Friedman test was used to check at a 5 % significance level a presence of significant differences in preferences regarding forests for each stakeholder. In other words can we state with 95 % probability that each stakeholders group has own set of preferences, i.e., some values are more important then others? For instance, does ranking of environmental values statistically differ from ranking local ones?

The real order of preferences was checked using the sign test. This test let us elicit (at 5 % significance level) a relevant ranking of forest values, their related importance for each stakeholder group. Results of this test enable us to identify stakeholders' cognitive maps of preferences which reflect individuals' or groups' attitudes.

The study area for this research is the city of Lviv and Zhovkva, Mykolaiv and Yavoriv administrative districts (Western Ukraine).

23.3 Discovering Stakeholders' Preferences Regarding Forest Ecosystem Services

This study was aimed to deepen insight of attitudes regarding regular forest ecosystem services. Four groups of stakeholders were identified in the study: Local population, Forest industry, Environmental NGOs and City inhabitants. 25 individuals from each of these groups were interviewed. The forest values universe, designed by respondents' answers is presented in the Table 23.1. Respondents identified nine themes and 37 sub-themes. All these sub-themes where identified, grouped and ranked by stakeholders according to their opinion.

Results of the Friedman test for checking statistical confidence of forest values differentiation are indicated in the Table 23.2. They prove the fact of existing priorities regarding forest ecosystem services for each group of stakeholders.

Table 23.1 Forest Values Universe

Dominant Themes	*Sub-themes*
1. Environmental	• Air purification, Oxygen supply • Climate regulation • Biodiversity • Water regulation • Nutrient cycling
2. Recreational	• Rest • Hiking • Picnics • Pastime with friends
3. Economic	• Income and benefits from forest industry spin off • Timber and other marketed products • Employment and relevant satisfaction • Options for tourist and recreational business development
4. Local values	• Non-wood forest products • Wild animals meat and furs • Firewood • Fodder
5. Educational	• Education and training • Science and research • Observations and monitoring • Educational activities
6. Health care and recovery	• Health improving • Medical herbs • Vitamins • Relaxation
6. Tourist	• Hunting • Rock-climbing • Tourism • Sports competitions
7. Aesthetic	• Picturesque landscapes • Wildlife observation • Decorative items • Scents and sounds
8. Cultural and Emotional	• Spiritual, cultural and historical values • Quietness, solitude, solitariness • Inspiring, stimulation creative ability • Attitude towards wildlife

The cognitive map of individual preferences regarding forest ecosystem services is presented in the Table 23.3. As we can see, the cognitive map of individuals' preferences is almost homogeneous. Most of the respondents appreciate *Environmental and Recreational* values; *Cultural and emotional* values take the third position; indeed, city inhabitants and environmental NGO are more sensitive to them. *Economic services* follow previous item and hold places from the second (for local population and ENGO) to the forth position (city inhabitants), *Health care, Educational and Aesthetic* values follow them. The last place belongs to *Tourist values.* The interesting fact of the survey is that all stakeholders were unanimous in such ranking.

Table 23.2 Testing statistical differences in preferences regarding forest values *using the Friedman test**

Stakeholders	***Local population***	***Forest industry***	***City inhabitants***	***Environmental NGO***
Calculated Friedman statistics value, *Fr*	468.00	593.57	477.20	445.00

* The critical value χ^2 for a 5 % significance level in case of nine themes equals $\chi^2_{k=9-1;\,p=0.95} = 15.51$

Table 23.3 Cognitive map of individuals' preferences regarding forest ecosystem services

Groups of stakeholders \ Themes	Environmental	Recreational	Economic	Local values	Educational	Health care	Tourist	Aesthetic	Cultural and Emotional
Local population	1	2	2	1	5	4	5	4	3
Forest industry	1	2	3	5	5	3	5	5	4
City inhabitants	1	1	4	6	4	2	5	3	1
Environmental NGO	1	1	2	5	3	4	6	4	2

Explanation to the lines in the Table 23.3:
- - - - Preferences with the highest homogeneity
········· Preferences with the highest differences in preferences

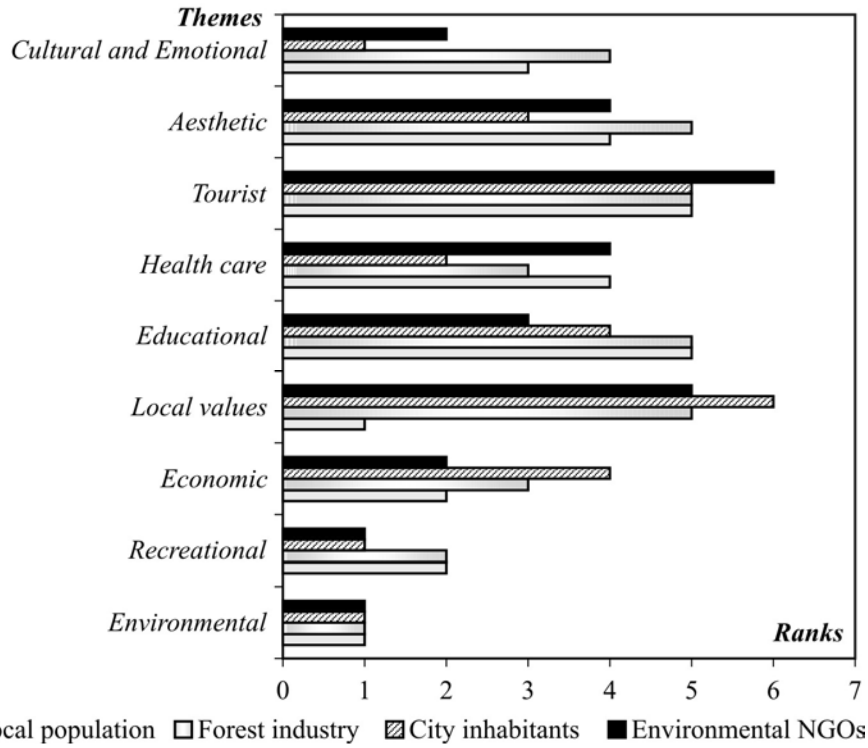

Fig. 23.1 Cognitive map of individuals' preferences regarding forest ecosystem values

One can easily note in terms of *Local values* the maximal divergence in individual preferences regarding forest ecosystem services. For local population *Local values* are of a primary interest and compete only with *Environmental* ones whereas other stakeholders do not pay any attention to it (last and next to last positions). For almost all other values difference in ranking varies from 0 (*Environmental values*) to 2 points (*Economic, Educational, Health care* and *Aesthetic values*) (Fig. 23.1).

Additional information gave the groups' preferences regarding services in question. The same respondents were asked to identify their own group point of view rather than their personal opinion that it was in a previous step.

As it comes from the cognitive map of groups' preferences (Table 23.4) differences in the favors among different stakeholders become more significant. There is not any theme with the same rank among all stakeholders, as we can see for *Environmental values* in individuals' cognitive map. Almost for all themes divergences in ranks make up at least two points. The only exclusion is *Cultural and Emotional* values, which gain the second rank among all stakeholders except *Local population* that considers this value to be the third. As it is seen from Fig. 23.2, ranks for this item are the most homogeneous in this map.

Table 23.4 Cognitive map of groups' preferences regarding forest ecosystem services

Themes (values) / Groups of stakeholders	Environmental	Recreational	Economic	Local	Educational	Health care	Tourist	Aesthetic	Cultural and Emotional
Local population	4	4	2	1	6	4	5	3	3
Forest industry	3	1	1	6	5	3	4	6	2
City inhabitants	1	2	4	6	5	1	3	3	2
Environmental NGOs	1	2	4	6	4	3	5	1	2

Explanation to the lines in the Table 4:

- - - - Preferences with the highest homogeneity

········· Preferences with the highest differentiation in preferences

The first positions belong to *Environmental* and *Recreational* values, but *Local population* considers them as the fourth item. All stakeholders rank *Cultural and emotional values* as a second item except *Local population. Economic values* are a little bit behind them: *Forest industry* and *Local population* treat them as the most important, but two other stakeholders set them as the fourth ones. *Health care* and *Aesthetic values* follow them. *Tourist values* seem to be of less importance, *Local* and *Educational* values are the last in this line.

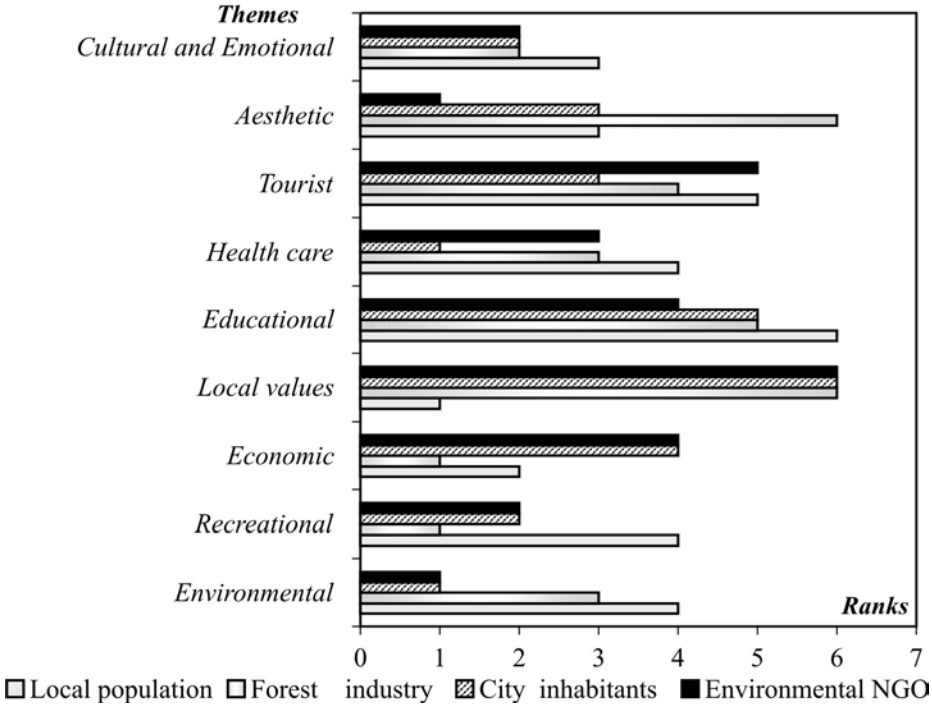

Fig. 23.2 Cognitive map of groups' preferences regarding forest ecosystem services

The highest misunderstanding among stakeholders can be easily predicted for *Local values*. As in individuals' cognitive map a *Local population* disagrees with other stakeholders' appraisal and for this item a conflict of opinions becomes more obvious: *Local population* sets only these values on the first position whereas all other stakeholders are unanimous in their decision: the last position, the least interest.

All six items except *Educational, Tourist* and *Cultural and Emotional values* have the highest rank at least per one stakeholder and at the same time their typical scattering is four points (from the first to the fourth rank). And only *Local* and *Aesthetic values* have the highest and the lowest ranks simultaneously.

23.4 Conclusions

Sustainable forest management incorporates a wide breadth of forest values and stakeholder preferences. Forest ecosystems are highly complex and sensitive yet resilient systems. However the consequences of unreasonable decisions are felt for a long time. There are many forest resource users, and their preferences often conflict (FAO 1992). To ensure cooperation and dialog among those benefiting from forest ecosystem goods and services it is necessary to identify the full set of resource demands and understand the priorities of all interested groups.

According to the tasks of post-normal science to search consensus and facilitate dialog and co-operative learning we dedicated this study to creating new knowledge about human attitudes concerning forest ecosystem services. We examined multifaceted issues of stakeholder preferences toward forest ecosystem services, revealing an elusive world of implicit, complicated, and subliminal preferences, which are transformed into explicit decisions with long-term consequences.

To capture a variety of forest ecosystem values we applied the Conceptual Content Cognitive Mapping technique and non-parametric statistical methods. These allowed us to obtain comprehensive and well-structured cognitive maps of preferences at a 95 % probability level. In this way we avoided market-oriented approaches and developed a representative universe of values and stakeholder priority sets which would have been impossible to synthesize using monetary measurements.

Table 23.5 Comparative cognitive map: individuals vs. groups preferences ecosystem services

Themes (values) / Groups of stakeholders	Environmental	Recreational	Economic	Local	Educational	Health care	Tourist	Aesthetic	Cultural and Emotional
Local population	1 / 4	2 / 4	2 / 2	1 / 1	5 / 6	4 / 4	5 / 5	4 / 3	3 / 3
Forest industry	1 / 3	2 / 1	3 / 1	5 / 6	5 / 5	3 / 3	5 / 4	5 / 6	4 / 2
City inhabitants	1 / 1	1 / 2	4 / 4	6 / 6	4 / 5	2 / 1	5 / 3	3 / 3	1 / 2
Environmental NGO	1 / 1	1 / 2	2 / 4	5 / 6	3 / 4	4 / 3	6 / 5	4 / 1	2 / 2

Explanation to the lines in the Table 23.5:
-------- Preferences with the highest differences between individuals' and groups' preferences

The forest values universe consists of nine themes and 37 sub-themes. The dominant themes are: *Environmental* and *Recreational* values, which are followed by *Cultural and emotional* and *Economic* values. *Aesthetical, Health care,* and *Tourist values* are more important in the group map. *Local and Educational values* conclude the line.

As it can be seen from the comparative cognitive map (Table 23.5), individual and group preferences are a bit divergent. In the group map, *Environmental* and *Recreational* values are not favored by stakeholders, they incline from *Cultural and Emotional* values. The *Economic* theme is more important for the forest industry and at the same time is less important to environmental NGOs. The most contradictory item is *Local values*: it is vital for *Local population* and it is completely and unanimously ignored by other stakeholders (Fig. 23.3). In our opinion a cause of this misunderstanding lies in asymmetric information and ignorance, and it could be easily overcome by case studies like this one.

As it follows from the group preferences map, preferences of local populations and participants from industry group are similar. Direct use values are more important for them. City inhabitants and environmental NGOs have different preferences and they create another cluster, most preferring indirect use values.

As we assumed in our hypothesis there is no strong differentiation between forest values universe and stakeholder preferences concerning forest ecosystem services identified by Kant and Lee (2004). The forest values universes are organized in somewhat different ways probably due to different data structuring methods, but all of them reflect the breadth of values – environmental and socio-economic ones regarding forest ecosystems goods and services. In the maps of Canadian stakeholders, the economic theme is more important. This difference can be explained by the fact that our investigations were conducted in a fragile mountainous region where timber harvesting is not an important sector of the regional economy.

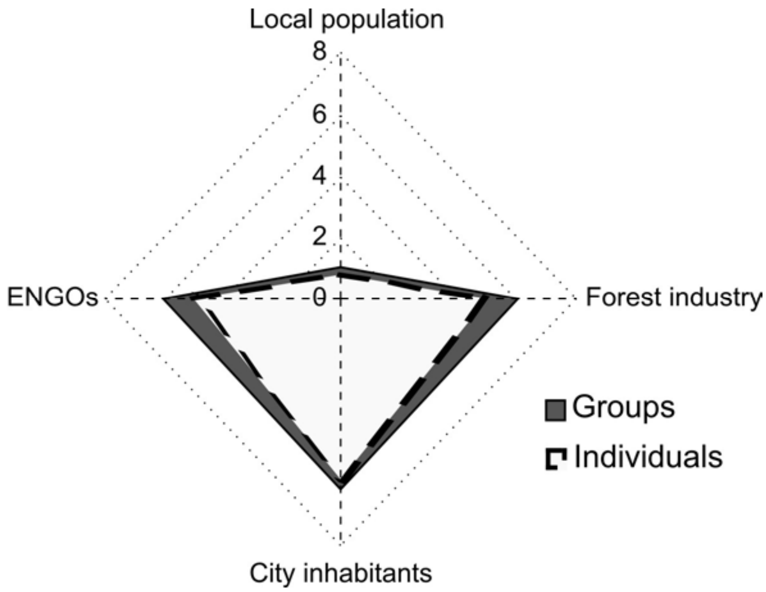

Fig. 23.3 Position of *Local values* across stakeholders

In conditions of transition to a market economy, where there is no land market and where property rights are not well defined, conflicts among stakeholder interests are more common, and a so called "political rent" and illegal agreements become a powerful instrument of their arrangement. Indeed, in this case short-term individual or group financial interests do not drive society towards sustainable resource use. Therefore, exploration of society's attitude concerning vital ecosystem resources and services provides an important message, helping to avoid nontransparent decision-making and strong conflicts among stakeholders in conditions of weak markets and ill-defined property rights.

Cognitive maps provide a comprehensive background for developing frameworks of natural recourse co-management and decision-making based on common understanding and responsibility (Bengston 1994). Approaching the full world, in which opportunity cost of growth is significant and welfare from economic services increases while benefits from ecological ones diminish (Daly and Farley 2004, Lawn 2006), we should avoid tremendous use of natural resources. Research revealing social preferences and perceptions regarding forest ecosystem services helps identify areas of commonality among stakeholders. Furthermore, it helps mitigate conflicts among forest user groups, thereby promoting sustainable forest management as an integrated ecosystem management paradigm.

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Виявлення цінностей та уподобань стейкхолдерів стосовно послуг лісових екосистем

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Успіх імплементування вимог ведення сталого лісового господарства, як комплексного менеджменту лісових екосистем, великою мірою залежить від розуміння і сприйняття цих вимог усіма учасниками (стейкхолдерами) процесу використання, охорони та відтворення лісових ресурсів. Адже розуміння ролі цих ресурсів визначає спосіб їх використання і відповідальність за їхній стан перед сучасними і майбутніми поколіннями. Належне розуміння ролі цього винятково важливого середовищетвірного ресурсу у функціонуванні глобальної екосистеми Землі слугуватиме рушійною силою переходу до збалансованого багатофункціонального використання лісових ресурсів для задоволення довкільних, економічних, соціальних і культурних потреб суспільства на довготермінову перспективу. Фрагментарне та утилітарне трактування слугуватиме обґрунтуванням деструктивних рішень і дій щодо цього умовно і повільно відновного ресурсу. Ось чому екологічно виважений менеджмент лісових ресурсів, який відповідає вимогам сталого розвитку, потребує широкого залучення громадськості до прийняття рішень, що своєю чергою вимагає виявлення та врахування уподобань усіх соціальних груп, їхніх пріоритетів і цінностей.

Дослідження цих уподобань є альтернативою софістичним і жваво дискутованим підходам до визначення вартості природного капіталу та його послуг (*Daly and Farley 2004, Kant 2003,* Загвойська та ін 2007) і є неодмінним для прийняття рішень з урахуванням екологічного імперативу. Ми здійснили дослідження уподобань населення Львівщини стосовно послуг лісових екосистем, використовуючи метод концептуально-змістовного когнітивного картування *(Conceptual Content Cognitive Mapping, 3CM)*. Цей метод дає змогу досліднику оминути труднощі і "підводні камені" методів оцінки повної економічної вартості, а також з'ясувати цінності та вподобання різних суспільних груп щодо досліджуваних ресурсів (*Kearney and Kaplan 1997, Kearney et al 1999, Kant and Lee 2004*, Загвойська, Зубач 2005). Його суть зводиться до ідентифікації, групування та ранжування уподобань зацікавлених сторін щодо досліджуваного об'єкта з подальшим опрацюванням виявлених преференцій методами непараметричної статистики. Він не пропонує респондентам дати грошову оцінку неринкових товарів і послуг, а навпаки, дає змогу описати свої погляди вербально, тобто у звичний і зрозумілий спосіб. Респондентам пропонують описати особисті уподобання, уподобання соціальної групи, яку вони репрезентують, а також свої міркування про уподобання інших груп щодо цього ресурсу.

Керуючись критеріями щодо визначення стейкхолдерів (Хотулева та ін. 2006), ми виділили чотири зацікавлені соціальні групи: місцеве населення, підприємці, які репрезентують лісову промисловість, неурядові організації та міське населення та опитали по 25 представників кожної групи. Дослідження було здійснено на території Львівської області у Жовківському, Миколаївському, Яворівському районах і в місті Львові.

Ідентифікований респондентами універсум вартостей і цінностей охоплює всі ресурси та послуги, котрі вони отримують від лісових екосистем. Ідентифіковані вартості і цінності було згруповано у 9 тем і 37 підтем, кожну з яких висловили та назвали самі респонденти (Загвойська, Бас 2007):

1) довкільні: очищення повітря і продукування кисню; регулювання клімату; біорізноманіття; водорегулювання; природний кругообіг;
2) економічні: вигоди від розгортання бізнесу; лісоматеріали та інші ринково оцінені товари, місце праці, туристичний бізнес;
3) рекреаційні: відпочинок; прогулянки; пікніки; проведення часу з друзями;
4) місцеві вартості: недеревні ресурси лісу; м'ясо та хутра тварин; дрова; корм для тварин; бджільництво;
5) пізнавальні, наукові: освіта; навчальні заходи і наукові дослідження; спостереження;
6) оздоровчі: покращення здоров'я; відновлення сил; лікарські рослини, фітонциди і збагачені вітамінами продукти харчування;
7) туристичні: полювання; альпінізм; туристичні екскурсії; спортивні змагання;
8) естетичні: мальовничі краєвиди; спів птахів і спостереження за тваринним і рослинним світом; предмети декору, аромати і запахи;
9) культурні та емоційні: культурні та історичні цінності; тиша, спокій, втеча від цивілізації; спілкування з природою; піднесеність настрою; світлість думок і натхнення.

Для кількісного аналізу уподобань ми використали методи непараметричної статистики (Newbold 2003), завдяки чому дослідили статистично значущі подібності та відмінності в уподобаннях кожної зацікавленої групи щодо послуг лісових екосистем.

Отримана когнітивна карта індивідуальних уподобань дає інформацію про те, що кожна людина, незалежно від соціального статусу, насамперед цінує послуги, які надають лісові екосистеми для забезпечення якості довкілля. Це доволі важливий висновок для суспільства, яке має спонукати менеджерів усіх рівнів дбати, насамперед, про примноження і збагачення лісових ресурсів. До того ж він дає підстави вважати, що різноманітні конфлікти інтересів суспільних груп, які виникають у лісокористуванні, можна вирішувати на користь інтересів довкілля, адже для цього є відповідне підґрунтя! На другому місці в когнітивній карті індивідуальних уподобань стоять рекреаційні функції. Культурні та емоційні цінності посідають третю позицію, хоча для представників неурядових організацій і міських жителів вони є важливішими, ніж для місцевого населення і лісової промисловості. За ними йде економічна тема, від другого (для місцевого населення і неурядових організацій) до четвертого місця (жителі міст). Наступні цінності – оздоровчі, освітні та естетичні. Як найменш важливу всі респонденти одностайно зазначили тему туристичних послуг. Карта індивідуальних уподобань респондентів доволі одноманітна, в ранжуванні тем представники різних груп відрізнялися щонайбільше на дві позиції. Винятком із цього узагальнення є тема культурних цінностей – її респонденти позиціонували і як одну з найважливіших (міське населення), і як найнезначнішу (підприємці), а також тема місцевих вартостей. Власне для цієї теми склалася унікальна ситуація: для місцевого населення – це тема найвищого пріоритету, поруч із темою послуг довкілля, а решта респондентів відвели їй останнє і передостаннє місця в рейтингу тем універсуму.

Уподобання **груп** цих стейкхолдерів дещо відрізняються від індивідуальних. Насамперед вони не є такими гомогенними, як індивідуальні уподобання. Немає жодної теми, яка мала б однаковий пріоритет для всіх стейкхолдерів. Майже всі теми мають розмах рейтингів щонайменше у три бали. Найближчими є оцінки стейкхолдерів щодо теми культурних та емоційних цінностей – друге місце в рейтингу і лише місцеве населення відводить їм третю позицію після місцевих та економічних вартостей. Найістотнішими є відмінності в пріоритетах найвищого рівня для представників місцевого населення і лісової та деревообробної промисловості. Для обох груп домінувальними є вартості прямого використання: для місцевого населення це теми насамперед місцевих вартостей, а відтак економічних, а для підприємців – економічних та рекреаційних. Для жителів міст і представників неурядових організацій – навпаки, важливішими є теми, пов'язані з вартостями непрямого використання, а саме – теми послуг довкілля, відпочинку і культурних та емоційних цінностей. Ще більше поглибився конфлікт для місцевих вартостей: усі розуміють, що для місцевого населення ця тема найважливіша, однак у картах уподобань решти груп її згадують останньою.

Не менш інформативними та важливими у процесі прийняття управлінських рішень є уявлення стейкхолдерів про уподобання інших груп – **міжгрупові** оцінки. Вони дають підґрунтя для порівняння самооцінки з оцінками зі сторони. Скажімо, місцеве населення в індивідуальних уподобаннях відводить найвище місце темі послуг довкілля, тоді, як коли в групових уподобаннях представників цієї ж групи вони займають аж четверте місце, що добре узгоджується з думкою решти стейкхолдерів про пріоритети згаданої групи. Аналогічно певні розбіжності можна побачити і в оцінці теми економічних послуг: в індивідуальній карті за оцінками самих підприємців вона посідає лише третю сходинку, а, на думку всіх інших стейкхолдерів, ця тема має найвищий пріоритет для підприємців, що теж цілком відповідає рейтингу теми в когнітивній карті групових уподобань.

Звичайно, визначення цілей, позицій і пріоритетів кожної зацікавленої групи не усуває всіх проблем і конфліктів, проте отримана інформація дає змогу передбачити дії різних груп населення у процесі використання, охорони і відтворення лісових ресурсів, а також зрозуміти ставлення різних груп населення до лісів і пов'язаних із ними послуг, що сприяє знаходженню компромісів на шляху успішної реалізації завдань менеджменту лісового господарства на засадах сталого розвитку.

Chapter 24

Analysis of Forestry Professionals' Attitudes Towards SFM Paradigm Implementation

Ihor Soloviy and Mariana Dushna[1]

Abstract The motivation context of a decision making process in a forest sector is important and at the same time not sufficiently developed research field. Especially consideration of attitudes is important in the context of transition of forest sector to market economy and democracy. The authors suggests that there is a lack of understanding of the forest mangers' attitudes towards new paradigms of forestry transformation according the societal needs, such as SFM paradigm. Only a few studies have focused directly on the forest sector stakeholdrs' attitudes, perceptions and values. Most of these studies have been carried out in the United States, Canada, Sweden, Finland, Germany, Great Britain, and Austria. These studies were focusing mainly on forest landowners'(especially nonindustrial private forest owners) motivations, and less on forestry professionals' values, attitudes and perceptions which regulates their professional behavior. The especial attention was given to economic aspects, especially to sociological researches of motivations which define the economic efficiency of state financed programs (forest management assistance, subsidy and other programs). Based on a survey among forestry professionals and other stakeholders of forest sector in the rural areas of Lviv region of Ukraine we can sketch a generalized picture of attitudes towards SFM paradigm. 735 respondents were involved in the survey, including 74 % of respondents that works for the public sector, 10 % – for the private sector, 8 %- the private entrepreneurs which are specialized in harvesting, wood processing or non-wood forest products processing, 4 % – temporary unemployed; 1 % – students. The results of study identify the low level of awareness with the sustainable forest management ideas among the respondents. Only 12.7 % gave an answer that they are know precisely what the term *sustainable forest management* means. The main

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share of respondents (63.5 %) are being in the know in the general terms concerning this term, and 23.8 % of respondents never heard about that. The lack of knowledge is a serious obstacle for SFM paradigm implementation. More than half of respondents recognized an economic (57.3 %) and an ecological role (60.7 %) of forests as the very important factors of regional development. Considerable part of respondents recognized the economic and ecological role of forests as important – 33.2 % and 38.1 % correspondingly, and the rest of respondents doesn't consider the forests as important ecological or economic factor. The 81 % of respondents stressed the need for further reforms in the Ukrainian forest sector, the rest of respondents are satisfied with the present state of this sector and current model of its development. The high percent of respondents which has positive attitudes towards the process of reforming of the sector confirms the favorable preconditions for further reforms and its potential support. First of all, those of respondents who are stressing the need to reform forest sector of economy they would like to reform the system of financing first of all (334 mentions, 45 % of respondents that answered), the system of governance (239 mentions, correspondingly 33 % of respondents), economic relations (149 mentions, 20 % of respondents). 13 % of respondents emphasize that at the moment it is a need to reform human resource policy (96 mentions). 18 % of respondents (132 mentions) denote on expediency of regulatory and legal framework reforming. Nearly half of forestry professionals participated in survey (48 %) are well-informed with the content of a Forest Act which is in force, including 45 % of respondents who think that Forest Act fully corresponds to the principles of forest restoration, resource use, and protection in the conditions of market economy. The respondents stressed the attention on the importance of the following activities adaptation in course of reforms: improvement of felling system (38 %,173 mentions), improvement of tree-planting system (38 %, 281 mentions), improvement of decision making in forest management (24 %, mentions), improvement of harvesting technique (26 %,191 mentions), development of forest roads network (23 %, 167 mentions), and improvement of nature protected areas management was mentioned as well (65 mentions, 8.8 %). For an opinion of 29 % of respondents an improvement of economic situation in Ukraine is a precondition for successful development of forestry. The only small part (5 %) of respondents believe that privatization of forests is a determinant factor for such development. Forest certification is one of the most successful instruments of forest policy, but only 48.4 % of respondents have positive attitude towards forest certification, 45.9 % – have a neutral attitude, and 5.7 % – are rather afraid of negative consequences of certification. The results showed that positive attitudes towards developments of reforms in a forest sector determined by cumulative influence (totally by 48.7 %) of such factors as level of knowledge about SFM paradigm, level of knowledge about Forest Act and educational level. Increase of knowledge about SFM on one level (diapason is framed from statement "first time I hear about it" to statement "I know very well what it is SFM") leads up to the respondents' positive attitude towards reforms in a sector on 53.4 %. The increase of knowledge about content of the Forest Act leads up to the respondents' positive attitude towards reforms on 7.3 %, and correspondingly increase of educational level will increase it on 7.0 %. This call for the need for enrichment and diversification of the national forest policy instruments set, first of all for diversification of the informational instruments for efficient communication, learning and trust building among the forestry professionals and society, and the same processes inside professional forest community as well as precondition of SFM paradigm initiatives implementation.

Аналіз ставлення фахівців лісового господарства до запровадження парадигми його сталого розвитку

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24.1 Вступ

Прибічники ідеї сталого розвитку здебільшого визнають потребу зміни багатьох вартостей, пріоритетів та поведінки людей. Особливо важливе формування екологічного світогляду у фахівців, задіяних у експлуатації та відтворенні природних ресурсів.

За усередненими даними наукових досліджень, 52 % респондентів схвалюють пріоритетність охорони довкілля над економічним зростанням та створенням робочих місць, а 74 % респондентів у Великобританії, Канаді, Італії, Німеччині, США, Франції та Японії надали перевагу охороні довкілля навіть, якщо це призведе до втрати робочих місць (Inglehart et al. 2004, Pew Res. Cent. People 2002). Екологічна зорієнтованість поведінки також має підтримку, але не таку високу, як схвальне ставлення до нагальності вирішення цих проблем. Дослідження, виконані у двадцятьох різних країнах, виявили, що в середньому 36 % респондентів відмовляються від продукції певних виробників, якщо ті мають негативну екологічну репутацію, 27 % відкидають продукцію, якщо вважають антиекологічним її пакування, а 25 % беруть до уваги екологічну інформацію (Environics Int. 2002).

Схвальне ставлення до охорони довкілля та екологічно зорієнтована поведінка не обов'язково втілюються у реальну політичну діяльність. Так, лише 10 % опитаних громадян упродовж останніх років написали листа чи зателефонували, щоб виявити свою стурбованість певною екологічною проблемою, 18 % взяли до уваги екологічний аспект під час голосування на виборах, а 11 % належать до громадських екологічних організацій чи підтримують їх конкретними справами (Environics Int. 2000).

Прогрес у досягнені сталості лісового господарювання полягає, зокрема, і у всебічному її дослідженні. У деяких публікаціях про соціальні аспекти сталого лісового господарства наголошено, що значення, яких набуває поняття сталості, невіддільні від людських інтересів (Fairweather et al. 2003). Адекватне розуміння вартостей, пов'язаних із лісами, та їхнє трактування різними групами лісокористувачів, є підставою для залучення громад у процеси прийняття рішень щодо планування та ведення лісового господарства й формування режимів узгодженого менеджменту (***co-management regime*** *– англ.*), які базуються на консенсусі інтересів різних лісокористувачів, про що засвідчили дослідження, виконані в канадській провінції Онтаріо (Lee S., Kant S. 2003).

Успіх політичних ініціатив, спрямованих на сприяння веденню сталого лісового господарства, ґрунтується на поглибленні розуміння мотивацій, ставлення та вчинків лісовласників та фахівців лісового господарства (Bliss & Martin 1990, Egan & Jones 1993). На сьогодні лише поодинокі дослідження стосувалися вартостей та ставлення до актуальних проблем фахівців лісового господарства. Ці дослідження впереваж виконано в Канаді, США та скандинавських країнах, однак вони охоплювали здебільшого лісовласників а не фахівців лісового господарства. За результатами досліджень, виконаних в Австрії (Pregernig 2001), не лише оцінено вартістні орієнтири фахівців лісового господарства, а й запропоновано їхнє застосування як джерела іінформації для вибору інструментів лісової політики.

24.2 Методика дослідження

Досліджуючи схильність респондентів до запровадження парадигми сталого розвитку та до реформування лісового сектора економіки тих, хто матиме безпосередній вплив на його перебіг, у 2008 р. ми здійснили опитування осіб, чия професійна діяльність (чи місце проживання) пов'язані з лісовим господарством.

Дослідження здійснювали за такими етапи:

- формування анкети та вибір методики анкетування:

для отримання потрібної інформації ми розробили анкету, що містила 17 запитань закрито-завершального типу, згрупованих у три блоки. Перший блок запитань стосувався значення лісу для респондента та його вагомість як екологічного, економічного та соціального чинника ведення сталого лісового господарства. Другий блок містив перелік запитань щодо передумов реформування лісового господарства загалом та деяких його сфер, а також про чинники, які мають вплив на рівень розвитку галузі. Останній блок запитань дав змогу отримати інформацію про самого респондента. Для цього було застосовано метод інтерв'ю;

- інтерв'ювання з дотриманням репрезентативності вибірки:

виконуючи дослідження, ми здійснили опитування 735 респондентів, з-поміж них 70 % – чоловіки, 30 % – жінки (така градація зумовлена тим, що у сфері лісового господарства здебільшого зайняті чоловіки).

Усі респонденти, котрі взяли участь в опитуванні, мають прямий чи опосередкований стосунок до лісового господарства: більше половини опитаних здобули вищу лісотехнічну освіту, значна частка респондентів – середню або середню спеціальну освіту за фахом "Лісове господарство".

Сфери зайнятості осіб, залучених до дослідження, такі: 74 % – державний сектор (з поміж них 97 % респондентів працює в державному секторі лісового господарства); 10 % – приватний сектор; 8 % – приватні підприємці, задіяні у лісозаготівельній, деревообробній галузях або ж у перероблянні недеревних продуктів лісу; 4 % – особи, які тимчасово не працюють; 3 % – належать до громадських організацій, 1 % – студенти або учні.

У віковій структурі опитаних найбільшу частку становлять особи віком від 35 до 45 років (31,3 %), решта – від 25 до 35 років (27,9 %), а також від 45 до 55 років (24,4 %). На частку осіб віком від 15 до 25 років та від 55 до 65 років припадає відповідно 10,9 % та 4,9 %. Найменша частка респондентів (0,7 %) – це особи віком від 65 років і вище;

- логічний підсумок отриманих даних та аналіз результатів:

на цьому етапі проаналізовано отримані дані на предмет логічної узгодженості, відповідності результатам аналогічних досліджень.

Для полегшення опрацювання інформації, отриманої за результатами дослідження, ми присвоїли бали відповідям респондентів на ключові запитання анкети (табл. 24.1).

Таблиця 24.1 Ключові запитання для респондентів та варіанти відповідей

Запитання	*Бал*	*Варіанти відповідей респондентів*
Чи існує потреба (чи схильні Ви до) подальшого	1	ні
реформування лісового сектора економіки?	2	так
Чи обізнані Ви з сутністю поняття	1	вперше дізнаюсь про таке
стале лісове господарство?	2	поінформований(-а) поверхово
	3	добре обізнаний(-а) з ним
Чи добре обізнані Ви зі змістом чинного	1	ні
Лісового кодексу України?	2	так
Стать	1	чоловік
	2	жінка
Вік	1	від 15 до 25р.
	2	25 до 35р.
	3	35 до 45 р.
	4	45 до 55 р.
	5	55 до 65 р.
	6	від 65 р. і більше
Освіта	1	незакінчена середня
	2	середня або середня спеціальна
	3	незакінчена вища або вища
Місце роботи	1	у державному секторі
	2	у приватному секторі
	3	у громадській організації
	4	приватний підприємець
	5	тимчасово не працюю
	6	студент або учень

Для обробки та аналізу отриманої за допомогою анкети інформації ми використали графічні методи її подання, а також апарат кореляційно-регресійного аналізу.

Розробляючи специфікацію економетричної моделі, залежною змінною (y) ми обрали схильність респондентів до реформування лісового сектора економіки й досліджували вплив на неї шістьох факторів (незалежні змінні: x_1, x_2, x_3, x_4, x_5, x_6).

Функцію впливу релевантних факторів на схильність респондентів до реформування лісового господарства можна подати так:

$$y = f(x_1, x_2, x_3, x_4, x_5, x_6), \quad (1)$$

де: y – схильність респондентів до реформування лісового сектора економіки,
x_1 – обізнаність з сутністю поняття стале лісове господарство,
x_2 – обізнаність зі змістом чинного Лісового кодексу України,
x_3 – стать,
x_4 – вік,
x_5 – освіта,
x_6 – місце роботи.

Для дослідження факторів, які найбільше впливають на прихильність респондентів до реформування лісового сектора економіки, ми використали:

- кореляційний аналіз:

кореляційний аналіз – це математичний апарат для виявлення зв'язку та його щільності між випадковими величинами. Кореляційний аналіз полягає у розрахунку коефіцієнтів кореляції для кожного чинника та перевірці їхньої значущості. Коефіцієнт кореляції – це відносний показник щільності лінійного зв'язку між двома факторами. Значення коефіцієнта кореляції міститься в інтервалі [-1, 1]. Що ближче його абсолютне значення до одиниці, то тіснішою є лінійність кореляційного зв'язку між факторами. Для факторів, між якими існує прямий зв'язок, коефіцієнт кореляції додатній. Якщо зв'язок зворотний, то цей коефіцієнт від'ємний. Характеристику щільності зв'язку було оцінено за п'ятиступеневою шкалою, де слабка – найменша, дуже сильна – найбільша щільність. Для оцінки коефіцієнтів кореляції потрібно переконатися у їхній значущості. Для цього було використано *t*-статистику, щоби визначити, чи статистично значимо коефіцієнт кореляції відрізняється від нуля. Для цього ми обрали певний рівень значущості *a,* далі за таблицями Ст'юдента знайшли табличне значення *t*-критерію. Якщо розраховане значення *t*-статистики більше за критичне, отриманий коефіцієнт кореляції значущий. В іншому разі – незначущий;

- парний регресійний аналіз:

регресійний аналіз – це наступний крок до визначення аналітичної залежності між випадковими величинами, тобто йдеться про визначення форми зв'язку між ними. Якщо досліджують зв'язок двох факторів, то мова йде про парний регресійний аналіз, в іншому випадку – про багатофакторний (множинний). Парний регресійний аналіз, на відміну від кореляційного, результатом якого є коефіцієнт кореляції (показує зв'язок двох змінних, проте не дає уявлення, як саме вони пов'язані) дає змогу, під час побудови статистичних моделей, отримати аналітичний вираз для залежностей між випадковими величинами, якщо вони досить сильно корельовані. Цей вид аналізу досліджуваної інформації містить оцінку параметрів парних регресійних моделей, які описує функція (Лук'яненко, Краснікова 1998):

$$y = b_0 + b_i x_i, \quad (2)$$

де y – залежна (пояснювана) змінна;
x_i – незалежна (пояснювальна) змінна;
b_0, b_i – коефіцієнти регресії.

Отже, результатами парного регресійного аналізу є, зазвичай, кореляційні поля (графічне зображення зв'язку між парами показників), оцінки параметрів лінійних рівнянь регресії та коефіцієнти детермінації (R^2), що показують, яка частка варіації залежної змінної зумовлена варіацією пояснювальної змінної. Якщо значення коефіцієнта детермінації близьке до одиниці, то рівняння регресії можна вважати адекватним, якщо ж значення R^2 близьке до нуля, то модель неадекватна, тобто лінійного зв'язку між залежною та незалежною змінними немає (Козловський 2005). Перевіряємо на адекватність парні регресійні моделі за допомогою *F*-критерію Фішера (якщо розраховане *F*-відношення більше від табличного, то з певною імовірністю модель можна використовувати для аналізу та прогнозу). Для визначення значущості коефіцієнтів кореляції використано *t*-статистику;

- множинний регресійний аналіз:

множинний регресійний аналіз дає змогу дослідити залежність однієї залежної змінної $\boldsymbol{y}$ від декількох пояснювальних (незалежних) змінних. Аналіз зводиться до отримання рівняння регресії, яке описує умовне математичне сподівання зміни $\boldsymbol{y}$ залежно від зміни $\boldsymbol{x}$. Отже, воно описує не точну залежність, а тенденцію зміни в середньому (Козловський 2005). Лінійна регресійна модель має вигляд:

$$y = b_0 + b_1x_1 + b_2x_2 + \ldots + b_ix_i, \quad (3)$$

де y – залежна (пояснювана) змінна;
x_i – незалежні (пояснювальні) змінні;
b_0, b_1, b_i – коефіцієнти регресії.

Ми використали множинний регресійний аналіз, щоб дослідити вплив усіх факторів на модель та визначити, які з них мають найбільший вплив. Для цього методом покрокового регресійного аналізу поступово вилучаємо незначущі чинники з моделі та перевіряємо її на адекватність.

Побудувавши регресійні моделі, які адекватно відображають реальні економічні процеси, маємо змогу дати їм економічну оцінку та за їх допомогою з'ясувати вплив кожного фактора $\boldsymbol{x_i}$ на результуючу змінну $\boldsymbol{y}$. Величину абсолютної зміни результуючої змінної $\boldsymbol{y}$ за умови, що лише фактор $\boldsymbol{x_i}$ змінить своє значення на одиницю, показують коефіцієнти регресії $\boldsymbol{b_i}$ регресійних моделей.

24.3 Значення лісу як екологічного, економічного та соціального чинника ведення сталого лісового господарства

Лісові ресурси – важливий складник національного багатства України, а лісове господарство є компонентом всієї соціо-еколого-економічної системи, тому рівень його розвитку безпосередньо впливає на економічний розвиток, стан довкілля та суспільного добробуту.

У контексті зростання важливості проблеми глобальної зміни клімату респондентам було поставлено запитання: чи стануть кліматичні зміни на глобальному рівні вагомим чинником для лісового господарства у найближчому майбутньому? Схвальну відповідь на це запитання дав 81 % респондентів, що свідчить про достатьо високий рівень обізнаності із проблемою зміни клімату та про усвідомлення того, що вона є викликом і для лісового сектора.

Згідно з дослідженнями громадської думки, здійсненими в окремих країнах Європейського Союзу, обізнаність із поняттям стале лісове господарство не надто висока, однак спостережено великі розбіжності між країнами. Найвищий цей показник у Великобританії – близько 50 %, в Австрії – 25 %, Франції – 8 %, Італії – 7 %. Водночас обізнаність із принципами сталого ведення лісового господарства в деяких країнах та регіонах зростає. Наприклад, із 1987 до 1996 р. у західній частині Німеччини цей показник зріс з 32 % до 57 % (Rametsteiner E., Kraxner F. 2003).

У дослідженні ми вивчали обізнаність із поняттям стале лісове господарство не широкої громадськості, а людей, близьких до проблем лісовго господарства, однак отримані результати свідчать також про брак обізнаності. Зі змістом цього поняття добре обізнані лише 93 респонденти, що становили 12,7 % опитаних. Найбільша частка опитаних 63,5 % (467 осіб) ознайомлені з такою концепцією розвитку лісового господарства поверхово, 23,8 % респондентів (175 осіб) вперше почули про сталий розвиток та сталість лісового господарювання. Така ситуація ускладнює запровадження концепції сталого лісового господарства. Як можна запроваджувати те, сутності чого не розумієш, чи з чим ознайомлений поверхово?

Визначення місця й значення лісів як екологічного, економічного та соціального чинника ведення сталого лісового господарства особливо актуальні в період, коли потрібно запропонувати на перспективу шляхи та моделі господарювання в контексті сталого розвитку України. Саме тому респондентам було поставлено запитання про важливість лісів як сегмента економіки регіону, а також про значення лісових екосистем для його екологічного добробуту. Відрадно, що більше половини опитаних означили вагомість лісів як економічного та екологічного чинників для регіону як дуже важливу (57,3 % та 60,7 % відповідно), значна частка респондентів наголосили на вагомості цих чинників (33,2 % та 38,1 % відповідно), решта – знехтували ними або назвали другорядними (рис. 24.1).

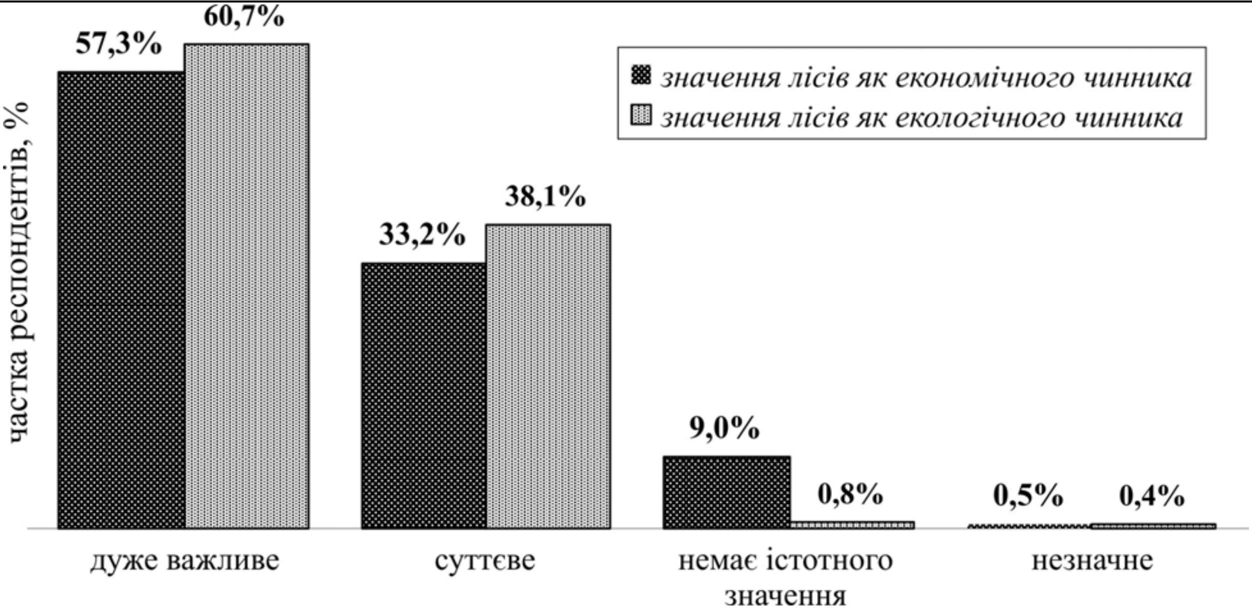

Рис. 24.1 Значення лісів як екологічного та економічного чинників ведення сталого лісового господарства

Загалом у країнах Центральної Європи, зокрема і в Україні, як показали результати нашого дослідження, більше акцентують увагу на екологічній ролі лісів. Так, у Німеччині громадськість ідентифікує їх за екологічними ознаками – як джерело депонування вуглецю, біорізноманітності чи за природним лісовідновленням. Однак не заперечують і економічної ролі лісів. У скандинавських країнах громадськість вибирає твердження про багатофункціональне значення лісів, акцентуючи увагу на особливому значенні лісової продукції (Rametsteiner E., Kraxner F. 2003).

Ліси становлять вагомий компонент природно-ресурсного потенціалу області, а ефективний розвиток лісового господарства, запорукою якого є успішне реформування галузі, зумовлює сталий поступ та стабільні соціально-трудові відносини в лісовому секторі економіки області (Синякевич та ін., 2008). Оскільки соціальний статус лісівничої професії значною мірою впливає на політичну значущість лісового сектора, ми спробували дослідити її суспільний імідж. Результати засвідчили: лише 9 % респондентів вважає, що престижність професії працівника лісового господарства у суспільстві дуже висока, найбільша частка респондентів вказала на посередній (40,7 %), а також високий (37,1 %) соціальний статус працівників лісового сектора у суспільстві (рис. 24.2).

Отже, лісовий сектор повинен орієнтуватися на концепцію сталого лісового господарства, а також, оскільки усвідомлення вагомості лісів як екологічного та економічного чинника ведення сталого лісового господарства дуже висока, надалі варто спрямовувати зусилля на досягнення максимального економічного, екологічного та соціального ефектів від використання і відтворення лісових ресурсів.

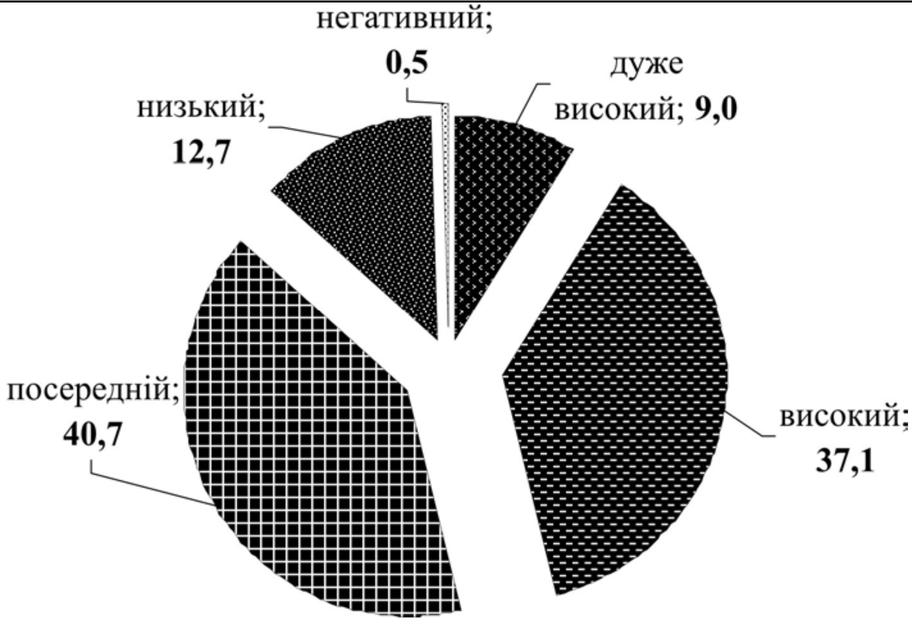

Рис. 24.2 Соціальний статус (престижність) професії працівника лісового господарства у суспільстві

24.4 Дослідження передумов реформування лісового господарства загалом та окремих його сфер

З набуттям чинності оновленого Лісового кодексу України з 1 квітня 2006 року та введенням у дію розпорядження Кабінету Міністрів від 18 квітня 2006 року за № 208-р "Про схвалення Концепції реформування та розвитку лісового господарства" увиразнилася державна концепція реформування лісового господарства України. Спираючись на зміст цих документів та зваживши на перші кроки владних органів щодо виконання їхніх вимог, можна спрогнозувати розвиток лісового господарства України в першій чверті двадцять першого століття, а також те, наскільки він відповідатиме концепції сталого екологічно збалансованого розвитку та сприятиме подоланню глобальних екологічних загроз і зміцненню екологічної безпеки (Синякевич та ін., 2008).

На потребі подальших реформ у лісовому секторі економіки наголосив 81 % респондентів (595 працівників лісового господарства), решту – 19 % відповідачів задовольняють сучасний стан та модель розвитку лісового господарства. Достатньо високий відсоток респондентів, налаштованих позитивно стосовно реформування, свідчить про сприятливий грунт для подальших змін та потенційну підтримку реформ.

Респонденти, які наполягають на нагальності реформування лісового сектора економіки, насамперед хотіли би реформувати систему фінансування лісового господарства (334 згадування, 45 % респондентів, які відповіли на запитання), систему управління (239 згадувань, відповідно 33 % респондентів), економічні відносини – 149 згадувань, 20 % респондентів. Недосконалість механізму державного управління лісами на обласному рівні полягає у тому, що третина площі лісів області перебуває поза сферою компетенції територіального органу Державного комітету лісового господарства України. Реформувати кадрову політику порадили 13 % респондентів (96 згадувань). Нормативно-правова база не влаштовує 18 % опитаних, відповідно 132 особи вказали на доцільність її реформування. Добре ознайомлені зі змістом чинного Лісового кодексу України 48 % фахівців лісового господарства, з них 45 % вважає, що Лісовий кодекс відповідає сучасним вимогам охорони, використання та відтворення лісів в умовах ринкової економіки.

Аналіз сучасного стану лісового сектора економіки вказує на потребу якісних змін структурного характеру у контексті реформування лісового господарства України.

Основними причинами, які гальмують розвиток лісового сектора економіки області, є:

- недосконалість механізму державного управління лісовим господарством;
- недосконалість чинного податкового законодавства;
- відсутність економічних механізмів державного стимулювання підприємств, які збільшують площі лісів держави;
- недосконалість структури лісогосподарських підприємств;
- нерозвиненість ринку послуг лісовому господарству;
- недосконалий ринок лісоматеріалів;
- неналежне фінансування робіт, пов'язаних з веденням лісового господарства;
- зношеність основних фондів у лісовому господарстві;
- значне здорожчання енергоносіїв;
- незаконні рубання лісу (Синякевич та ін. 2008).

У процесі реформування лісового сектора національної економіки і адаптуванні його до ринкових умов господарювання потрібно враховувати, що не всі проблеми сталого екологічно збалансованого розвитку лісового господарства можна вирішити за допомогою ринкових інструментів. Одразу ж після розпаду СРСР американські економісти застерігали лісових політиків на пострадянському просторі, що не варто квапитися з приватизацією лісів і відмовлятися в лісовому господарстві від позитивних надбань адміністративно-командної економіки. Цікаво, що промислово найрозвиненіші країни з ринковими системами організації лісового господарства наприкінці двадцятого століття почали запроваджувати неринкові методи подолання еколого-економічних проблем у лісовому секторі економіки (Синякевич та ін. 2008).

Одним із найважливіших у нашій анкеті було запитання про економічні чинники, які можуть мати визначальний вплив на ведення сталого лісового господарства в майбутньому. У їхньому переліку , респондентам було запропоновано такі: стабільний і достатній рівень державного фінансування галузі, ріст приватних інвестицій у галузь, загальне покращання економічної ситуації в державі, приватизація частини лісів, сприятлива ситуація на міжнародному ринку деревини. На рис. 24.3 зображено розподіл респондентів за пріоритетними, на їхній розсуд, економічними чинниками, які впливають на рівень розвитку лісового господарства. Із запропонованого переліку економічних чинників визначальним та нагальним виявилося стабільне і достатнє фінансування лісового сектора (56 % респондентів, 414 згадувань). Позаяк держава часто недофінансовує лісове господарство, загальне покращання стану національної економіки, на думку 29 % респондентів, є одним із визначальних чинників успішного господарювання. Лише 5 % опитаних вважає приватизацію частини лісів за визначальний чинник розвитку лісового господарства. Важливим економічним інструментом ведення сталого лісового господарства є екологічна сертифікація лісів, проте лише 48,4 % респондентів вбачає у ній позитив, 45,9 % – нехтує, а 5,7 % – побоюється негативних наслідків сертифікації.

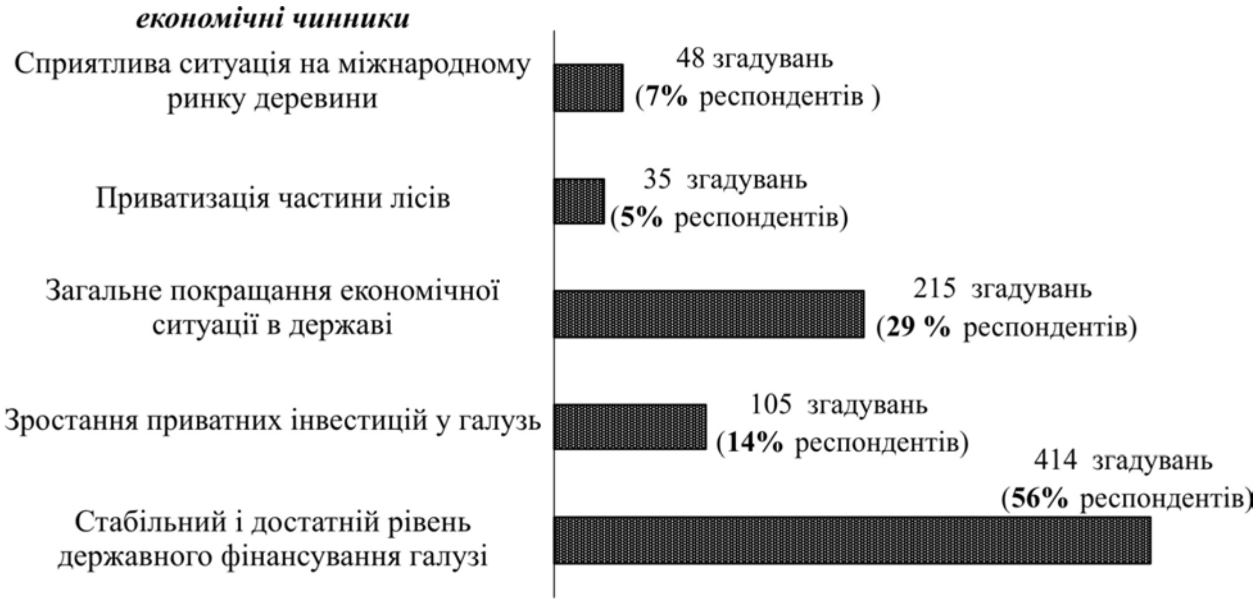

Рис. 24.3 Економічні чинники, які впливають на рівень розвитку лісового господарства

Працівникам лісового сектора було запропоновано перелік заходів, які насамперед потребують удосконалення чи реформування: лісовий менеджмент, методи ведення рубань, лісовідновлювальні та лісозасаджувальні роботи, генетико-селекційну діяльність, лісозаготівельну техніку, лісову транспортну мережу, лісовпорядкувальні роботи, мисливське господарство, функціонування природнозаповідних об'єктів. Розподіл респондентів за їхнім ставленням до реформування окремих сфер ведення лісового господарства наведено на рис. 24.4. За результатами опитування проблеми удосконалення способів рубань, а також реформування системи лісовідновлювальних та лісозасаджувальних робіт однаково важливі для відповідачів (281 згадування, відповідно 38 % респондентів) Тези щодо потреби удосконалення лісового менеджменту (24 %, 173 згадування), покращення лісозаготівельної техніки (26 %, 191 згадування), а також лісової транспортної мережі (23 %, 167 згадувань) респонденти повторювали однаково часто, що може свідчити про рівнозначну важливість цих сфер практичного ведення лісового господарства для його фахівців. Удосконаленням системи функціонування природнозаповідних об'єктів фахівці лісового господарства переймаються найменше (65 згадувань, відповідно – 8,8 % респондентів).

Рис. 24.4 Розподіл респондентів за ставленням до реформування окремих сфер практичного ведення лісового господарства

На основі світового досвіду ведення лісового господарства, аналізу наукових праць з проблем економіки лісокористування, екологічної і лісової політики та екологічної економіки колектив науковців НЛТУ України сформулював такі принципи економічної реформи лісового господарства України:

- врахування світового досвіду організації лісового господарства, лісового менеджменту та управління лісами;
- врахування українських традицій лісокористування та ментальності громадян;
- протидія деструктивним силам глобалізації, які спрямовані на деградацію лісового господарства і послаблення стійкості лісових екосистем;
- реформування лісового господарства на основі глибокого еколого-економічного обґрунтування і оцінки чисельних кваліфікованих експертів, яка б враховувала політичні, правові, економічні, екологічні, соціальні та духовні аспекти;
- реформа лісового господарства повинна бути тривалою, еволюційною, комплексною, системною, поетапною та враховувати чисельні еколого-економічні та регіональні особливості ведення лісового господарства;
- реформування лісового господарства України з метою подолання глобальних економічних загроз, зміцнення глобальної екологічної безпеки і забезпечення сталого екологічно збалансованого лісового господарства (Синякевич та ін. 2008).

Отже, для того, щоби Національна програма реформування лісового господарства набула цілісності, треба, щоб вона стала предметом грунтовного обговорення громадських організацій, лісокористувачів, владних органів та провідних науковців. Крім цього, вона повинна опиратися на багатий досвід розвинених країн, бути адаптована до умов України, враховувати ментальність громадян, мати наукове обґрунтування.

24.5 Аналіз чинників, які впливають на схильність фахівців лісового господарства до реформування лісового сектора економіки

На ставлення фахівців лісового господарства до запровадження парадигми сталого розвитку шляхом реформування лісового сектора економіки, звичайно, впливають різні фактори. Релевантними факторами є: обізнаність із сутністю поняття стале лісове господарство, обізнаність із змістом чинного Лісового кодексу України, стать, вік, освіта, місце роботи.

Досліджуючи чинники впливу, ми використали апарат кореляційно-регресійного аналізу. Його застосування дало нам змогу глибше з'ясувати причини схильності до реформування лісового сектора економіки фахівців лісового господарства.

Отже, завдання полягало у дослідженні впливу релевантних факторів на схильність до процесу реформування лісового сектора економіки працівників лісового господарства.

Для дослідження чинників, які найбільше впливають на прихильність респондентів до реформування лісового сектора економіки, ми вдалися до кореляційного аналізу (отримана за результатами дослідження вибірка налічує 735 відповідей). Кореляційний аналіз передбачає розрахунок коефіцієнтів кореляції, що показують щільність лінійного зв'язку кожного з факторів із залежною змінною та перевірку їхньої значущості. Коефіцієнти кореляції досліджуваних факторів із залежною змінною представлено у кореляційній матриці (табл. 24.2).

Таблиця 24.2 Кореляційна матриця зв'язку досліджуваних чинників із залежною змінною

Досліджувані чинники	*y*	*x_1*	*x_2*	*x_3*	*x_4*	*x_5*	*x_6*
y	1						
x_1	0,6794	1					
x_2	0,1292	0,0763	1				
x_3	0,0399	0,0180	0,2300	1			
x_4	0,0215	0,0508	-0,0715	-0,0374	1		
x_5	0,3654	0,3563	-0,0674	-0,0491	-0,0237	1	
x_6	0,0888	0,0777	0,0427	0,0495	-0,0554	0,0658	1

Аналіз кореляційної матриці показників засвідчив, що прихильність респондентів до реформування лісового сектора економіки має прямий зв'язок (додатні значення коефіцієнтів кореляції) з досліджуваними факторами (обізнаністю із сутністю поняття стале лісове господарство, обізнаністю зі змістом чинного Лісового кодексу України, статтю респондентів, їхнім віком, освіченістю, місцем роботи). Найбільший коефіцієнт кореляції залежної змінної із обізнаністю респондентів з сутністю поняття стале лісове господарство (помітний зв'язок). Помірний зв'язок існує між залежною змінною та освіченістю респондентів. Спостережено слабкий зв'язок досліджуваного процесу й таких факторів як обізнаність респондентів із змістом чинного Лісового кодексу України, місце роботи, стать, вік респондента.

Отже, аналізовані показники можна проранжувати в такому порядку залежно від щільності (тісноти) зв'язку із залежною змінною:

1) обізнаність із сутністю поняття стале лісове господарство;
2) освіта;
3) обізнаність із змістом нового Лісового кодексу України;
4) місце роботи;
5) стать;
6) вік.

Здійснемо оцінки коефіцієнтів кореляції між залежною змінною (y) та вибраними незалежними змінними (x_1, x_2, x_3, x_4, x_5, x_6). Значущість оцінок коефіцієнтів кореляції перевірено за допомогою критерію Ст'юдента. Критичне значення розподілу Ст'юдента для α=0,05, n=735 дорівнює 1,96. Зведені результати кореляційного аналізу наведено в табл. 24.3.

Таблиця 24.3 Кореляційний зв'язок між залежною змінною (ставлення респондентів до реформування лісового сектора економіки) та досліджуваними показниками

Незалежна змінна	*Коефіцієнт кореляції, r_{xy}*	*Розрахункове значення t-критерію Ст'юдента*	*Характеристика зв'язку*
Обізнаність із сутністю поняття стале лісове господарство (X_1)	0,6794	25,0651	прямий, помітний, значущий
Обізнаність із змістом чинного Лісового кодексу України (X_2)	0,1292	3,5278	прямий, слабкий, значущий
Стать (X_3)	0,0399	1,0800	прямий, слабкий, **незначущий**
Вік (X_4)	0,0215	0,5835	прямий, слабкий, **незначущий**
Освіта (X_5)	0,3654	10,6266	прямий, помірний, значущий
Місце роботи (X_6)	0,0888	2,4131	прямий, слабкий, значущий

За результатами кореляційного аналізу можна дійти висновку, що з похибкою 0,5 % статистично значущими факторами, які впливають на схвальне ставлення респондентів – працівників лісового господарства до його реформування, є такі: обізнаність із сутністю поняття стале лісове господарство, обізнаність із змістом чинного Лісового кодексу України, освіченість та місце роботи. Статистично незначущими факторами є стать і вік респондентів.

З метою поглибленого вивчення впливу досліджуваних факторів на думку респондентів щодо реформування лісового сектора економіки застосуємо парний регресійний аналіз.

Із переліку незалежних змінних, що, за нашими припущеннями, мали вплив на прихильність респондентів до реформування лісового сектора економіки, ми відкинули змінні x_3 (стать) та x_4 (вік), для яких коефіцієнти кореляції виявилися слабкими та незначущими. За результатами парного регресійного аналізу оцінено параметри лінійних рівнянь регресії та розраховано коефіцієнти детермінації (R^2).

Отримані оцінки параметрів регресійних моделей ми перевірили на адекватність за F-критерієм Фішера, отримані значення F-статистики свідчать про адекватність парних регресійних моделей, тобто з імовірністю 95 % їх можна використовувати для аналізу та прогнозу. В усіх регресійних моделях знаки відповідають припущенням.

Результати парного регресійного аналізу зведено у табл. 24.4.

Таблиця 24.4 Зведені результати аналізу адекватності парних лінійних регресійних моделей

Незалежна змінна	*Коефіцієнт регресії*		*Коефіцієнт детермінації, R^2*	*Розрахункове значення t-критерію Ст'юдента*		*Розрахункове значення F-критерію Фішера*	*Характеристика моделі (рівень значущості 95 %)*
	b_1	b_0		b_1	b_0		
X_1	0,587	0,499	0,462	16,831	25,065	628,261	адекватна
X_2	0,102	1,039	0,017	3,528	22,604	12,445	адекватна
X_5	0,904	0,169	0,133	29,716	10,627	112,924	адекватна
X_6	0,005	0,187	0,008	12,679	2,413	5,823	адекватна

Критичне значення t-критерію Ст'юдента дорівнює 1,96
Критичне значення F-критерію Фішера дорівнює 3,84

За результатами парного регресійного аналізу (на основі отриманих рівнянь регресії) маємо можливість виявити вплив окремих факторів на схильність респондентів, фахівців лісового господарства, до реформування лісового сектора економіки.

Так, з імовірністю 95 % можна стверджувати, що зростання освітнього рівня на одиницю (діапазон значень від 1 (незакінчена середня освіта) до 3 (незакінчена вища або вища) забезпечить підвищення схильності фахівців лісового господарства до реформування цієї галузі на 90,4 %, а зростання обізнаності з поняттям стале лісове господарство на один рівень (діапазон зміни значень від 1 (вперше дізнаюсь про таке) до 3 (добре обізнаний з ним) приведе до підвищення схильності респондентів до реформування лісового господарства на 58,7 %. Зростання обізнаності опитуваних із змістом чинного Лісового кодексу України на один рівень (діапазон значень від 1 (обізнаний) до 2 (необізнаний) приведе до підвищення схильності респондентів до реформування лісового господарства лише на 10,2 %.

Коефіцієнт детермінації залежної змінної (схильність респондентів до реформування лісового господарства) та обізнаності з поняттям стале лісове господарство (x_1) становить 0,462, отже, що 46,2 % дисперсії залежної змінної описано дисперсією незалежної змінної x_1, тобто обізнаність із поняттям стале лісове господарство на 46,2 % пояснює поведінку респондентів щодо їхньої схильності до реформування лісового сектора економіки. Рівень освіти лише на 13,3 % зумовлює поведінку респондентів щодо їхньої схильності до реформування лісового сектора економіки. Обізнаність із змістом чинного Лісового кодексу України та місце роботи респондента зумовлюють лише на 1,7 % та 0,8 % поведінку респондентів стосовно їх ставлення до реформування лісового сектора.

Таблиця 24.5 Зведені результати адекватності моделей, побудованих методом покрокового регресійного аналізу

Кроки	*Фактори*	*Модель, побудована методом покрокового регресійного аналізу*	*Розрахункове значення t-критерію Ст'юдента*	*Значущість коефіцієнта*	*Коефіцієнт детермінації, R^2*	*Розрахункове значення F-критерію Фішера*	*Критичне значення F-критерію Фішера*	*Характеристика моделі (рівень значущості 95%)*
1	обізнаність з поняттям стале лісове господарство (x_1) обізнаність зі змістом чинного Лісового кодексу України (x_2) стать (x_3) вік (x_4) освіта (x_5) місце роботи (x_6)	$y=0{,}533x_1+0{,}069x_2+$ $+0{,}013x_3+0{,}001x_4+0{,}698x_5$ $+0{,}056x_6+0{,}263$	21,508 3,197 **0,537** **0,078** 5,264 **0,996**	значущий значущий **незначущий** **незначущий** значущий **незначущий**	0,488	115,76	2,10	**адекватна**
2	обізнаність з поняттям стале лісове господарство (x_1) обізнаність зі змістом чинного Лісового кодексу України (x_2) стать (x_3) освіта (x_5) місце роботи (x_6)	$y=0{,}532x_1+0{,}069x_2+$ $+0{,}013x_3+0{,}07x_5+$ $+0{,}056x_6+0{,}267$	21,589 3,202 **0,536** 5,271 **0,994**	значущий значущий **незначущий** значущий **незначущий**	0,488	139,10	2,21	**адекватна**
3	обізнаність з поняттям стале лісове господарство (x_1) обізнаність зі змістом чинного Лісового кодексу України (x_2) освіта (x_5) місце роботи (x_6)	$y=0{,}533x_1+0{,}072x_2+0{,}07x_5$ $+0{,}057x_6+0{,}279$	21,608 3,409 5,256 **1,018**	значущий значущий значущий **незначущий**	0,487	173,97	2,37	**адекватна**
4	обізнаність з поняттям стале лісове господарство (x_1) обізнаність зі змістом чинного Лісового кодексу України (x_2) освіта (x_5)	$y=0{,}534x_1+0{,}073x_2+$ $+0{,}07x_5+0{,}332$	21,693 3,454 5,307	значущий значущий значущий	0,488	231,60	2,60	**адекватна**

Критичне значення t-критерію Ст'юдента дорівнює 1,96

Отже, найкраще описує поведінку залежної змінної обізнаність відповідачів із сутністю поняття стале лісове господарство.

Визначаючи перспективи реформування лісового сектора економіки та факторів, які мають найбільший вплив на цей процес, ми здійснили множинний регресійний аналіз. Модель впливу досліджуваних факторів на схильність до реформування лісового господарства фахівців цієї галузі побудовано методом покрокового регресійного аналізу.

Спочатку ми здійснили множинний регресійний аналіз із урахуванням усіх шістьох незалежних змінних. Оскільки покроковий регресійний аналіз потребує поступового вилучення незначущих факторів із моделі, поступово було виведено такі фактори: стать (x_3), вік (x_4), місце роботи (x_6).

Зведені результати покрокового регресійного аналізу, адекватності побудованих моделей та перевірки значимості коефіцієнтів регресії за *t*-статистикою наведено в табл. 24.5.

Здійснивши множинний регресійний аналіз з урахуванням усіх шістьох незалежних змінних, ми отримали модель, що має такий вигляд:

$$y=0{,}533x_1+0{,}069x_2+0{,}013x_3+0{,}001x_4+0{,}698x_5+0{,}056x_6+0{,}26, \quad (4)$$

де: y – схильність респондентів до реформування лісового сектора економіки,
x_1 – обізнаність з поняттям стале лісове господарство,
x_2 – обізнаність зі змістом чинного Лісового кодексу України,
x_3 – стать,
x_4 – вік,
x_5 – освіта,
x_6 – місце роботи.

Коефіцієнт детермінації для моделі становить 0,488 (48,8 % дисперсії залежної змінної описується дисперсією незалежних змінних). Тобто 48,8 % поведінки респондентів щодо їх схильності до реформування лісового господарства пояснюється поведінкою незалежних чинників $x_1,\ldots, x_6$. Розрахункове значення *F*-критерію Фішера становить 115,76 (критичне значення 2,10), тому отримана модель адекватна. Однак при цьому *t*-статистика завірила незначущість факторів x_4 (вік респондентів), стать (x_3) та місце роботи (x_6), (розрахункові значення *t*-статистики для них становили 0,078, 0,537, 0,996 відповідно, тоді як критичне значення – 2,447). Тому ці фактори поступово потрібно вивести з моделі. Після виведення незначущого фактора, що має найменше розрахункове значення *t*-критерію Ст'юдента – x_4, ми отримали таку модель:

$$y=0{,}532x_1+0{,}069x_2+0{,}013x_3+0{,}07x_5+0{,}056x_6+0{,}267. \quad (5)$$

Коефіцієнт детермінації залишився на тому ж рівні – 0,488. Значно покращився *F*-критерій Фішера – 139,1 (критичне значення 2,21) – рівень адекватності моделі. Проте, за результатами перевірки значущості коефіцієнтів регресії за *t* – статистикою, незначущими факторами залишилися стать (x_3) та місце роботи (x_6). Тому наступним кроком буде виведення з моделі незначущого фактора x_3:

$$y=0,533x_1+0,072x_2+0,07x_5+0,057x_6+0,279. \quad (6)$$

Після виведення наступного незначущого фактора з моделі коефіцієнт детермінації залишився майже на тому ж рівні – 0,487. Рівень адекватності моделі (F-критерій Фішера – 173,97, при тому, що критичне значення – 2,37) значно покращився. Проте, за результатами перевірки значимості коефіцієнтів регресії за t – статистикою, незначущим фактором у моделі залишився x_6 (місце роботи). Тому остаточний вигляд моделі такий:

$$y=0,534x_1+0,073x_2+0,07x_5+0,332. \quad (7)$$

Отже, після виведення з моделі всіх незначущих факторів, робимо висновок про її адекватність та можливість використання її з імовірністю 95 % для аналізу й прогнозу.

Виконавши покроковий регресійний аналіз, можемо зробити такі висновки: оскільки коефіцієнт детермінації після вилучення трьох незначущих факторів майже не змінився і дорівнює 0,487, це означає, що виведені з моделі незалежні змінні не мали істотного впливу на залежну змінну, а прихильність респондентів до реформування лісового сектора економіки на 48,7 % зумовлена впливом таких трьох факторів: обізнаністю з поняттям стале лісове господарство (x_1), обізнаністю зі змістом чинного Лісового кодексу України (x_2) та рівнем освіти респондентів (x_5).

Отриману модель можна трактувати таким чином: кожен з трьох (x_1, x_2, та x_5) значущих факторів має вплив на схильність респондентів – фахівців лісового сектора економіки до його реформування, проте вплив кожного з них різний. Так, з імовірністю 95 % можна стверджувати, що зростання обізнаності з поняттям стале лісове господарство на один рівень (діапазон зміни значень від 1 (вперше дізнаюсь про таке) до 3 (добре обізнаний з ним) приведе до підвищення схильності респондентів до реформування лісового господарства на 53,4 %.

Однаковий вплив на підвищення схильності респондентів до реформування лісового господарства, за результатами досліджень, мають обізнаність зі змістом чинного Лісового кодексу України та рівень освіти. Зростання обізнаності опитуваних із змістом чинного Лісового кодексу України на один рівень (діапазон значень від 1 (обізнаний) до 2 (необізнаний) приведе до підвищення схильності респондентів до реформування лісового господарства на 7,3 %, а зростання освітнього рівня на одиницю (діапазон значень від 1 (незакінчена середня освіта) до 3 (незакінчена вища або вища) поліпшить ставлення фахівців лісового господарства до реформування лісового господарства на 7 %.

Порівнюючи результати парного та множинного регресійного аналізу, можна зауважити, що відсоток впливу кожного фактора зокрема на залежну змінну (парний регресійний аналіз) відрізняється від впливу на неї кількох незалежних факторів водночас (множинний регресійний аналіз).

24.6 Висновки

Дослідивши ставлення фахівців лісового господарства до запровадження парадигми сталого розвитку шляхом реформування лісового сектора економіки на території Львівської області, ми дійшли висновку про потребу перепідготовки галузевих фахівців шляхом проведення тренінгів, науково-практичних семінарів, круглих столів із залученням провідних експертів. Це дасть змогу перевести у практичну сферу дискусії про стале ведення лісового господарства, урізноманітнити арсенал інструментів лісової політики та методів сталого ведення лісового господарства з метою реалізації на практиці визнаних пріоритетів міжнародної лісової політики. Обізнаність працівників лісового господарства з концепцією сталого його ведення, як показали результати нашого дослідження, приведе до поліпшення ставлення респондентів до реформування лісового господарства, а отже, до певних кроків, які поліпшать рівень його розвитку.

За результатами аналізу інформації, отриманої під час дослідження, вплив на прихильність респондентів до реформування лісового сектора економіки на 48,7 %зумовлена впливом таких трьох факторів: обізнаністю з поняттям стале лісове господарство, обізнаністю зі змістом чинного Лісового кодексу України та рівнем освіти респондентів.

Зростання обізнаності з поняттям стале лісове господарство на один рівень (діапазон зміни значень від 1 (вперше дізнаюсь про таке) до 3 (добре обізнаний з ним) приведе (з імовірністю 95 %) до підвищення схильності респондентів до реформування лісового господарства на 53,4 %.

Зростання обізнаності опитуваних із змістом чинного Лісового кодексу України на один рівень (діапазон значень від 1 (обізнаний) до 2 (необізнаний) приведе до підвищення схильності респондентів до реформування лісового господарства на 7,3 %, а зростання освітнього рівня на одиницю (діапазон значень від 1 (незакінчена середня освіта) до 3 (незакінчена вища або вища) забезпечить поліпшення ставлення фахівців лісового господарства до реформування лісового господарства на 7 %.

Звідси можна зробити висновок про доречність урізноманітнення арсеналу інструментів національної лісової політики, насамперед – інформаційних, та спрямування їх на вирішення завдань сталого розвитку лісового господарства.

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Chapter 25

Assessment of Non-wood Resources Value for Local Communities' Development in the Carpathians

Pavlo Kravets[1] *and Petro Lakyda*[2]

Abstract The transition of forest management to the principles of sustainable development stipulates the strengthening of the social components of forestry activities. This chapter was based on a socio-economic study to evaluate the role of non-wood resources – also known as "non-timber forest products" (NTFPs) – and to define the critical issues for cooperation between rural communities and the State Committee of Forestry of Ukraine (SFCU), Forest Management Enterprises (FMEs). The study was based on data collected in a field survey of rural inhabitants in the Vygodskiy FME region.

The results of survey show that NTFPs play more than an inconsequential role for local communities. The prevailing attitude was that NTFPs, particularly mushrooms and berries, were regarded as "important." Despite the consumptive and commercial values of NTFPs, rural inhabitants were quick to point out that they perceive of the forest not only as source of wood and food, but primarily as living ecosystem and the source of recreational values. The majority of the population surveyed considered using non-wood resources as an indisputable, traditional right. Even when they were made aware of the problems of the protection and renewal of NTFPs, they did not express a "willingness to pay" (WTP) for them. The situation with recreational resources was perceived somewhat differently. The WTP for improved access and services in recreational areas was expressed by about half of the respondents. The average WTP increases as the income of respondents increases.

The local population has unrestricted, free access to the forests for recreation and a source for collecting NTFPs. Conflict among the state forest enterprise and local communities was not observed in the study area (it was anticipated that conflicts related to encroachment of private landowners on state land or unregulated

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development of state forest lands would be voiced). Likewise, there were no complaints of discrimination towards locals in regards to employment. It was generally accepted that the FME supports the functioning and development of the social infrastructure in the rural settlements.

Nonetheless, challenging social issues were found, namely: a low-level of trust towards government agencies and administration; an insufficient knowledge of the local population about forestry management activities, not accepting current forestry practices by local population as environmentally sound and the socially responsible and the absence of formalized mechanisms for taking into account the needs of the local community. Notwithstanding the realization of this challenging situation by the majority of the local inhabitants, they were not ready or prepared to get involved in forest management planning or shifting the decision-making responsibility for the improvement of the forest management away from the state forest authorities.

The authors developed recommendations to improve forest management and move current the situation towards sustainable forest management, in particular through increasing the role of local communities.

Оцінка цінності недеревних ресурсів у контексті розвитку місцевих громад Карпат

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25.1 Вступ

Серед принципів управління лісами на засадах сталого розвитку чільне місце посідають право місцевих громад користуватися ресурсами лісу та підвищення їх ролі в управлінні лісами. Саме цим питанням приділяють особливу увагу під час здійснення сертифікаційних процедур за схемою Лісової опікунської ради. Вимоги принципів 2 та 4 передбачають дотримання права місцевих громад на користування лісовими ресурсами, зокрема в порядку загального користування, залучення до участі в плануванні соціально чутливих лісогосподарських заходів, формування механізмів оскарження дій, пов'язаних із порушенням цих прав та компенсації у випадку втрат і збитків, які завдаються їхнім правам, власності, ресурсам і умовам життя (Principles 1993).

Метою цього дослідження[3] стали оцінка цінності недеревних ресурсів у контексті розвитку місцевих громад, виявлення основних проблемних питань співпраці підприємства та сільських громад з метою врахування інтересів останніх, а також удосконалення ведення лісового господарства на засадах сталого розвитку.

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[3] Дослідження проводилося в рамках проекту "Зміцнення інституційної структури лісової сертифікації в Україні" за фінансового сприяння компанії IKEA.

За об'єкт дослідження слугували місцеві громади (смт. Вигода та с. Шевченкове), які у своєму розвиту безпосередньо пов'язані з діяльність Вигодського лісового господарства Івано-Франківської області. Вибір об'єкта дослідження зумовлений участю лісогосподарського підприємства в зазначеному вище проекті та бажанням здійснити заходи щодо удосконалення співпраці з місцевим населенням на основі рекомендації за підсумками опитування.

25.2 Методи

В основу методики дослідження покладено загальноприйняті підходи і прийоми соціологічних досліджень, тобто опитування представників органів місцевих громад та жителів. Загальна кількість опитуваних становила 54 особи, або 1,7 % усього дорослого населення. Вибірка є репрезентативною за статевим і віковим складом місцевих громад.

Предметом дослідження стала суб'єктивна оцінка цінності недеревних ресурсів лісу місцевими жителями.

Соціологічні дослідження, як інструмент наукового пізнання та елемент системи прийняття збалансованих управлінських рішень, набувають дедалі більшого поширення та застосування в різних сферах суспільних відносин, зокрема і в лісовому господарстві (Public 2008).

Універсальність інструментарію методів опитування полягає у можливості виконання низки завдань, таких як ідентифікація проблемних питань в лісовому господарстві, наприклад дотримання прав місцевих громад у користуванні лісовими ресурсами, рівень інформованості громадськості, наявність конфліктних питань між громадами та лісовим господарством, а також і виявлення декларованих уподобань з метою здійснення економічної оцінки лісових ресурсів на основі "готовності платити".

Методи суб'єктивної оцінки неоднозначно сприймаються як інструментарій економічної оцінки цінності навколишнього природного середовища. Методологічними засадами цих методів є неокласичні постулати "людини економічної", яка здатна оцінювати в економічних категоріях зміни в якості та кількості продуктів і послуг, які надають зокрема лісові екосистеми. По-іншому, споживач лісових продуктів і послуг здатний оцінити їхню цінність, декларуючи свої вподобання навіть за умови відсутності ринку (Pakhomova 2003). Критика методологічних та методичних засад суб'єктивної оцінки полягає у нехтуванні інституційного базису та гуманістичного складника в системі світоглядних і ціннісних установок людини, обмежуючи їх лише раціональними та егоїстичними мотивами і вчинками. Ці та інші чинники ставлять під сумнів обґрунтованість і достовірність отриманих результатів внаслідок високого рівня суб'єктивності та упередженості, чутливості методу до помилок (Ahlheim 1998, Bateman 1995, Venkatachalam 2004).

25.3 Результати та обговорення

Питання поділяли на три групи. Перша група питань характеризувала респондента (вік, освіта, щомісячний дохід); друга – була присвячена оцінюванню обсягів користування недеревними ресурсами лісу (тривалість і частота відвідування, величина збору недеревних продуктів лісу протягом сезону) та наявності проблемних питань у лісовому господарстві під час здійснення користування лісовими ресурсами та корисними властивостями. Третя група питань торкалася економічної оцінки недеревних лісових ресурсів.

Ключовими в опитувальному листі були питання щодо суб'єктивної оцінки важливості недеревних ресурсів лісу за такою градацією: "неважливо", "мало важливо", "важливо", "дуже важливо". Оцінюванню підлягали: харчові продукти лісу (гриби, ягоди, лікарські рослини і дикорослі плоди) та оздоровчо-рекреаційні функції лісу.

Відповідно до результатів опитування, місцеві жителі сприймають ліс як невід'ємний та важливий складник свого життя. В середньому місцевий житель з неробочою метою відвідує ліс: узимку – 2 рази; навесні – 3; улітку – 12; восени – 8 разів. Середня тривалість одного візиту – близько 5 годин.

Протягом сезону місцевий житель збирає в середньому, кг: грибів – 10; ягід – 10; лікарських рослин – 0,5; дикорослих плодів – 0,5. Заготівлю ягід для 7 % опитуваних та заготівлю грибів для 11 % опитуваних здійснюють в обсягах, які суттєво перевищують власні потреби і, зазвичай, призначаються для подальшої реалізації. Водночас, лише менше половини цієї категорії опитуваних підтверджували це припущення.

Різні види недеревних ресурси лісів отримували відмінні оцінки місцевого населення, але беззаперечно, те, що всі вони сукупно становлять невід'ємну частину культурного і релігійного життя, є умовою збереження традиційного гірського укладу. Переважає оцінка щодо можливості збору грибів і ягід "важливо", тоді як для лікарських рослин і дикорослих плодів – "не важливо" (рис 25. 1).

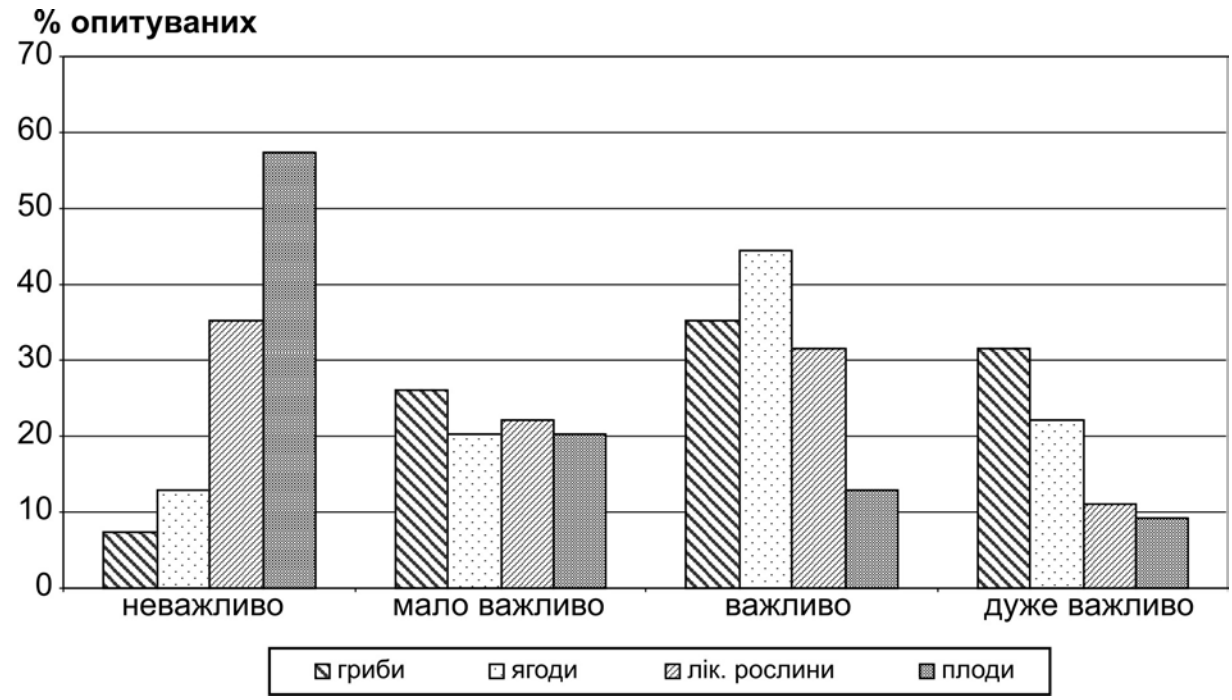

Рис. 25.1 Оцінка цінності недеревних функцій лісу

Респондентам не вказували критерії, за якими має встановлюватися "важливість" ресурсів. Тобто опитувані мали самостійно визначити для себе, які характеристики недеревних ресурсів є визначальними. Аналіз кореляційної матриці аналізованих показників засвідчив наявність значно тіснішого зв'язку важливості недеревних ресурсів із кількістю їх заготівлі (значення коефіцієнта кореляції змінюється 0,64-0,77 за його критичного значення – 0,26), а ніж із важливістю оздоровчо-рекреаційних функцій в житті місцевих жителів (0,22-0,35). Це своєю чергою дає підставу стверджувати, що "важливість" недеревних ресурсів лісу для місцевих жителів зумовлюється їхньою прямою споживчою цінністю як харчових продуктів, а не оздоровчо-рекреаційними властивостями лісу, отримання яких відбувається в процесі збору недеревних ресурсів.

Проте, хоча переважаючою оцінкою рекреаційно-оздоровчих функцій є "дуже важливо" (57 % опитуваних), а опитувані відвідували ліс з метою здійснення збору недеревних ресурсів, місцеве населення усвідомлює ліс важливим рекреаційним ресурсом та середовищем власного існування. Підтвердженням цьому може бути переважне вживання таких ключових слів про значення лісу в житті людей, як "природа", "земля" та "життя".

Вільне та безоплатне користування недеревними ресурсами лісу місцеві жителі розглядають як їхнє традиційне і непорушне право. Переважною більшістю (63 % опитуваних), незважаючи на визнання актуальності поліпшення якості лісів та підвищення їхньої продукційної здатності, респонденти відкидають можливість платити за "дар Божий". Інша частина респондентів була готова платити у разі, коли кошти спрямовуватимуть на підтримання цих ресурсів у належному стані. Обсяг плати становив від 1 до 10 % ринкової вартості заготовлених продуктів лісу, або в середньому 4,8 %. Результатом оптимізації протилежних функцій максимізації кількості відвідувань лісу з метою заготівлі недеревних ресурсів (на жаль, у процесі дослідження їх не можна було розділити на ресурси загального та спеціального користування) з одного боку, та максимізації економічної ефективності ведення лісового господарства (в частині недеревних продуктів) з іншого, є таке їхнє співвідношення, за якого 37 % усіх відвідувачів лісу будуть готові внести плату в обсязі 1 % ринкової вартості недеревних ресурсів.

Майже половина (48 %) респондентів задекларували готовність платити за використання рекреаційних ресурсів (під час відвідування рекреаційно-оздоровчих територій), доступ та якість яких буде поліпшуватися за рахунок їхнього облаштування та підтримки в належному стані. У такому випадку опитувані погоджувалися вносити плату в обсязі від 5 до 20 грн за кожне відвідування. В середньому ця величина становить трохи більше 9 грн. Готовність платити за рекреаційні ресурси негативно корелює з віком опитуваних, а величина плати зростає із рівнем доходу. Середнє значення місячного доходу опитуваних, які погодилися вносити плату, сягає майже 1300 грн. Загалом отримані значення плати збігаються з результатами дослідження у

Львівській області, коли опитувані погоджувалися вносити плату за відвідування заповідників з рекреаційною метою обсягом 5,36 грн за один день відвідування за середнього значення місячного доходу для 63 % респондентів – 500 грн (ймовірно опитування здійснювали в 2004 році) (Kulchytska 2005).

Місцеві жителі мають повний і безперешкодний доступ у ліси з метою здійснення загальних видів користування. Не виявлено конфліктів між підприємством та місцевими громадами (самовільне захоплення або використання земель лісового фонду тощо). Невиявлено фактів дискримінації місцевих жителів під час працевлаштування. Підприємство здійснює підтримку функціонування та розвитку соціальної інфраструктури населених пунктів: ремонт доріг, надання лісоматеріалів та дров для бюджетних установ і організацій. Надає допомогу пенсіонерам і ветеранам, забезпечуючи їх дровами для опалення.

Водночас виявлено низку проблемних питань, а саме: брак поінформованості населення про лісогосподарську діяльність; низький рівень довіри до державних органів управління лісами усіх рівнів; незгода із твердженням щодо здійснення підприємством екологічного безпечного і соціально відповідального використання лісових ресурсів; немає формальних механізмів врахування інтересів місцевих громад у процесі планування та здійснення екологічно і соціально чутливих лісогосподарських заходів; низький організаційний та технологічний рівень здійснення лісогосподарських заходів для мінімізації впливу на навколишнє середовище та збереження недеревних ресурсів лісу.

Попри усвідомлення зазначених вище проблем, у переважній більшості місцеві жителі не готові активно залучатися до управління лісами, перекладаючи відповідальність за це на державні органи влади.

Невідкладними заходами щодо поліпшення співробітництва лісогосподарських підприємств з місцевими громадами є такі:

- використання повною мірою існуючих консультаційних механізмів роботи з місцевими громадами та іншими зацікавленими сторонами (технічні й лісовпорядні наради під час розробки проекту організації та розвитку лісового господарства; спільні наради і засідання, присвячені соціально-економічному розвитку підприємства та сільських територій в зоні діяльності підприємства тощо);
- активне залучення місцевих жителів до лісогосподарських та природоохоронних заходів і акцій (висаджування лісу, прибирання та облаштування рекреаційних пунктів тощо);
- активна співпраця з громадськими інспекторами охорони навколишнього природного середовища та сприяння збільшенню їхньої мережі;
- посилення співпраці з неурядовими громадськими організаціями, зокрема в частині спільної ідентифікації лісів високої охоронної цінності, здійснення заходів щодо їх охорони і збереження;
- поліпшення інформування широкого кола зацікавлених сторін.

25.4 Висновки

За результатами виконаних досліджень можна зробити такі висновки.

1. Застосування такого соціологічного методу досліджень як опитування слугує за ефективний інструмент вивчення соціальних аспектів лісогосподарської діяльності, виявлення проблемних питань взаємодії з місцевими громадами, оцінки відповідності ведення лісового господарства міжнародним стандартам лісової сертифікації.
2. Недеревні лісові ресурси відіграють важливу роль у житті місцевих громад. Критеріями "важливості" недеревних ресурсів для місцевих жителів є радше їхня пряма споживча цінність як харчових продуктів, аніж оздоровчо-рекреаційні корисності, які одержують в процесі збору недеревних ресурсів. Для майже 10 відсотків місцевого населення заготівля недеревних ресурсів є вагомим джерелом поповнення сімейного бюджету.
3. Застосування суб'єктивного методу економічної оцінки недеревних ресурсів серед місцевих жителів завдяки усвідомленню свого традиційного і невід'ємного права на користування благами, які створені природою, є обмеженим. Його можна використовуватися як додатковий механізм уточнення або ж коригування величини плати за спеціальне використання недеревних ресурсів лісу.
4. Майже половина місцевих жителів позитивно сприймає можливість плати за рекреаційні ресурси, отримання яких буде супроводжуватися наданням мінімального набору послуг і зручностей. Це вказує на значні потенційні можливості диверсифікації економічних видів діяльності підприємства за рахунок використання корисних властивостей лісів та підвищення економічної ефективності лісового господарства.
5. Підприємство має значні резерви та невикористані можливості поглиблення взаємодії з місцевим населенням, зокрема з метою залучення до процесу прийняття управлінських рішень, поліпшення його інформованості та підвищення рівня довіри до лісового господарства загалом.

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Chapter 26

Convention on the Protection of the Alps and Convention on the Protection and Sustainable Development of the Carpathians: Comparative Analysis

Anna Storozhuk[1]

Abstract The aim of this study is to give emphasis about some aspects in analysis of both Alpine and Carpathian Conventions. The Alpine Convention was the first regional Convention created worldwide for the protection and sustainable development of a mountain region. The Carpathians are the ideal prosecution of the Alpine Arc and are the largest mountain range of Europe. A necessity in working out and introducing of the Carpathian convention was caused by such main problems of the region: erosion and loss of fertile soil, unfavourable political conditions, promotion of the development of the region was not enhanced; area belongs to less developed areas. The Alpine-Carpathian partnership proved that sustainable mountain development can be advanced considerably through regional and subregional initiatives, cooperation and actions. Both the Alpine and Carpathian Conventions are based on the principle of sustainable development, aiming at conservation of the outstanding cultural and natural heritage of the region as the basis of its sound development.

26.1 Introduction

Over the last years the world has realized the need for completely new values and criteria for assessing human activities, for a fundamental transformation in the concept of efficiency of social processes. It has resulted in a radically new format of social development. The global tasks of mankind, problems of conserving and

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protecting natural habitats and world heritage sites, principles of systematic ecological and social development are widely discussed in scientific literature in the context of sustainable development.

At the United Nations Conference on Environment and Development (UNCED) sustainability was recognized as a main principle for contemporary and future development. Agenda 21 adopted on the conference is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations System, Governments, and Major Groups in every area in which human impacts on the environment can take place. Chapter 13 of the Agenda defines Mountains as an important source of water, energy and biological diversity. They are recognized as an source of such key resources as minerals, forest and agricultural products, and important areas for recreation development. As a major ecosystem representing the complex and interrelated ecology of our planet, mountain environments are essential to the survival of the global ecosystem. Mountain ecosystems are, however, rapidly changing. They are susceptible to accelerated soil erosion, landslides and rapid loss of habitat, and genetic diversity. In terms of human aspect there is widespread poverty among mountain inhabitants and loss of indigenous knowledge. As a result, most global mountain areas are experiencing environmental degradation. Hence, the proper management of mountain resources and socio-economic development of the people deserves an immediate action. That is why introducing and establishing of international programs, plans and other normative documents for sustainable development of mountain regions are one of the most important aspects.

26.2 The Alpine Convention

The Alpine Convention is the first international agreement aimed at the protection and promotion of sustainable development in a transboundary mountain region. It is intended to protect the natural ecosystem of the Alps and to promote sustainable development in the area, whilst fully promoting the economic and cultural interests of the populations residing in the member Countries.

In order to reconcile the protection of the natural ecosystem of the Alps with a proper social and economic development, the Countries of the Alpine Arc, who met for the first time in Berchtesgaden from October 9th to 11th 1989, have decided to sign the Alpine Convention. The Convention was signed by the Contracting Parties on November 7th 1991 in Salzburg and it entered into force on March 6th 1995. The member Countries that have joined the Convention are: Austria, France, Germany, Italy, the Principality of Monaco, Liechtenstein, Switzerland, Slovenia, and the European Community.

The Alpine Convention is a Framework Convention and, as thus, it just defines the general principles. The details concerning the implementation of the Convention are laid down by the Protocols, which have successively been adopted by the Member States in the following areas:

- regional planning and sustainable development
- protection of nature and landscape

- mountain farming
- mountain forests
- soil conservation
- tourism and recreation
- energy
- transport
- conflict resolution

Further Protocols are envisaged in the future and they will concern the following thematic areas:

- water management
- prevention of air pollution
- waste management

Italy ratified the Alpine Convention under Law 403 dated October 14th 1999. According to this law, the Ministry of the Environment and Territory is entrusted with the task of implementing the Convention in agreement with the Ministries interested in the respective Protocols, and with the State-Region Conference of the Alpine Arc, a body allowing the necessary co-ordination with the autonomous regional and sub-regional authorities involved in the implementation of the Convention (EURAC research 2008).

Programs and plans are established with a view to identify the needs and measures required to conserve nature and the countryside in the Alpine region.

Measures aimed at promoting conservation and the development of natural and semi-natural habitats of wild plant and animal species as well as other structural features of nature must be developed consistently according to local planning and on the basis of reports.

Mountain farming must be promoted which means accessing mountain areas in their country context as part of land use planning, zoning, the reorganization and improvement of land use respecting nature and the countryside landscape. Farming compatible with the environment and suited to the location are considered of the utmost importance: conservation or the regeneration of the traditional features of the rural environment – such as woodland, woody boundaries, hedges, thickets; wet, dry, or low yield pasture, upland pastures- and their farming. Special measures for the conservation of traditional farms and rural architecture are also included as well as further use of traditional building materials and methods.

The Protocol also includes soil protection as part of the conservation area, when soil requires it. In principle, the Protocol set limits on use of the soil and land, as well as a limited use of ore, and mining or quarrying in the areas.

The protection of nature and countryside have to be contextualised with the needs of the tourist industry and incentives. The Contracting Parties undertake an initiative to encourage compatible projects respecting nature and the landscape 'as far as possible'. The Protocol also makes provisions for ongoing comprehensive research into tourist industry supply, bearing environmental issues in mind. Exchange of experiences and the development of common action programs aimed at raising standards are also included. Tourist flow plans and measures will be included considering that tourist growth may have to be suited to the special features of the environment and of the resources available in the area or the region involved.

Renewable energy sources should be preferred and used: hydroelectric facilities must preserve the environmental operativity of waterways and landscape integrity. Minimum output thresholds are to be defined, as are the adoption of regulations aimed at reducing the artificial variations in water levels and the defence of animal migration. Furthermore, existing hydroelectric facilities will receive support to remain competitive and the water system must be protected especially in areas where drinking water must be preserved. The buffer areas, and conservation zones as well as wild natural areas and countryside landscapes will be preserved.

Fossil fuel energy production has to make use of state of the art technology and in the event of fossil fuel thermal plants needing to be replaced, the option of switching to other energy sources will be considered.

The Alpine Convention is a treaty under international law with the purpose to preserve and protect the Alps by ways of a sustainable, universally applicable policy encompassing a wide range of aspects.

The main objectives of the Convention are the protection of the Alpine territory and the safeguarding of the interests of the people inhabiting it, embracing the environmental, social and economic dimensions in the broadest sense. In order to achieve this objectives, over the years the framework treaty has been equipped with a large number of thematic protocols. The associated protocols that enable the Alpine Convention are implemented in such areas: spatial planning and sustainable development, mountain forests, mountain farming, soil protection, energy, protection of nature and landscapes, tourism and transport.

The Alpine Convention and its Protocols are not about finding a standard solution for sustainable development in the alpine region. Instead it is about highlighting the existing diversity of conditions and parameters, and preserving a sustainable environment.

26.3 The Carpathian Convention

Another valuable mechanism for sustainable development of the mountains is the Carpathian Convention that represents another tool in terms of biological and cultural diversity conservation.

The Carpathians are not just one of Europe's largest mountain ranges but it is also a unique natural heritage resource with great aesthetic beauty and ecological value, and a source of the headwaters of major rivers. They also constitute a major ecological, economic, cultural, recreational and living environment in the heart of Europe, shared by numerous peoples and countries.

The Carpathians are an important reservoir for biodiversity, and Europe's last refuge for large mammals- brown bear, wolf, and lynx, habitat to populations of European bison, moose, wildcat, chamois, golden eagle, eagle owl, black grouse, plus many unique insect species.

Over the last twelve- to fifteen years in the countries that belong to the Carpathian region the was uneven regional development with its consequences, the regional crisis was not only a problem for geographers, economists and sociologists but the governments of the participating countries and the leaders of the country and settlement levels also became concerned about it. Uneven regional growth was understood similarly both by the researches and the politicians: the positive results of market economy were concentrated into a few "privileged places", in the centers, while negative outcomes were remind in the regions without production outputs.

Most of the regions were suffering from environmental problems, lack of infrastructure, unemployment, problems of economical co-operations and political, psychological, and socio-cultural problems. Besides the creation of cross-border development programs and the effective operation of partnerships came up against difficulties. The situation was further complicated by the preconditions of the use of the various EU funds which these usually require integrated programs planned for a long-term period although the majority of the programs in these regions were sector oriented and were not planned for more than one or two years.

The regional structure of the area was being transformed very slowly. Some of its elements– such as the settlement system could change over centuries while other components – like infrastructure and communication network changed in decades. Despite of these general arguments there were relatively rapid changes in the state of the economy, in the urban gravitation zones, in the employment and regional mobility of the population on the area of the Carpathian region.

It may be admitted that the past twelve- to fifteen years there we such fundamental socio-economic changes in the Carpathians. These changes suddenly brought to the surface some hidden regional processes which have been formed for a long time. The new phenomena could explained by two sets of reasons:

- increase in the ratio of the private sphere, the beginning of market economy and the direct relationship between the economic actors and the international economy;
- the spatial processes

The economic transformation process and recession following the transition in the Carpathian region caused a serious shock for all member countries. The economic recession first appeared in Poland and Hungary and the further regression of the production was also the first to appear in these countries. In the other three countries the hesitations around the privatization processes prolonged the interval of the transition. At the same time, it may be observed that due to their lower industrialization level the regions belonging to the Carpathian region were less affected by the industrial recession of the 1990^{th}. The share of the agricultural areas in the five countries – because of the mountains of the region– was smaller than its share from the total area due to the physical geographic conditions of the region. Only Hungary is an exception from this correlation where the extent of lowlands was relatively high, and the ratio of forests and pastures was much higher from the total area in Carpathian region then anywhere else.

The transformation of the economies of the Carpathian region happened by circumstances causd by a crisis. Rural population of the Carpathian region had to endure a series of unpleasant (external and negative) impacts, like a floods which made life drastically more difficult. The unemployment due to the decrease in the production of the large-scale industry built on the export to FSU countries, the liquidation of business facilities with obsolete equipments in the countryside and the rapidly growing rate of unemployment had significant role in this process. As a consequence of the economic and political crisis in the large scale farms the rural social guarding net became more and more pulled apart which to be not negligible establishing factors in some countries until early nineties (Strategic Development Programme 2004).

As a conclusion we can say that there was a great demand for the development of the border regions of the Carpathian countries through a common regional development policy. The cooperation was needed both for economic, environmental and political reasons.

Transition to a market economy, increasing and integrating role of the civil society and dynamic economic development imply profound changes and challenges. The Carpathians are shared by seven Central and Eastern European Countries. This increases the possibilities of sustainable development based on the rich natural, environmental, cultural and human resources of the region, and for preserving its natural and cultural heritage for future generations.

A Framework Convention on the Protection and Sustainable Development of the Carpathians has been signed in 2003 in Kyiv (Ukraine) by 7 countries: Czech Republic, Hungary, Poland, Romania, Serbia and Montenegro, Slovak Republic and Ukraine. After the ratification by the first 4 countries (Czech Republic, Hungary, Slovak Republic, Ukraine) the convention entered into force in January 2006. The United Nations Environment Program (UNEP) acts as the Interim Secretariat of the Carpathian Convention.

In 2001, United Nations Environment Program / Regional Office for Europe UNEP/ROE was requested by the Government of Ukraine to service a regional cooperation process aiming at the protection and sustainable development of the Carpathian Mountains, a major transboundary mountain range shared by the seven different countries. In response to this request, UNEP/ROE promoted an Alpine-Carpathian Partnership. In 2002, during the UN International Year of the Mountains, the Alpine-Carpathian partnership has been initiated and launched by the Ministry of the Environment and Territory of Italy, at the time President of the Alpine Convention. Since then, UNEP/ROE serviced five negotiation meetings of the Carpathian countries. At the Fifth Ministerial Conference "Environment for Europe" (Kyiv, May 2003), the Carpathian countries adopted the Framework Convention on the Protection and Sustainable Development of the Carpathians consequently signed by all seven countries.

The Parties acknowledged that the Carpathians are a unique natural treasure of great beauty and ecological value, an important reservoir of biodiversity, the headwaters of major rivers, an essential habitat and refuge for many endangered species of plants and animals and Europe's largest area of virgin forests. The Carpathians constitute a major ecological, economic, cultural, recreational and living environment in the heart of Europe shared by numerous peoples and countries. The Parties also realize the importance and ecological, cultural and socio-economic value of mountain regions, which prompted the United Nations General Assembly to declare 2002 the International Year of Mountains. The importance of mountain areas is outlined in Chapter 13 (Sustainable Mountain Development) of the Declaration on Environment and Development ("Agenda 21", Rio de Janeiro 1992), and in the Plan of Implementation of the World Summit on Sustainable Development. The Parties recall the Declaration on Environment and Sustainable Development in the Carpathian and Danube Region (Bucharest 2001). They recognize that the Carpathians constitute the living environment for the local people, and acknowledge the contribution of the local people to sustainable social, cultural and economic development, and to preserving traditional knowledge in the Carpathians. The Parties also acknowledge the importance of sub-regional cooperation for the protection and sustainable development of the Carpathians in the context of the 'Environment for Europe' process. The experience gained in the framework of the Convention on the Protection of the Alps (Salzburg 1991) is recognized as a successful model for the protection of the environment and sustainable development of mountain regions, providing a sound basis for new partnership initiatives and further strengthening of cooperation between Alpine and Carpathian regions.

The Parties are supported a comprehensive policy and cooperate for the protection and sustainable development of the Carpathians with a view to inter alia improving quality of life, strengthening local economies and communities, and conservation of natural values and cultural heritage.

In order to achieve the objectives the Parties must take appropriate measures by promoting:

- the precaution and prevention principles,
- the 'polluter pays' principle,
- public participation and stakeholder involvement,
- transboundary cooperation,
- integrated planning and management of land and water resources,
- a programmatic approach,
- the ecosystem approach.

To achieve the objectives set forth in this Convention and to ensure its implementation, the Parties may, as appropriate, develop and adopt Protocols.

The Parties must apply the approach of the integrated land resources management, by developing and implementing appropriate tools, such as integrated management plans, relating to the areas of this Convention.

The Parties have to pursue policies aiming at conservation, sustainable use and restoration of biological and landscape diversity throughout the Carpathians. The Parties have to take appropriate measures to ensure a high level of protection and sustainable use of natural and semi-natural habitats, their continuity and connectivity, and species of flora and fauna being characteristic to the Carpathians, in particular the protection of endangered species, endemic species and large carnivores.

The Parties have to pursue policies of spatial planning aimed at the protection and sustainable development of the Carpathians to consider the specific ecological and socio-economic conditions in the Carpathians and their mountain ecosystems, and provide benefits to the local people.

The other articles of the convention contain the following: spatial planning; sustainable agriculture and forestry; sustainable transport and infrastructure; sustainable tourism; industry and energy; environmental assessment/information system, monitoring and early warning; awareness raising, education and public participation; conference of the parties; secretariat; subsidiary bodies; financial contributions; protocols; amendments to the Convention; settlement of disputes; entry into force, withdrawal; depositary.

One aspect that has been extensively discussed already in the preparatory phase is the delimitation of the area the convention applies to. Several delimitation proposals have been presented by the member countries and by non-governmental organizations, but no final definition of the area was approved. The intrinsically political nature of defining boundaries in space, including the difficulties of seeking biophysical justifications for a political project, has already been stressed.

Therefore, the Framework Convention therefore does not contain a precise delimitation of the convention area but states that it will have to be defined by the Conference of the Parties. In this context EURAC-Research has been asked by UNEP to present a scientific approach for a homogenous, transnational delimitation of the Carpathian Convention. Furthermore a possible delimitation, based on the principles developed, was presented.

The choice of the perimeter of the Carpathian Convention is of strategic importance for its implementation as it defines the area in which the signatory states will pursue their sustainability strategy specifically developed for the region. The perimeter must therefore represent the Carpathian region in such a manner that the convention can really become affective. At the same time, the perimeter must be acceptable at the political level and comprehensible for the local inhabitants.

The methodology developed is based on the 5 principles:

- integrated approach based on the thematic goals of the convention,
- transnational delimitation criteria,
- global and local characteristics,
- administrative units,
- stepwise, transparent approach

Looking for principles and guidelines for the delimitation of the Carpathian Convention area one necessarily has to begin with the Convention itself and from the objectives specified. (Kozlowski, Haladyj 2006)

The "Framework Convention on the Protection and Sustainable Development of the Carpathians" is a transnational mountain convention. The title itself already specifies the main goals of this treaty. On one side there is the protection of the natural richness of the Carpathians, on the other the is the sustainable development of this mountain area. Therefore, the convention consider the Carpathian area from a holistic perspective covering all its characteristics, sensitivities, and potential for development, and has a purpose to derive a common policy for the region as a space for human settlement, nature protection, culture, business, and recreation.

The Carpathian Convention is a framework type convention pursuing a comprehensive policy and cooperating for the protection and sustainable development in the Carpathians. Designed to be an innovative instrument to ensure protection and foster sustainable development of this outstanding region and living environment, the Convention is willing to improve the quality of life, to strengthen local economies and communities. It aims at providing conservation and restoration of unique, rare and typical natural complexes and objects of recreational and other significance located in the heart of Europe preventing them from negative anthropogenic influences by the promotion of joint policies for sustainable development among the seven countries of the region (Czech Republic, Hungary, Poland, Romania, Serbia and Montenegro, Slovak Republic and Ukraine).

26.4 Economic Analysis of the Carpathian region

The analysis of economic structure, demographic processes and the level of qualification in the Carpathian region revealed the shortages and advantages in the region. The following negatives and positives:

- highly qualified population,
- high share of forest area, developed forestry,
- economic accessibility, good transportation,
- developed infrastructure,
- enterprises based on local natural resources,
- production cooperation,
- multiple job opportunities,
- full scale supply of training,
- high income level,
- successful lobbying activities.

The strengthening of the deficiencies may result in the intensification of the lagging behind of the Carpathian region and thus

- new and dynamic sectors do not come to stay without the presence of highly qualified staff;
- if the international relations turn unfavourable then the geographic situation of the region might produce further disadvantages;
- the lack of positive changes in the transport situations of the wider part of the region may intensify the peripheral situation and may result in further disadvantages in the competition of getting access to the investments and foreign direct capital;
- the decrease of the population and impoverishment may become irreversible in the seriously underdeveloped settlements and regions due to the slow decentralization of the regional development funds;
- the local and regional self-governments which lack capital and resources do not have necessary capacity for the tenders;

Overs:

- willingness to cooperate;
- transfer role;
- beautiful natural landscape;
- arable land;
- nature conservation areas;
- organizational (professional)culture;
- social sensitivity

The enhancement of the surpluses increases the chances of the attempts for breaking out, including the following:

- through the willingness to co-operate the lobby activities may be improved in the region;
- the strengthening of the transfer role may contribute to intensification of the participation of the Carpathian region in cross-border co-operations;
- the spread of the sustainable development approach may increase the inclination of the settlements and settlement associations to execute joint environment-friendly infrastructural elements;
- the intensified protection of the sensitive nature conservation areas may odd the ecological potentials of Carpathian region;
- the implementation of estate re-allocation, the authoritative registration of land-use and the target oriented support system would make possible the development of adapted to landscape arable land-use, environment-friendly farming, wildlife management, etc. and would help the development of the EU-conform of the agriculture;
- as a consequence of the EU- membership of Hungary, Poland and Slovakia, the expected intensification of the Ukrainian and Romanian relations may contribute to the upgrading of a geographic location of the region, and thus this region may also become attractive for the foreign capital and tourism with the better utilization of the comparative advantages and strengthening of international co-operations.

The key issue of the near future in the Carpathian region is that how efficient will entrepreneurs produce high quality goods with a help of an affective support system (investment supports, vocational training etc.) which will mainly have to be formed in parallel with – but by all means separately from – the educational-training elements of the environmental and social supportive forms. Resource, environmental and other conflicts might be avoided by the leaders of the member countries of the Carpathian region if they set as a goal the social evolution, environmental harmony and economic development together with the development of human resources.

26.5 The Alpine-Carpathian Partnership

The first regional Convention created worldwide for the protection and sustainable development of a mountain region was the Alpine Convention involving seven alpine countries, their local authorities, NGOs and European Community. Since the seventh meeting of the Alpine Conference, the contracting parties have supported the establishment of mountain partnerships outside the alpine area (focused in the Carpathians, the Caucasus, Central Asia and the Balkans). The Carpathians are the ideal prosecution of the Alpine Arc and are the largest mountain range of Europe and that is why the Alpine countries and several players of the Alpine Convention decided to support the efforts of the seven Carpathian countries being involved in the negotiation process. The Alpine-Carpathian partnership proved that sustainable mountain development can be advanced considerably through regional and subregional initiatives, cooperation and actions. In order to be successful and achieve lasting results, cooperation among mountain region must address a great variety of interlinked issues in an integrated way: agriculture and forestry; energy and transport; landscape planning and water basin management, and sustainable tourism and biodiversity protection. Partnerships such as the Alpine-Carpathian one with the interaction among different actors have proven themselves to be useful approaches and powerful incentives for mountain-related actions as well as frameworks of the creation of sub-partnerships focusing on specific topics. The achievement of such broader implementation UNECE (United Nations Economic Commission for Europe) region of the principles of the integrated land recourse management in the mountain areas would provide substantial benefits to their social and economic development.

Thus, the Framework Convention on the Protection and sustainable Development of the Carpathians became the second sub-regional treaty-based regime for the protection of a mountain region worldwide, after the Alpine Convention. Both the Alpine and Carpathian Conventions are based on the principle of sustainable development, aiming at valuing and safeguarding the outstanding cultural and natural heritage of the region as the basis of sound development. The Conventions strive to draw a balance between economic progress and social and environmental protection. This is the major challenge taking into account the particular economic, social and geographic features of the mountain countries. The Alpine Convention provides a successful model for coordinated or joint international action for protection of mountain ecosystems. The Berchtesgaden Declaration on Mountain Range Regional Cooperation recognized "the global significance of the lessons provided by the Alpine Process as the only example worldwide of a legally binding intergovernmental mountain agreement", and stated further that the Convention has evolved – despite some difficulties – into a successful platform for regional exchange and negotiations and sustainable development. The Alpine Convention was caused by the need to have common mountain policies for tourism, transport, forest management, agriculture, physical planning, economics, protected areas and energy. The problems faced in the Alps, including extensive tourism and traffic, are specific to those mountains. As the EU expands eastward, some of these problems can be expected to also develop in the Carpathians. In addition, poverty and unemployment are among the problems to be tackled through a sustainable use of the natural resources of the Carpathians. The Carpathians regime will benefit greatly from the 16 years experience of the Alpine Convention as the earliest international legal instrument of the protection of the mountains. In 2002 experts from the Alpine and the Carpathian countries met in Bolzano for the Conference entitled "Sharing the experience". During the meeting, the determination to develop the Carpathian Convention was confirmed with the help of the Alpine experts, and agreement was reached on potential elements to be included in the convention. It also gave shape to the Alpine-Carpathian partnership, through which individual Alpine countries supported cooperation on the Carpathians and the development of the Convention.

The approach taken in both Conventions to integrate and link various sectoral concerns should be considered also while also developing the future thematic protocols of the Conventions, with a view to avoid conflicting aims and to ensure a coherent approach. The implementing experience of the Alpine Convention will be extremely valuable for the Carpathian countries in this respect.

The transition to market economy system and the accession to the European Union of Carpathian countries represent a significant change in the socio-economic system of the region and a challenge for the future in terms of combining economic and infrastructural development with environmental protection concerns. In moving towards joining the EU, the Carpathian region can positively benefit from European legislation such as the Water Framework Directive, the directives on Environmental Impact Assessment and on Public Access to Environmental Information, and the Birds and Habitats Directives.

Considering that the Carpathians are a natural resource, which belongs both to the countries that own it and to all Europe as well, the Framework Convention represents an investment for the future. It is hoped that the process of implementing the Convention will help to preserve the natural treasures of the region, enhance transboundary cooperation and dialogue, and attain sustainable development of the region.

26.6 Conclusion

About 10 per cent of the world's population depends on mountain resources. A much larger percentage depends on such mountain resources as water, biodiversity, recreational areas. Mountains are a storehouse of biological diversity and endangered species. Mountains are highly vulnerable to human and natural ecological imbalance. Mountains are the most sensitive areas to all climatic changes in the atmosphere. Specific information on ecology, natural resource potential and socio-economic activities is essential. That is why sustainability is the main principle that is able to provide a careful use of mountain resources.

As a result, we can say that sustainable development is the main principle on which both the Alpine and Carpathian Conventions are based. A concept of sustainability represents a response to unsustainable use of renewable goods and services ultimately aimed at the sustainable use of natural resources based on satisfying ecological, economic and social values. The use of forests, forest lands, water and all living resources as well as cultural (human) components must be provided in a way that promotes sustainable use and conservation to fulfill, now and in the future, relevant ecological, economic and socio-cultural functions of landscapes at multiple scales through good systems of governance with the participation of all concerned stakeholders.

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Альпійська конвенція та Конвенція про охорону та сталий розвиток Карпат: порівняльний аналіз

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Метою цього дослідження є аналіз Альпійської та Карпатської конвенцій. Альпійська була першою регіональною конвенцією міжнародного рівня, її мета – захист та сталий розвитку гірського регіону. Карпатські гори є однією з найдовших гірських систем у Європі. Потребу розроблення та впровадження Карпатської конвенції спричинили такі основні проблеми: ерозія та втрата родючих ґрунтів, несприятливі політичні умови, відсутність відповідного заохочення для розвитку регіону, належність регіону до слабко розвинених територій. Альпійсько-Карпатське співробітництво змогло довести, що сталий розвиток гір може бути забезпечений за підтримки регіональних ініціатив, проектів та дій. Альпійська та Карпатська конвенції засновані на принципах сталого розвитку, а також мають за мету збереження природної та культурної спадщини регіонів.

Chapter 27

Sustainable Forest Management from Policy to Practice, and Back Again: Landscapes as Laboratories for Knowledge Production and Learning in the Carpathian Mountains

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Abstract Ukraine is currently in a rapid and complex transition from socialist planned to market economy. The current Ukrainian forest and woodland policy issues include introduction of sustainable forest management, increasing the forest cover, forest certification, land privatisation, development of recreation infrastructure as well as securing ecosystem services, cultural heritage, and biodiversity conservation. Sustainable development as a continuous process and sustainability as a long-term goal have thus started to engage new actors and stakeholders. Management and governance in this new situation implies a need to include not only stand and local spatial scales, but also regional as well as national and international levels. An important challenge is to maintain and build social and ecological infrastructures within a landscape, i.e. a geographical area with actors involved with different sustainability dimensions, actors in different sectors and at different societal levels. Communication, education and public awareness are critically important, together with the need for transparent information for decision-makers exercising governance based on information about the state and trends of ecological, economic, social and cultural dimensions of landscapes as social-ecological systems. The term landscape approach captures this and can be operationalised by supporting traditional village systems or applying concepts such as Model Forest and Biosphere Reserve. Located in the very centre of Europe, the globally recog-

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nised Carpathian Mountain range with its diversity forests and cultural landscapes has a complex geopolitical history. A comparative study approach looking at landscapes in different regions and countries with different governance legacies and economic histories is one way of understanding how different societies attempt solving this issue. We discuss the need to develop (1) accounting systems for different sustainability dimensions so that actors and stakeholders are provided with transparent information about states and trends, and (2) tools for adaptive governance and management at multiple scales. We then present an approach in seven steps that encourages applied interdisciplinary collaboration between non-academic and academic actors for knowledge production. Finally, we discuss the challenge of learning where practice, education and research are integrated to address and solve real world problems.

27.1 Introduction

According to the Carpathian Convention (2003, www.carpathianconvention.org) the Carpathian Mountains are "a unique natural treasure of great beauty and ecological value, an important reservoir of biodiversity, the headwaters of major rivers, an essential habitat and refuge for many endangered species of plants and animals and Europe's largest area of virgin forests". In addition the Convention states that "the Carpathians constitute a major ecological, economic, cultural, recreational and living environment in the heart of Europe, shared by numerous peoples and countries".

Since the appearance of the sustainability discourse during the late 1980s a range of international and national policies related to ecologically, economically, socially and culturally sustainable use of renewable natural resources have been formulated (e.g., Innes and Hoen 2005, Havnevik et al. 2006, Mayers and Bass 2004). Actors and stakeholders involved with management and governance of natural forests and cultural woodlands in rural regions are thus subject to the challenges of implementing sustainability policies on the ground in actual landscapes. Traditional sustained yield forestry and agriculture systems are thus challenged with demands of supplying a broader range of goods, ecosystem services and landscape values than wood, fibres, energy and food (e.g., MCPFE 1993, Angelstam et al. 2005, Birot et al. 2005, Merlo and Croitoru 2005).

Implementing these ecological and socio-cultural dimensions of sustainability is consistent with the view that a landscape is an integrated social-ecological system, with components, structures and processes at different scales and different levels of organisation (e.g., Berkes et al. 2003). At the Pan-European policy level the European Landscape Convention captures this (Anon. 2000). At the same time there is a strong desire to satisfy market demands by increased production of goods, rather than ecosystem services and ecological and socio-cultural values. On top of this there is a need of considering uncertainties relating to climate change (Johnston and Williamson 2007), and globalisation (Havnevik et al. 2006). Dealing with this complexity is a paramount challenge for society in the quest for genuine progress.

With regard to forest and woodland landscapes sustainable development as a process and sustainability as a long-term goal have thus started to engage new actors and stakeholders concerning the use of goods, ecosystem services and landscape values, and the identification and development of products from these natural resources. To implement the vision of sustainable forest management (SFM) (e.g., Higman et al. 2004) it is necessary to continue with efficient wood production, and at the same time expand beyond the traditional forest sector to include also other sectors involved with for example rural development and biodiversity conservation. This implies a need to plan and manage not only at stand and local spatial scales, but also at regional as well as national and even international levels. A key challenge is thus to build bridges in a geographical area among actors involved with different SFM dimensions, actors in different sectors at different societal levels, and different disciplines to facilitate knowledge production and mutual exchange of experiences (e.g., Barbour et al. 2004, Borrini-Feyerabend et al. 2004, Blagovidov et al. 2006). Communication, education and public awareness are therefore important to support implementation of SFM, as is the case for its different criteria including ecological (e.g., Convention on Biological Diversity), socio-cultural ones (e.g., European Landscape Convention) and spiritual ones (e.g., the IUCN/WCPA "Delos Initiative"). The term landscape approach captures this integrated approach to knowledge production and learning for sustainable development and sustainability (e.g., Dudley et al. 2006, Singer 2008).

A paramount challenge is to translate to practice the landscape approach as a tool to implement the principles of SFM via policy level criteria and indicators to management practices in actual landscapes on the one hand, and how innovations that appear locally and regionally can be extracted and affect policy on the other. There are two important challenges that actors and stakeholders at multiple levels (local forest management unit (FMU), regional, national and global) are faced with. First, there must be transparent information about both states and trends or different sustainability criteria (economic, ecological, social, cultural and spiritual) based on suites of indicators that make it possible to operationalise the SFM principle within a management unit. To assure sustainability as defined in official and company policies performance targets for indicators often need to be formulated for different forest and societal contexts (e.g., Angelstam et al. 2004, Villard and Jonsson 2009). Second, tools for adaptive governance and spatial planning are needed at multiple spatial and temporal scales in a geographical area (e.g., forest management unit, geographical landscape, administrative unit, catchment) with multiple actors and stakeholders representing private, public and the civil sectors of society (e.g., Borrini-Feyerabend et al. 2004).

In this paper we focus on how knowledge production and problem-based learning approaches in education and vocational training can be developed using landscapes with different histories in the Carpathian Mountains as natural experiments (sensu Diamond 1986, see also Angelstam 2006)) and laboratories for knowledge production and learning to support communication, education and public awareness (cf. www.cepatoolkit.org). As a concrete introduction, based on results from a workshop with local and regional stakeholders held raion Turka in November 2008, we present the range of issues local challenges stakeholders are faced in the Carpathians Mountains. However, to implement policies aiming at satisfying ecological, economic and socio-cultural dimensions, as SFM, the context of a landscape in terms of environmental history, biophysical conditions and models for government and governance need to be considered (Angelstam and Törnblom 2004). To implement a landscape approach in practice we summarise the main challenges in terms of knowledge about the state and trends of different sustainability dimensions, and the development of platforms for local and regional governance. Further, responding to the need for applying new approaches to knowledge production and learning (e.g., Tress et al. 2006), we describe a systematic step-wise integrative research approach in seven steps towards realising the vision of sustainable natural forest and cultural woodland landscape management and governance. The empirical base should be a suite of existing local and regional development initiatives as case studies, or landscape laboratories (Angelstam and Törnblom 2004, Angelstam et al. 2007a, b). Finally, as an example of developing learning, we describe the contents of the ongoing co-operation between the Swedish and Russian forest sectors and educations units about how to translate SFM policies to practice by mutual learning (see also Angelstam and Elbakidze 2007, Angelstam et al. 2007a). The discussion focuses on the need to bridge existing gaps between practice, policy, education as well as research in human and natural sciences in general, and in Ukraine in particular.

27.2 Development Issues in the Carpathian Raion Turka

During a two-day workshop in November 2008 held in the raion Turka, located in the Carpathian Mountains in Ukraine's Lviv region, 28 local politicians, managers and stakeholders interested in forest landscape issues and governance systems for management of natural resources (goods, ecosystems services and landscape values) discussed the opportunities and obstacles for local and regional development. Presentations were made about governance, management and assessment of the Turka raion's wood and non-wood goods, ecosystem services and natural and cultural values as foundations for economic and socio-cultural development. Viewing the Turka municipality (raion) as a social-ecological system, or simply a landscape, we summarise the participants' perceived issues and challenges for local development. The Turka raion is made up of a series of shallow valleys and highland plateaus with traditional villages with gardens, fields and grasslands. These valleys are separated by mountain ridges with Norway spruce and mixed beech and fir forest, and a few tops above the tree line. The development issues brought up by the participants included forestry as the first and then agriculture, tourism, settlements, nature conservation, transport infrastructure and industry. In the discussion section we suggest and approach for how democratic governance could be strengthened at local to international levels.

27.2.1 Forestry

Forests cover around 40 % of the Turka raion. Tree species composition was changed from beech and fir to introduced German and Austrian Norway spruce provinces already during the times of the Austro-Hungarian Empire before 1919 and Polish government until WW2. At higher altitudes and in remote valleys natural mixed beech-fir forests are found, and the upper tree line in the mountains is formed by native Norway spruce provenances. During the Soviet time logging volumes were higher than today. At present there are several forest enterprises in the area. They harvest almost the entire estimated annual allowable cutting volume. During recent years there has several flooding events associated with heavy rains, and there is hot discussion about how and if forestry affects on flooding events. Logging operations have approached villages. Logging thus interferes with local users' harvest of berries and mushrooms, the roads to villagers' fields are damaged, and heavy truck traffic on narrow roads involves risks to people and domestic animals. Local people do not accept all rules of logging operations. For example, according to the rules all wood should be taken out of the forest. The consequence is that no fuel wood is left that local people can use for fuel. Forest roads are absent or poor and creeks are often used as forest roads, and thus damaged. The Turka raion earns small incomes through the stumpage fees, but the bulk of wood-based incomes go the state as taxes paid by enterprises and to actors outside Turka. Nevertheless forestry creates jobs in the Turka region, both directly in forestry and in the transport sector. Careless and unplanned harvesting on steep slopes has in several cases lead to land slides and erosion. Hence, the perceived usefulness of local forestry as it is carried out today was limited among the participants of the meeting.

27.2.2 Agriculture

Since hundreds of years the Turka raion could be characterised as a traditional village system. This involves zoning from houses, village roads and gardens, often in the valley bottom, and fields, grasslands on the hill slopes on the one hand, and a local system of governance on the other (Elbakidze and Angelstam 2007). During the Soviet time collective farming was introduced. Today subsistence farming is important, but the overall production of agricultural products has declined compared with the Soviet period. The main local product is meat from cattle that graze on large upland grasslands. However, cattle numbers are decreasing because old people can not manage as much, and young family members leave the area. There is no working market for local products. Three milk factories in the region accept milk but offer very low prices (10 litres of milk costs one Euro). The main trend is that the agricultural land is abandoned, and junipers and deciduous trees are encroaching. This change from traditional land use will change the cultural landscape with traditional villages, and thus the landscapes' attractiveness for tourists.

27.3.3 Tourism

Providing services for tourists is seen as the main future new business sector. Compared with other areas such as the neighbouring Skole raion, tourism enterprises are new landscape actors in Turka. To improve the accessibility of the area there is a need for improvements of roads with respect to both state long distance trunk roads and municipal roads. There is one road building company that has monopoly, but the view is that it acts on its own with respect to planning, road building and control. An oblast (regional) level programme supports tourism by loans. However, interest among local tourist entrepreneurs is low because the bank interest is very high (up to 30 %). It is almost impossible to get credit for investments. There is no real tourism agency in Turka. However, some information about tourism opportunities can be obtained from the Turka raion web site. There is a desire to create a plan to maintain cultural landscape values in a few selected villages as a critically important tourism infrastructure.

27.4.4 Settlements

There are 65 villages and 2 towns (Turka and Borinya) in the Turka municipality. The main demographic trends are population decline, and that old stay and young leave without coming back. The numbers of abandoned and seasonally used houses are increasing. City people buy land, which sometimes means that locals cannot expand their farms to provide opportunity for children to settle. During the Habsburg period there were forest commons and private forest, and villagers used the entire forest and woodland landscape. There is concern that villagers do not own forests today. However, there are both proponents and opponents for allowing private forest ownership. This discussion is focused on the competence needed for owning and managing forest. The traditional look of the villages is changing very fast. Villages as a socio-cultural units are degraded. There is corruption in local administrations about how land is distributed. There are very few job opportunities for local people. The main employer is the public sector (schools, health care, administration, culture centres and libraries).

27.5.5 Nature Conservation, Transport Infrastructure and Industry

Turka raion hosts one Biosphere Reserve, two regional landscape parks and a part of the Skole Beskid National Nature Park. There was a desire to establish another regional landscape park, but local people did not approve. The ecological consciousness in Turka is high, but people do not want to be restricted in the use of the landscape. The general perception was that protected areas do not fulfil their functions well. Regarding transport infrastructure there is a road building monopoly. This enterprise gets money from the state. The participation of local stakeholders in planning and design is poor. There is good market for public transportation. Finally, consideration industry, expect for a few small local sawmills there is no industry in Turka.

27.6 From Policy to Practice, and Back Again

27.6.1 SFM, Criteria & Indicators (C&I), and Performance Targets

SFM is a principle that needs to be broken down into broad topics (criteria) and variables (indicators) to be operationalised in actual forest management units (e.g., Higman et al. 2004). This came out clearly from the workshop in Turka, even if SFM policy was not referred to explicitly. Defining, measuring and evaluating what sustainable forest management actually is in practice is not easy, but in the last decade there has been considerable effort to do that by numerous international, national, regional and business initiatives that use criteria and indicators as a way of operationalising the SFM principle (Mayers and Bass 2004). Policies (both official and private) not only define criteria and indicators, but also formulate goals (or performance targets) to be reached to achieve sustainability for a given indicator over a specified time frame. The four most commonly used criteria are economic, ecological, social and cultural. Targets can be short-term and voluntarily negotiated such as forest certification standards (e.g., PEFC and FSC) and politically negotiated environmental quality objectives to be reached within a certain time frame (Higman et al. 2004). The targets can also be long-term and mirror policy statements about sustainability, such as the amount of habitat to maintain viable population of all species (e.g., Villard and Jonsson 2004).

27.6.2 Government and Governance of Forest Landscapes

Ukraine and the other six countries (Czechia, Hungary, Poland, Romania, Serbia and Montenegro, Slovakia) that signed the Carpathian Convention are in a transition from government-based decision-making to multi-level governance. Given transparent knowledge about the state and trends of all dimensions of SFM, forest landscape managers in different sectors thus have to balance the different SFM dimensions by making sure the desirable performance targets are reached without resulting conflicts. There are several examples of conflicts between economic and ecological dimensions. Additionally, emigration of the human population from economically remote areas is a vital problem, which has to be solved also in many other countries (e.g., Lehtinen 2006). This means that SFM also includes how to deal with social issues. As a consequence, forest landscape managers must be able to communicate with a wide range of users and stakeholders involved with goods, ecosystem services and values in forest landscapes, as well as different markets. There is extensive empirical experience to support that when actors and stakeholders in a governance system in forest landscapes represent multiple sectors (public, private and civil) and levels of organisation (local, regional, national, international), then sustainable development and sustainability will be easier to achieve (e.g., Borrini-Feyerabend et al. 2004).

The Carpathian Mountains is a very large and diverse ecoregion. The landscapes have different ecological and economic histories, and potential for economic and socio-cultural development. Therefore the driving forces towards SFM are different in different regions. Given these differences, SFM is best developed and realised by drawing upon place-based experiences from landscapes as social-ecological systems that represent (1) different histories of forest landscape use, and (2) different societal contexts ranging from top-down state government to multi-stakeholder governance.

We argue that it is vital to draw upon experiences from traditional knowledge and village systems (e.g., Elbakidze and Angelstam 2007 and this volume). The traditional village system can be described both as a model of local governance, and as a human habitat including not only a settlement with fields and pastures, but also all the natural forest and cultural woodland landscape's goods, ecosystem services and values. Also sacred groves and forest chapels are typical features of the symbolical landscape, which is important for cultural identity of local people (Davydov 2004). In addition several concepts have appeared during the last decades that aim at sustainability on the ground based on the idea of a landscape approach, such as a Model Forest, EU Leader and Biosphere Reserve (Axelsson and Angelstam 2006, Axelsson et al. 2008).

27.6.3 Linking C&I to SFM by Planning in Space and Time

The two previous sections are consistent with Lee's (1993) mental picture about transparent information about the state and trends of sustainability dimensions as a "compass", and local and regional governance arrangements as a "gyroscope". Planning processes are an important link between these two dimensions. One approach to link criteria and indicators to forest landscape planning is to focus on the spatial and temporal dimensions of planning that links governance and management within a management unit at multiple scales. Ideally, both bottom-up collaborative and communicative, and top-down regional approaches should be combined (Blicharska 2009).

As an example we focus on a fictive geographical area that delivers 2,000,000 cubic meters of timber and pulpwood to sawmills and, pulp and paper industries every year, as is the case in Sweden and Finland. Assuming a growth rate of 4 cubic metres per year the size of the forest management unit would be about 500,000 ha. However, from biodiversity conservation and regional planning perspectives the entire landscape needs to be included, and not only productive forest land. Thus, assuming that forest cover in this region is 50 %, excluding mountains and wetlands, cities and settlements, agricultural and other land covers, this would be equivalent to an administrative region or catchment of about 1,000,000 ha. With the wood supply provided through 2-3 commercial thinnings per forest rotation as in Sweden, the annual allowable cut would be higher, and the management unit thus smaller.

But how large is a landscape from the perspective of an ecological dimension such as population viability of species? Using specialised bird species listed in the EU Birds Directive, Angelstam et al. (2004) estimated the average size of an area hosting 100 females of several specialised boreal forest bird species over a long time with ideal habitat to be ca 40,000 ha. However, also the dynamics of habitat patches in the landscape has to be estimated. As an example, a species using a 20-year period in a succession of 100 years needs an area at least five times as large and well planned for its long-term presence compared with being present in the short term. Using the minimum occurrence thresholds at the home-range and landscape scales it was estimated that the average minimum area needed for 100 females of the same suite of bird species was approximately 250,000 ha for a dynamic managed landscape. However, we do not know how many such local landscapes are needed to maintain a viable population. Assuming that viable populations would need to encompass an effective population of 500 females, the area needed for viable populations would thus exceed 1,000,000 ha for the birds in the example above. Ecological integrity is a higher level of ambition for biodiversity conservation. This means that populations of species should be able to interact with each other through different natural ecological processes. Large carnivores are an example of a group of species for which interactions between forest dynamics and large herbivore prey need to be understood. For species with large area requirements such as raptors as well as large herbivores and large carnivores this means the appropriate management unit would be equivalent to the scales of one large or several smaller European countries. Thus, to maintain ecological processes and adaptive capacity several such large landscape units need to be maintained (e.g., Linnell et al. 2005).

To satisfy and take into account socio-cultural dimensions of SFM is also more area-demanding than satisfying sustained yield wood production, and may require landscape planning (von Haaren 2002). The countryside in forest regions is dominated by production of renewable resources. Use of forest goods, services and values provide monetary incomes and sense of place. Wood harvesting and production is the base for large scale value-added industrial production that provides income to the national level. However, the local benefits depend on land ownership and use rights. For example, in Fennoscandia landscapes with family farms provide diversified local income, while landscapes owned by large companies have by and large been abandoned during the past 30 yrs of mechanised forestry (e.g., Lehtinen 2006). With the appearance of markets for "post-modern" products rural regions has potential for further production services, assets and values, such as recreation, outdoor activities and ecosystem services (FORMAS 2007). The natural and cultural heritage is also an attractive living environment that could gives rise to new economic activities that are associated with traditional land use in a region. It is also important to be aware of regional differences within countries with respect to social capital towards long-term planning, business culture and small-scale business entrepreneurship (Johannisson 2003). Finally, the use of different forest certification systems is an example of cultural differences among markets with respect to their awareness about and interest in ecological, social and cultural dimensions of SFM.

27.7 Seven Steps Towards Place-based Knowledge Production

By knowledge production we refer both to the creation of new knowledge, and the processes of communication and learning among users and producers of knowledge to ensure that results become available to all relevant actors and stakeholders in different sectors at multiple levels (e.g., Lee 1992, Gibbons et al. 1994). Knowledge production to support sustainable forest landscape management requires the use and integration of both natural and human sciences, in close collaboration with the users of knowledge (e.g., Tress et al. 2006).

Andersson et al. (2005) concluded that there are several types of gaps between the current multifunctional definitions of SFM at the policy level on the one hand, and what is practised in actual management units on the other. The range of gaps can be divided into two topics. The first is related to the key challenge of incorporating multifaceted values into management and governance. There are severe gaps between the way we describe and monitor forests and woodlands in practice (focus on wood products at the stand scale) and what ought to be the case based on the current definition of sustainable landscapes (that includes economic, ecological and socio-cultural dimensions at multiple scales). To resolve this top-down integrated planning is needed. The second is related to the limited understanding on how to develop regionally adapted functional systems for decision-making in multi-level and multi-stakeholder governance systems. For example, while the Carpathian ecoregion forms networks of forests and cultural landscapes through seven countries, the legacies of governance and management history vary considerably among countries and regions (Törnblom 2008). Additionally, the range of values people associate with forests and cultural woodlands is not the same in these different societal contexts. Coping with this complexity requires bottom-up approaches that are smoothly integrated with the top-down planning.

Knowledge production and learning for sustainable landscapes requires a transdisciplinary approach were human sciences (i.e. humanities and social sciences) and natural sciences on the one hand, and relevant non-academic actors are involved (e.g., Tress et al. 2006). As theoretical and methodological frameworks to deal with this complexity we use the concepts ***policy cycle***, including the interactions among policy, governance, management and assessment (e.g., Mayers and Bass 2004), and ***landscape***, including its biophysical, anthropogenic and perceived dimensions (e.g., Grodzinski 2005). We thus do systematic integrative research, which has been divided into seven steps for each case study landscape with its integrated social and ecological systems (Fig. 27.1).

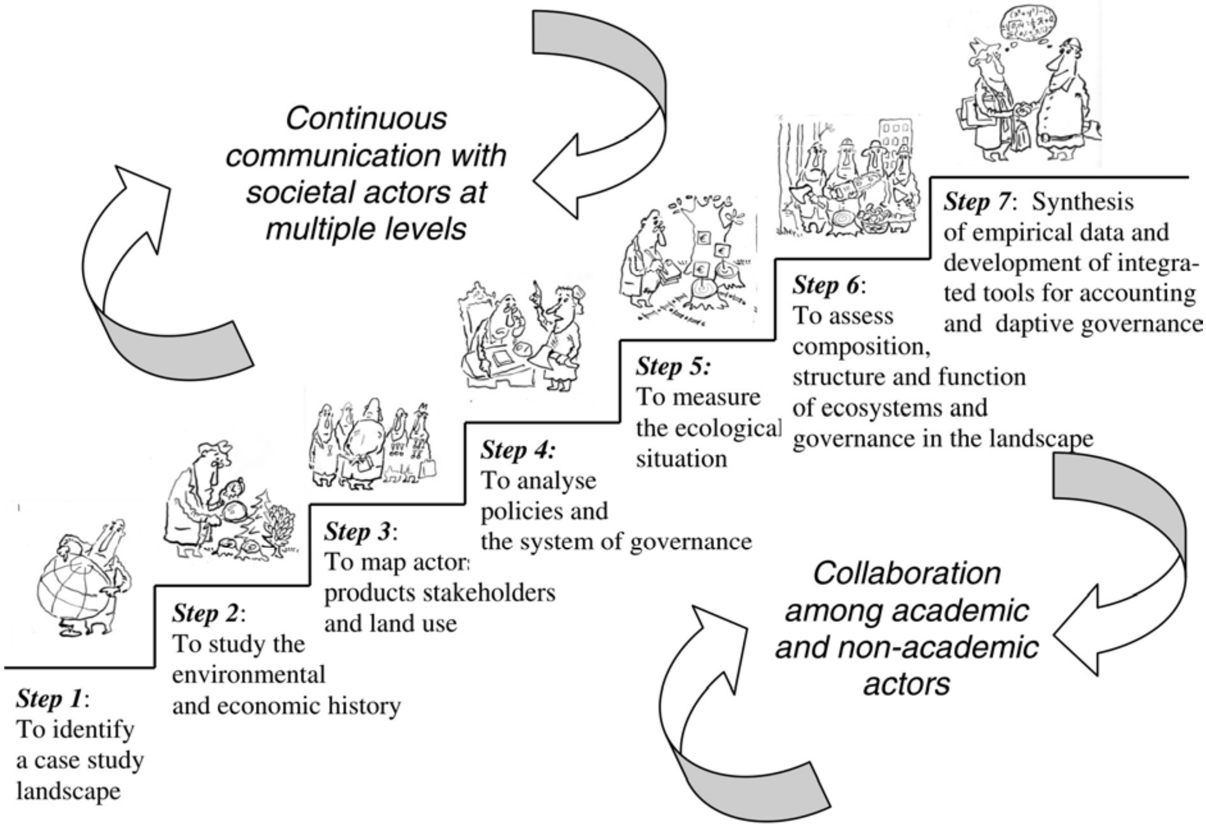

Fig. 27.1 Illustration of the step-wise approach to knowledge production and learning to support the development of accounting systems for ecological, economic and socio-cultural dimensions of sustainability, adaptive management and adaptive governance (from Angelstam et al. 2007b). Drawings by Leonid Kovriga.

Step 1. To identify a case study landscape

Research in support of sustainable forest landscape development with large management units, catchments or administrative units as replicated case studies requires sampling in gradients that represent variation in different dimensions. We thus use a natural experiment design (sensu Diamond 1986). Natural experiments differ from field experiments and laboratory experiments in that the experimenter does not establish the perturbation but instead selects sites where the perturbation is already running or has run. The perturbation may have been initiated naturally or by humans other than an experimental researcher. Along with the experimental sites, the investigation selects control sites so that the two types of sites differ in presence and absence of the perturbation but are as similar as possible in other respects. To cover the bulk of the variation in Europe's East and West, the location of landscapes as case studies is stratified according to the following groups of factors:

1. the biophysical conditions (e.g., topography, bedrock and soils, ecoregion);
2. the environmental and economic history, including the structures of land ownerships and rights in the landscape;
3. the institutional structure and system of governance and planning.

To assure involvement of non-academic actors we focus on selecting places that represent regional centres of interests, ideally also containing units for research, education and communication with society in general. Our aim is to cover entire large catchments (see Törnblom 2008).

Step 2. To study the environmental and economic history

Landscapes have been shaped by different natural and cultural disturbance regimes, with different intensities and over different time spans. To understand the prerequisites for sustainable forest landscape development, the ecological, economic and socio-cultural history of forest landscapes is analyzed. There is a need to consider and understand the consequences of past human use and influence in the landscape (e.g., Gunst 1989). Inspired by Worster (1993) we focus on three aspects: (1) Natural history, or environments of the past. How did the ecosystem develop in terms of composition, structure and function? (2) Modes of production. These include technologies and ways of organizing production. How did the social and ecological systems interact? This includes socio-economic, production and power issues. (3) Ideas, ideology, perception, and values. This means to understand the role of the human being in the ecosystem.

Step 3. To map actors, stakeholders, products, and land use

To understand the current state and trends of ecological, economic and socio-cultural dimensions, and the governance system, it is important to consider all actors and stakeholders involved with the use and management of a forest landscape, and with the different planning and governance processes. This involves multiple levels, from local and regional to national and global. Several sub-steps should be taken:

1. Map all forest landscape users, actors and stakeholders and group them into different categories;
2. Describe the wood and non-wood goods, ecosystem services and values, and the products derived from them using quantitative data; if necessary estimate the total economic value using multiple methods (e.g., Merlo and Croitoru 2005);
3. Identify property right structure;
4. Identify the types of land use related to the use of the desired goods, ecosystem services and landscape values, this includes land use-rights to understand what kinds of interest that are connected with the particular landscape;
5. Evaluate and model the potential impact of land use on land cover in the future.

Step 4. To analyze institutions, policy visions and the system of governance

The implementation of sustainability policies requires understanding of the institutions, i.e. rules and norms in use, policy visions, and collaboration among many actors and stakeholders at multiple levels with different interests and agendas within a landscape or region. A critical issue is to understand the policy visions for sustainability. Such "benchmarks of sustainability" can be derived from analyses of policy documents and interviews with representative landscape actors and stakeholders. This vision can then be used to define the "reference landscape" for different dimensions of sustainability. The evaluation of the policy cycle concerns how policy is formulated, analyses of policy contents and the level of consistency and integration among sectors and levels, how policies are translated into regulations, and how these are communicated by criteria and indicators, and implemented by management and governance in a defined forest landscape. Actors and organizations implementing policies in a forest landscape, affected actors and organizations are studied to evaluate their understanding of policies, their ability to act and their attitudes. In this way gaps in forest policy implementation, and creation, in the case study landscape can be understood.

Step 5. To Measure the Ecological, Economic, and Socio-cultural Situation

The aim of this step is to measure the ecological, economic, social and cultural state of the selected forest landscape. Technically, this means to operationalise the SFM principle's different criteria using indicators reflecting different spatial scales (Table 27.1). Additionally, changes occurring in the case studies, including effects on biodiversity, land use, social interactions, and cultural dimensions are studied. Equally significant for evaluations are modifications and new developments in the governance system at multiple levels that affect both the investigated landscapes and their surroundings. However, communication among stakeholders is a major challenge (Andersson and Angelstam 2008)

Table 27.1 To measure the state and trend of SFM its different criteria need to broken down into different indicators that reflect different spatial scales.

Criteria	***Spatial scale***		
	Micro	Meso	Macro
Ecological	*Indicators*	*Indicators*	*Indicators*
Economic	*Indicators*	*Indicators*	*Indicators*
Socio-cultural	*Indicators*	*Indicators*	*Indicators*

Step 6. To assess sustainability dimensions and governance, and to make scenarios

Apart from dividing the sustainability concept into different criteria and indicators and to estimate their states and trends (step 5), it is necessary to compare the state and trends of indicators with performance targets representing the sustainable and preferred states as defined in policies (step 4). Defining the acceptable habitat loss for biodiversity maintenance is one example. Knowledge about the critical habitat loss for a particular species allows evaluation of the past and present impact of land use in the landscapes (e.g., Angelstam et al. 2004, Villard and Jonsson 2009). Examples of appropriate tools for evaluation of biodiversity conservation are regional gap analysis and habitat suitability modelling to prepare necessary input for landscape planning processes by different actors. Using information on current land cover trends and future actors' interests, landscape structure can be modelled based on scenarios for future development of governance, including uncertainties and climate change. The results of the assessments and scenarios should be communicated among actors and stakeholders involved in decision-making processes at strategic, tactical and operational levels.

Step 7. Synthesis and development of integrated tools

Once the six previous steps have been replicated in a sample of case studies, best practices for learning about management and governance can be identified and scaled up. Ultimately, an accounting system for sustainability and a social platform or forum for adaptive management and governance can be developed in a way that matches the landscapes' regional context. Data on indicators for different criteria and knowledge of associated performance targets allow assessment of the level sustainability of different dimensions of sustainability. This information forms the base for transparent communication of the state and trends of sustainability dimensions in the landscape among decision-makers and stakeholders at multiple levels, and to the general public through different media.

27.8 Education Based on Problem-based Learning

Reality is not disciplinary. There is thus a need for novel courses (=syllabi) and updated education materials, didactic approaches based on the principles of problem-based learning, and good understanding about where in the present education programmes (=curricula) this can be fitted in (e.g., Hosny El-Lakany 2004, Farley et al. 2005, Hammer and Söderqvist 2001). A detailed background regarding the challenges of learning for sustainable forest management in the Russian Federation's NW can be found in Angelstam and Elbakidze (2007, 2008). This is highly relevant also with a Ukrainian context. The components of the development of a formal education program include:

- Curriculum development (program)
- Syllabi development (courses)
- Competence development (building capacity lecturers)
- Teaching material development (lectures, textbooks)
- Training of students and lectures (landscape laboratories for demonstration/practice)
- External facilities for teaching and learning (demonstration/practice)

Lectures

Implementing policies about SFM is a challenge for actors at local to global levels. Communication, education and public awareness about ecological, economic and socio-cultural dimensions as well as different governance approaches are critically important components. Focusing on higher education the current Swedish-Russian co-operation as an example we produce a course plan based on reaching learning outcomes by a combination of (1) lectures, (2) seminars and practical studies based on the ideas of problem-based learning, and (3) individual work, as well as the use of the local landscapes for learning and knowledge production. The course on SFM from principle to practice, and back again, has been prepared to satisfy the official requirements by universities in Ukraine, the Russian Federation and Sweden. The SFM course syllabus is planned for one semester and is based on eighteen two-hour lectures, which are grouped into six themes:

1. Introduction of the SFM principle and sustainable development based on natural resources in terms of goods, ecosystem services and values in forest landscapes by evaluation of policy, assessment, management and governance (1 lecture)
2. Policy, politics and legislation, and C&I in general + performance target (2 lectures)
3. Knowledge about ecological, economic and socio-cultural criteria (6 lectures)
4. How practical management in different countries is made and planned to affect local indicators in different biophysical, historical and governance settings (6 lectures)
5. Governance of landscapes as social-ecological systems under different societal contexts (2 lectures)
6. Synthesis (1 lecture)

Exercises and seminars based on problem-based learning

Problem-based learning (PBL) is an approach to learning, in which students collaboratively solve problems and reflect based on their experiences and search for new knowledge. Some characteristics of PBL are that learning is driven by challenging, open-ended problems where students are encouraged to work in small collaborative groups, and that teachers are facilitators of learning. Thus, students are encouraged to be responsible for and organise the learning process with support from the facilitator. Given the multi-sector and multi-scale endeavour of sustainable forest management seminars and practical studies are based on learning from experiences in concrete landscapes (social-ecological systems) as laboratories. To invite forest landscape actors and stakeholders to interact and discuss with students is one approach that has proven effective.

Writing own projects

The most common way of searching for information is to read texts. These can be shorter as on the internet and in newspapers or longer as in reports, journals and books. As a consequence we write to communicate new knowledge, ideas, opinions or instructions. Writing a report should be an integrated part of designing and planning a project.

It is thus essential to learn and practice the craft of designing a project and writing a text that reports this project. In other words what the learner did, why it was done, how it was done and what was learned from it. The final product envisioned is a short fact sheet, a research paper or a longer report. ***IMRAD*** is a commonly used acronym for the logic of short or long reports that are standardized to answer the following questions (e.g., Day 1998):

- What is the question (problem) studied? (***Introduction***)
- How was the problem studied? (***Methods***)
- What were the findings? (***Results*** and ***Analysis***)
- What do these findings mean? (***Discussion***)

To design a study and write a report the following steps and tools work well to divide the craft of preparation and writing into different stages, which allows the learner to plan the work and be ready in time.

1. Formulate what you want to do in 2-3 sentences, and write the title. Learn from others by reading and talking to people with valuable experience. Make a short presentation for your co-workers/ colleagues using black board, overhead projector or a computer.
2. Design the study: how to collect, analyse and present your data. Make dummy graphs, tables or sketch illustrations for analysis and presentation of data. Make a data file to store the data for analyses. Make a presentation.
3. Write outline with headings based on the previous step, write introduction and methods. Let your team members read the outline.
4. Collect data. Analyse, present and discuss them according to IMRAD.
5. Invite colleagues to review the report. Revise.
6. Finalise the report with text, data and illustrations.

Communication and public awareness

Being a complex challenge, the implementation of policies about sustainable development and sustainability requires public awareness about both state and trends and decision-making processes. This requires the combination of the abilities of content providers (scientists, researchers and stakeholders) and communicators (journalists, radio and TV producers) in several countries. To support this approach we have taken the first steps to set up a web site in English and Russian (www.euroscapes.org). The focus is on people, places and practices. The site will be used as a tool to attract attention and disseminate information among scientists, researchers, policy-makers and practitioners interested in how to realise the vision of sustainable landscapes. The maintenance of high level, relevant up-to-date scientific content is important as a quality guarantee for users of the site. The existence of the site will be made known through a series of activities (press conferences, meetings with scientists, professionals, politicians and other stakeholders) during the first year after setting up the web-site. The second step is to use the material gathered at the site in condensed form as educational or informational projects, edited and packaged with a more specific target audience, i.e. students, professionals or other communicators. In this step society can also help arrange seminars or gatherings that will serve to discuss specific topics within the wider context of landscape sustainability.

27.9 Discussion

27.9.1 Linking Levels of Democratic Governance Bottom-up

The experience from the 2-day workshop in the Carpathian Mountain raion Turka demonstrates that there is strong social capital in the Turka municipality's civil, public and private sectors. This is consistent with previous empirical work (Elbakidze and Angelstam 2007, this volume). However, workshop participants presented many examples of the difficulties to bring issues and needs for change to decision-makers at regional and national levels. Finally, corruption was brought up as a serious issue.

To bridge the gap between the local to the regional and national levels in policy formulation and policy creation processes the idea came up to create a national network of local efforts towards well informed and transparent democratic governance with the aim of more efficient work towards sustainable landscapes and regions in Ukraine. Focusing on the local dependency of landscapes' wood and non-wood goods, ecosystem services and natural and cultural values is a good tool for democratic governance towards economic, socio-cultural and ecological sustainability. To be successful at the local and regional levels it is necessary to partner with politicians at the national level. However, to avoid corruption, workshop participants argued that funding should go directly to the receiving local or regional level.

A first step could be to organise a national level workshop with local actors representing the diversity of Ukrainian regions in order to discuss opportunities and obstacles for democratic governance towards sustainable development based on natural resources from natural forest and cultural woodland landscapes. This would also provide additional opportunity for exchange of experiences about democratic governance with representatives from other countries where the new democratic initiatives are being developed. Five areas that would cover Ukraine's main ecoregions, and the challenge of democratic governance in a diversity of natural resource dependency situations in Ukraine, and with outlooks to neighbouring countries, are the Carpathian Mountains, the transnational Ukrainian-Polish Roztochya area, the Kherson and Poltava regions, and the upper Priyat valley in Belarus.

27.9.2 Towards transdisciplinary knowledge production

The landscape network idea above should be the base for new knowledge production and learning about development successes and failures (e.g., Angelstam and Elbakidze 2006, 2007, Elbakidze et al. 2008). During the past decade a large number of initiatives have been initiated and new approaches tried in countries in transition. To extract useful new knowledge from a sample of case studies, a transdisciplinary approach is needed where researchers from different disciplines work together with representative local and national actors and stakeholders. This brings new challenges to researchers, their networks, academia, and donors as well as to all other involved actors and stakeholders (Gibbons 1999, Svensson et al. 2002). In spite of this, to solve major sustainability issues in landscapes understood as socio-ecological systems we truly believe that this is the way to go.

Experiences from landscape approach initiatives such as traditional village systems, Model Forests, Biosphere Reserves and other similar concepts provide a rich pool of experiences that can be used to gain necessary knowledge, and to develop a landscape forum for adaptive governance and management (Elbakidze et al. 2007a, b). However, by and large this knowledge is localized, and exchange of experiences among regions and sectors is limited. To solve the current challenges of implementing SFM there is a need to encourage new forms of knowledge production and learning based on improved collaboration among sectors using landscape goods, ecosystem services and values. Bridging such gaps are necessary in both Western and Eastern Europe (e.g., Borgström et al. 2006, Sandström et al. 2006, Lazdinis et al. 2007, Blicharska 2009). This stresses the need for international sharing of knowledge about SFM relevant to European natural forests and cultural woodlands, and co-operation to produce new knowledge (e.g., Lazdinis and Angelstam 2005). Learning for sustainable forest landscape management requires (see Angelstam and Elbakidze 2007):

(1) Revised education programmes at multiple levels,
(2) The bridging of cultural barriers by connecting forests, people and markets,
(3) Future development regarding forest policy and legislation and the role of multi-level forest landscape governance, and
(4) Cross-sectored integration.

Thus, to extract information from existing research and traditional knowledge, to produce new knowledge from a suite of landscape-scale case studies and to disseminate successful experiences, requires a transdisciplinary approach (Tress et al. 2006). This is a process that requires careful planning and facilitation.

The idea of establishing multilevel partnerships for sustainable forest landscapes should be promoted by encouraging networking between non-academic actors and academia representing different disciplines. In-depth exchange to bridge sectors and cultures using forest goods, services and values is the only solution for the long-term success of SFM implementation. There are good opportunities for twinning between MFs, and other practical attempts to develop SFM on the ground in Europe's East and West. Comparisons of solutions to make the transition from socialist planned economy to market economy are also useful for a range of other countries, such as the new EU member states, Ukraine, and the Caucasus. The role of BRIC countries (i.e. Brazil, Russia, India and China) countries is particularly important to consider (Goldman Sachs 2003).

27.9.3 Knowledge Production for Adaptive Management and Governance

Because reality is both uncertain (Table 27.2) and not disciplinary there is an urgent need for holistic knowledge production (Farley et al. 2005). By knowledge production we refer both to the creation of new knowledge, and the process of communication between users and producers of knowledge to ensure that results are communicated to the surrounding community (e.g., Lee 1993, Gibbons et al. 1994).

Table 27.2 Illustration of the need to learn how to learn and adapt, rather than to learn rules.

		Social system	
		Predictable →	Unpredictable
Ecological system	Predictable ↓	Traditional forestry	Adaptive governance
	Unpredictable	Adaptive management	*New production of knowledge and learning*

To realise the vision of sustainability a "societal learning process" (Lee 1993, Gibbons et al. 1994) needs to be developed by exploring different existing approaches to integration and communication, as well as testing them in actual rural landscapes. To be successful this requires (1) new types of knowledge production (quality assured with scientific methods), (2) successful dissemination of information, and (3) action. We argue for the need to develop and use (i) an accounting system as a "map and a compass" that informs natural resource managers, policymakers, media, authorities exercising governance, students and the general public about the state and trends of natural resources (goods, services and values), (ii) ways of establishing societal platforms for local and regional adaptive governance and spatial planning as a "gyroscope" (Lee 1993), (iii) including the role of entrepreneurs as initiators of social platforms and partnerships (Folke et al. 2005). This would contribute to make informed decisions based on knowledge. Societal systems would thus both get information from and inform social stakeholders, and should have a role in a wide range of arenas, regardless of scale and ecosystem context. According to Gibbons et al. (1994) this transdisciplinary approach has four features that separate it from traditionally disciplinary sciences: (1) It develops an evolving framework to guide problem-solving efforts, which focuses on achieving holistic understanding; (2) It develops research methods and modes of practice, based on the input from different disciplines; (3) Unlike the disciplinary sciences where results are communicated through organisations and education, results of transdisciplinary knowledge production are communicated by scientists and practitioners who participated in the work; (4) It is about problem solving on the move and socially robust knowledge (Gibbons 1999). Thus, communication in ever-new configurations is crucial.

Daniels and Walker (2001) describes 5 distinct phases in a collaborative learning process; 1) assessment- where an evaluation of the context and the potential for collaboration takes place, 2) training- where stakeholders build an appreciation for collaboration and learn some specific techniques of collaborative learning, 3) design- development of a context specific strategy for involving stakeholders in a meaningful process, 4) Implementation/facilitation- to conduct project activities and decision making, 5) Evaluation- data gathering and reflection to learn from participating stakeholders what was most and least effective approaches to be able to adapt the project or learn for future projects. This knowledge production concept includes humanities, social and natural science disciplines, and close collaboration between academic and non-academic actors, i.e. a transdisciplinary approach (Table 27.3).

Table 27.3 Transdisciplinary knowledge production is located at the interface between research and management and requires close collaboration between different types of actors.

Academic actors				***Non-academic actors***
Basic research	Applied research	Education	Extension	Implementation
Disciplinary	***Transdisciplinary knowledge production***			Management

Learning by development requires quality assurance and continuous documentation. Nonaka and Takeuchi (1995) use the terms tacit knowledge as subjective knowledge and explicit knowledge as objective knowledge. Tacit knowledge is implicit and personal. Hence the knowledge is not directly accessible to others and it is impossible to assess its significance in relation to existing knowledge. In contrast, explicit knowledge is accessible to others. Explicit knowledge is mostly tangible; it is fixed on some kind of medium such as a book, scientific journal, CD, video or a web site. As a consequence, it is brought into the wider context of the public domain. This process allows us to judge results in relation to existing beliefs and commonly held attitudes (see Table 27.4). Scientific documentation and exposure to peer review could act as an important quality assurance system for all kinds of knowledge production systems.

Table 27.4 Characteristics of tacit and explicit knowledge (after Tress et al. 2006).

Tacit knowledge	*Explicit knowledge*
implicit	expressed in language
personally bound	not bound to an individual
not accessible for others	available on a medium and accessible for all
not put in context of other knowledge	seen in the context of existing knowledge

27.9.4 Communication, education and public awareness

Implementation of policies about sustainable development and sustainability are closely related to the level of public awareness about the state and trends of ecological, economic and socio-cultural sustainability dimensions, and the ability to participate in decision-making processes. This is alleviated by two preconditions. The first is the combination of the knowledge and skills of information providers (e.g., teachers, scientists, researchers and stakeholders) and communicators (e.g., journalists, radio and TV producers) to communicate and disseminate knowledge on local, regional, national and international levels in order to increase public awareness concerning sustainable development. The second is that local and regional governance arrangements that represent different sectors and levels are in place. The Model Forest concept is one example. According to the Model Forest development guide, a MF should satisfy six attributes (IMFN 2008). These are (1) a landscape large enough to address an area's diverse forest uses and values, (2) an inclusive and representative partnership, (3) a commitment to sustainability, (4) a governance system that is representative, transparent, and accountable, (5) a program of activities reflects the values, needs and management challenges among the partners, in the local community and on regional to national levels, (6) a commitment to knowledge sharing, capacity building and networking, from local to international levels.

There are, however, several challenges. (1) There is insufficient knowledge about how the vision of sustainable landscapes can satisfy societal needs of goods, services and values, and how economic, ecological and socio-cultural dimensions can be realised. (2) Existing knowledge is not communicated well among different sectors. (3) Cultural barriers between countries in the Baltic Sea Region are a challenge for efficient communication and information exchange. There is thus an urgent need to disseminate holistic or landscape level knowledge from producers to practitioners and stakeholders to support the sustainable development process (e.g., Lee 1993, Gibbons et al. 1994). This often termed landscape approach (e.g., Singer 2007, Dudley et al. 2006).

27.9.5 Towards an International Network of Landscape Approach Efforts

To bridge gaps among academia, private and public sectors, as well as non-governmental organisations, for developing governance and management, as well as to integrate academic disciplines, towards sustainable development and sustainability is a challenge. Our solution is that an interdisciplinary team of researchers and practitioners should focus on being a hub for real-world actors and academia (to reach the aim of transdisciplinary knowledge production) in landscapes based on the following principles.

(1) Base the transdisciplinary knowledge production on a suite of landscape level case studies in a gradient from centres to peripheries of economic development, and with different governance systems and in collaboration with local stakeholders. This multiple case study approach (i) allows both depth and overview, (ii) includes different types of resource use and trajectories of development, and (iii) different systems of governance (i.e. top-down and bottom-up). International networking and co-operation is a necessity.

(2) Each social-ecological system case study (=landscape) should have a platform for collaboration, negotiation and implementation of the combined results from practice, ongoing development efforts and transdisciplinary knowledge production. Forest and woodland landscapes with different biophysical characteristics, histories and systems of governance in Europe's East and West thus form a suite of excellent and unique "laboratories" for producing knowledge to solve contemporary and future challenges (e.g., Angelstam et al. 2005).

(3) The case studies should represent both designed initiatives to move towards sustainability objectives (e.g., EU Leader and InterReg projects, Model Forests, Biosphere Reserve, the Canadian Forest Communities programme etc.), and "randomly" selected areas without special efforts in this direction.

(4) The production of knowledge and learning should not be centred solely at one major organisation, authority or university, the reason being that easy access and thus more regular exposure to case study landscapes should be prioritised. By involving researchers and other key-persons from several centres and countries, transdisciplinary knowledge production and a "researcher-governor-practitioner" interface will be developed.

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Стале лісокористування і лісоуправління – від політики до практики: ландшафти як лабораторії для продукування знань і навчання в Карпатських горах

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В Україні триває перехідний період від планової соціалістичної до ринкової економіки. Сучасне лісове законодавство України містить положення щодо запровадження сталого лісового управління і лісокористування, лісової сертифікації, збільшення площі лісового покриву, приватизації землі, розвитку рекреаційної інфраструктури, а також збереження послуг екосистем, культурної спадщини та біорізноманіття. Управління і механізм прийняття рішення щодо використання природних ресурсів в нових умовах потребують врахування різних чинників від локального до міжнародного рівнів. Вкрай потрібні створення і підтримка соціальної та екологічної інфраструктур у межах ландшафту із врахуванням того, що природокористувачі та зацікавлені сторони із різних суспільних груп зорієнтовані на різні аспекти сталого розвитку. Процес обговорення і передачі інформації, освіта і розвиток екологічної свідомості суспільства є надзвичайно важливими, особливо для тих, хто залучений до процесу прийняття рішення стосовно питань щодо екологічного, економічного і соціально-культурного розвитку ландшафтів як соціально-екологічних систем. Одним із варіантів запровадження сталого розвитку є підтримка традиційних сільських поселень, модельних лісів та біосферних заповідників. На глобальному рівні визнано, що Українські Карпати, розміщені в центрі Європи, характеризуються різноманітними лісовими та культурними ландшафтами і мають складну геополітичну історію. Комплексний підхід до вивчення ландшафтів різних регіонів і країн, які мають історії економічного розвитку й управління, – один із шляхів для розуміння того, як різні суспільства намагаються вирішити питання сталого розвитку. У дослідженні йдеться про потребу розроблення (1) підходів для балансування складників сталого розвитку і для надання прозорої інформації всім зацікавленим сторонам щодо стану і тенденцій цих складників; а також (2) засобів для адаптивної системи прийняття рішення й управління на різних рівнях. Ми запропонували підхід "семи кроків", який є своєрідною трансдисциплінарною співпрацею академічних і неакадемічних учасників для продукування знань щодо запровадження сталого розвитку. Також проаналізовано виклики щодо освіти, яка базується на інтеграції практики та досліджень і спрямована на вирішення реальних проблем.

FOR NOTES

ДЛЯ НОТАТОК