

Advances in Agroecology

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Agroecology

A Transdisciplinary, Participatory and
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Preface..

Foreword

Acknowledgments

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Contributors

Chapter 1

Introduction

V. Ernest

Chapter 2

Agroecology

Stephen

Chapter 3

Transformation

Thought

Graham

Chapter 4

Political

Manuel

Chapter 5

Learning

Charles

Tor Arv

Chapter 6

Complex

Agroecology

John Va

Chapter 7

Agroecology

Eric Hol

Chapter 8

The Inter

Francisco

Contents

Preface.....	vii
Foreword	ix
Acknowledgments.....	xi
Editors	xiii
Contributors	xv
Chapter 1	
Introduction: Agroecology as a Transdisciplinary, Participatory, and Action-oriented Approach	1
V. Ernesto Méndez, Christopher M. Bacon, and Roseann Cohen	
Chapter 2	
Agroecology: Roots of Resistance to Industrialized Food Systems.....	23
Stephen R. Gliessman	
Chapter 3	
Transformative Agroecology: Foundations in Agricultural Practice, Agrarian Social Thought, and Sociological Theory	37
Graham Woodgate and Eduardo Sevilla Guzmán	
Chapter 4	
Political Agroecology: An Essential Tool to Promote Agrarian Sustainability.....	55
Manuel González de Molina	
Chapter 5	
Learning Agroecology through Involvement and Reflection	73
Charles Francis, Edvin Østergaard, Anna Marie Nicolaysen, Geir Lieblein, Tor Arvid Breland, and Suzanne Morse	
Chapter 6	
Complexity in Tradition and Science: Intersecting Theoretical Frameworks in Agroecological Research	99
John Vandermeer and Ivette Perfecto	
Chapter 7	
Agroecology, Food Sovereignty, and the New Green Revolution	113
Eric Holt-Giménez and Miguel A. Altieri	
Chapter 8	
The Intercultural Origin of Agroecology: Contributions from Mexico	123
Francisco J. Rosado-May	

Chapter 9	
Participatory Action Research for an Agroecological Transition in Spain: Building Local Organic Food Networks.....	139
Gloria I. Guzmán, Daniel López, Lara Román, and Antonio M. Alonso	
Chapter 10	
Agroecology, Food Sovereignty, and Urban Agriculture in the United States.....	161
Margarita Fernandez, V. Ernesto Méndez, Teresa Mares, and Rachel Schattman	
Chapter 11	
On the Ground: Putting Agroecology to Work through Applied Research and Extension in Vermont.....	177
Debra Heleba, Vern Grubinger, and Heather Darby	
Chapter 12	
Agroecology as a Food Security and Sovereignty Strategy in Coffee-Growing Communities: Opportunities and Challenges in San Ramon, Nicaragua.....	193
Heather Putnam, Roseann Cohen, and Roberta M. Jaffe	
Chapter 13	
The Mesoamerican Agroenvironmental Program: Critical Lessons Learned from an Integrated Approach to Achieve Sustainable Land Management.....	217
Isabel A. Gutiérrez-Montes and Felicia Ramírez Aguero	
Chapter 14	
Analysis of Tropical Homegardens through an Agroecology and Anthropological Ecology Perspective.....	233
Alba González-Jácome	
Index	259

CHAPTER 1

Introduction

Agroecology as a Transdisciplinary, Participatory, and Action-oriented Approach

V. Ernesto Méndez, Christopher M. Bacon, and Roseann Cohen

CONTENTS

1.1	Introduction	1
1.2	Agroecological Mainstreaming	2
1.3	An Examination of the Different “Agroecologies”	3
1.4	Agroecology as a Transdisciplinary, Participatory, and Action-oriented Approach	4
1.4.1	Agroecology and Transdisciplinarity	5
1.4.2	Participatory and Principles-based Approaches in Agroecology	5
1.4.3	Toward Transformative Agroecology	8
1.4.4	Challenges	9
1.5	Examples of Agroecological Initiatives Seeking a Transdisciplinary, Participatory, and Action-oriented Approach	9
1.5.1	The Vermont Agricultural Resilience in a Changing Climate Initiative	9
1.5.2	Application of a Transdisciplinary and PAR Approach	10
1.5.3	Discussion of Selected Results	11
1.5.4	Challenges, Opportunities, and Lessons	11
1.5.5	Food Security and Sovereignty with Smallholder Coffee Cooperatives and Farmers in Nicaragua	12
1.5.6	Application of a Transdisciplinary and PAR Approach	12
1.5.7	Selected Results	13
1.5.8	Opportunities, Challenges, and Lessons	14
1.6	Scaling Agroecology Out: Optimizing Production and Democratizing Access	15
1.7	Discussion of the Contents of the Edited Volume	16
	References	18

1.1 INTRODUCTION

Agroecology has emerged as an approach that helps us to better understand the ecology of traditional farming systems and respond to the mounting problems resulting from an increasingly globalized and industrialized agri-food system (Altieri 1987). In its early stages, agroecology mainly focused on “applying ecological concepts and principles to the design of sustainable agricultural systems” (Altieri 1987; Gliessman 1990). This was followed by a more explicit integration of

concepts and methods from the social sciences, which were necessary to better understand the complexity of agriculture that emerges from unique sociocultural contexts (Guzmán-Casado et al. 1999; Hecht 1995). In the last decade, the number of publications and initiatives that people describe as agroecological has increased exponentially (Wezel and Soldat 2009). The result is the emergence of several distinct standpoints, which, in this paper, we refer to as different agroecological perspectives or “agroecologies.” As can be expected in any field of science or knowledge, we can observe some important differences between specific agroecologies. Hence, the objectives of this introductory chapter are to (1) discuss the implications of the increasing use and adoption of agroecology in unprecedented scientific, social, and political spaces; (2) examine the evolution of the field of agroecology into distinct perspectives or “agroecologies;” (3) illustrate the application of an agroecological perspective grounded in transdisciplinary, participatory, and action-oriented approaches, including two case studies; (4) discuss the issue of scalability in agroecology; and (5) introduce the reader to the objectives and contents of this edited volume.

1.2 AGROECOLOGICAL MAINSTREAMING

Agroecology has reached a high level of prominence in a diversity of academic, policy, and advocacy spaces worldwide (Guzmán-Casado et al. 1999; IAASTD 2009; Wezel and Soldat 2009). An important example of this was the recently held International Symposium on Agroecology for Food Security and Nutrition in September 2014 (<http://www.fao.org/about/meetings/afns/en/>), organized by the United Nations Food and Agriculture Organization (FAO). This was the first event on agroecology organized by the FAO in its history, and it was attended by several high-ranking officials and agriculture ministers from France, Brazil, Costa Rica, Senegal, Algeria, Japan, and the European Commission. In addition, through persistent, long-term efforts, agroecologists have been able to institutionalize the field in academic organizations, including the establishment of a growing number of agroecology programs and degrees at universities of both developed and developing countries (Francis et al. 2003; <http://sustainableaged.org/projects/degree-programs/>). Other applications of agroecology are more recent, but just as important. These include the adoption of the field by policy-oriented actors, as well as a wider use of agroecology within rural social movements and farmer or peasant organizations.

The appearance of agroecology in international food and agricultural policy debates is not new. However, until recently it was mostly used in the context of nongovernmental organizations focusing on sustainable agriculture and rural development topics and more specifically those oriented toward empowering small-scale farmers and resource-poor rural communities (e.g., Food First).

The turning point for the inclusion of agroecology at higher policy circles probably came with the publication of the International Assessment of Agricultural Knowledge, Science, and Technology for Development (IAASTD), and its recognition that the field represented a promising alternative approach to resolve the interrelated global problems of hunger, rural poverty, and unsustainable development (IAASTD 2009).^{*} Subsequently, Oliver De Schutter, who was appointed as the United Nations Special Rapporteur on the Right to Food between 2008 and 2014, continually advocated for the use of an agroecological approach to confront global food insecurity and advance the right to food. De Schutter did this through policy-oriented presentations

* The IAASTD is a high-profile report commissioned by the World Bank, the United Nations, and the World Health organization, which sought to direct research and development policy solutions to the issues of global hunger, poverty, and sustainable agricultural development. It brought together hundreds of scientists and institutions from all regions of the world over a seven-year period. It is considered by many as the agricultural equivalent of the Intergovernmental Panel for Climate Change (IPCC) reports. On the other hand, other scientists have expressed serious doubts about the rigor of the report. Its findings remain somewhat controversial.

and lectures, publications geared for a broad audience, and an interactive website (see [De Schutter 2010; De Schutter and Vanloqueren 2011]; <http://www.srfood.org/>). The aforementioned FAO symposium represents another key event in the advancement of agroecology in international policy circles, as it could be influential on national and international agriculture and rural development actors. Most recently, an International Panel of Experts on Sustainable Food Systems (IPES-Food) has been established, with the goal of using agroecology and a political economy approach to transform food systems to sustainability (www.ipes-food.org).

1.3 AN EXAMINATION OF THE DIFFERENT “AGROECOLOGIES”

A comprehensive review by Wezel et al. (2009) interpreted agroecology as a field that has expressions as a science, a social movement, a practice, or a combination of all three. The authors concluded that there is “certain confusion in the use of the term ‘agroecology’” (Wezel et al. 2009: 10), and that the different uses of the term are affected by a variety of factors related to geographic, scientific, and contextual backgrounds. We disagree with the notion that there are no clear lines between existing agroecological perspectives. Rather, we argue that a persistent depiction of agroecology as unclear explicitly ignores important aspects of its evolution as a field of knowledge. Furthermore, presenting the agroecological approach as confusing justifies the application of narrow definitions. This interpretation is favored by those who view agroecology solely as a new form of natural science endeavor, devoid of its transdisciplinary nature and its links to farmer knowledge, social sciences, and rural social movements (see Figure 1.1).

Although there are a wide diversity of interpretations and applications of agroecological approaches, we have identified two predominant perspectives. The first one tends to apply agroecology as a framework to reinforce, expand, or develop scientific research, firmly grounded in the Western tradition and the natural sciences (Wezel et al. 2009; Wezel and Soldat 2009; e.g., see Martin and Sauerborn 2013). These agroecological approaches represent important endeavors for

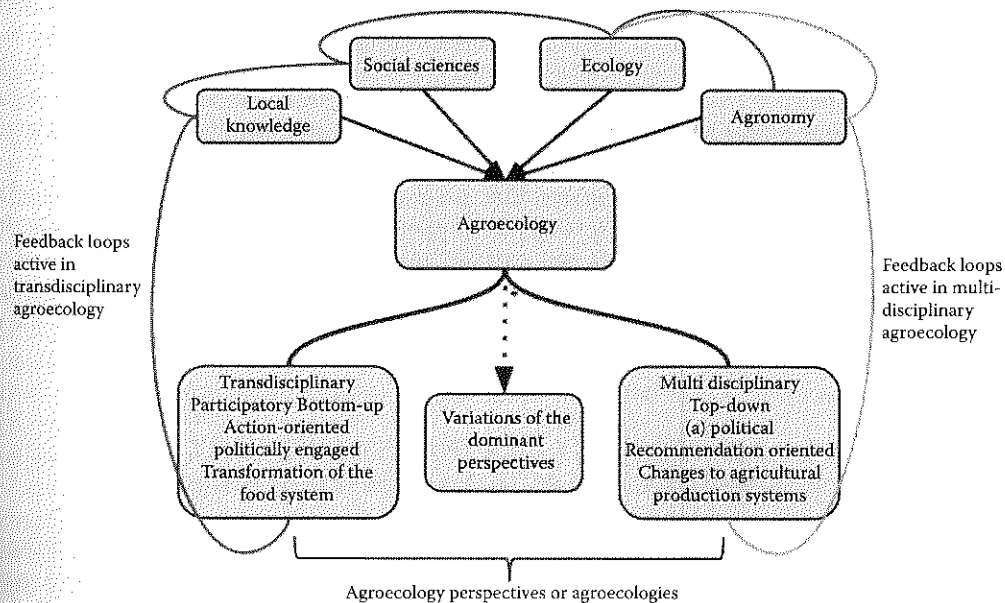


Figure 1.1 Schematic representation of the evolution of different types of agroecologies. (Adapted from Méndez et al. 2013.)

advancing findings on agronomic and ecological processes, and for improving the management of farms and landscapes. The information they generate can contribute to redirect agricultural production and management toward an ecologically based approach. However, although these standpoints may seek to impact broader agri-food systems, their approach remains largely grounded in natural science research with a primary focus on ecological analyses at different scales of *agricultural landscapes* (i.e., farm, region) not of agri-food system (i.e., from farm to table). These perspectives provide useful ecological information to inform agroecological applications, but, on their own, they cannot accomplish a comprehensive understanding of agriculture as a complex socioecological system, especially its social, cultural, and political dimensions. An agroecology that focuses only on the ecology of agricultural systems/landscapes runs the risk of silencing contributions of knowledge from within the social sciences and constructed outside of the Western scientific paradigm (i.e., local, traditional, cultural knowledge, and practice). The exclusion of the social science disciplines and local knowledge also diminishes the possibility of creating feedback loops that enrich these approaches through insights gained from this broader agroecological approach (see Figure 1.1).

In contrast to the perspective outlined in the previous paragraph, some agroecological scholars, often trained in natural science disciplines (e.g., entomology, ecology, and agronomy) and frequently cross-trained in critical social science approaches, have pursued a path that seeks to simultaneously deepen conceptual inquiry within specific subfields, while expanding and redefining a broader agroecological perspective; one that engages with the social sciences and broader agri-food system issues. This agroecological approach developed from firm roots in the sciences of ecology and agronomy into a framework that integrates transdisciplinary, participatory, and action-oriented approaches, as well as critically engages political-economic issues that affect agri-food systems (Gliessman 2006; Méndez 2010; Sevilla-Guzmán 2006b; Wezel et al. 2009).

The use of terms such as “transdisciplinary,” “participatory,” and “action oriented” can be interpreted and applied in a diversity of ways, some of which can be controversial (Francis et al. 2008; Kindon et al. 2007a). Others may consider that these terms are overly optimistic and unrealistic in terms of research and applications. However, we perceive that the evolution of this particular form of agroecology has explicitly embraced these characteristics through an in-depth, and frequently challenging, process of research, reflection, and action. We are not arguing that all scientific endeavors should be transdisciplinary, participatory, and action oriented. In fact, we believe that the best-case scenario would be to have basic, discipline-oriented science actively informing and interacting with this reflexive perspective that seeks to be more participatory (by collaborating with and including knowledge from multiple actors) and with an explicit bias toward generating knowledge that can contribute to direct actions for agri-food system transformation.

In the previous paragraphs, we argue that there are two predominant agroecological perspectives. However, it is important to recognize that in between these two broader approaches there exists a gradient of interpretations and applications that may lean more toward one or the other, or seek a relatively balanced position between the two (see Figure 1.1). For a recent example of an agroecological perspective located in between the two dominant ones, see a review by Tomich et al. (2011).

1.4 AGROECOLOGY AS A TRANSDISCIPLINARY, PARTICIPATORY, AND ACTION-ORIENTED APPROACH

In this section, we discuss an agroecological perspective with the following characteristics: (1) it originated from a predominantly ecological and agronomic interpretation of the field in the early 1970s; (2) it has evolved toward an approach grounded in transdisciplinary and participatory research through engagement with social scientists, agricultural communities, and nonscientific knowledge systems; (3) it incorporates a critique of the role of prevalent political-economic

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structures in the construction of the current agri-food system; and (4) as an action-oriented effort, it seeks to directly contribute to redirect current agri-food systems toward sustainability. This particular agroecological perspective has been advanced by some of the most influential academics in the field, including Stephen R. Gliessman (Gliessman 2015), Miguel Altieri (Altieri and Toledo 2011), John Vandermeer (Vandermeer 2009), Ivette Perfecto (Perfecto et al. 2009), and Eduardo Sevilla-Guzmán (Sevilla-Guzmán 2006b). In this section, we undertake an in-depth examination of the key characteristics of this perspective.

1.4.1 Agroecology and Transdisciplinarity

We consider transdisciplinary approaches as those that value and integrate different types of knowledge systems, which can include information from scientific or academic disciplines, as well as experiential, local, indigenous, or other forms of knowledge. In addition, transdisciplinary approaches often adopt a problem-based focus (Aeberhard and Rist 2009; Belsky 2002; Francis et al. 2008; Godemann 2008). An appreciation for farmer-generated knowledge challenges conventional approaches to agricultural research and related policymaking that privileges Western epistemologies of knowledge production (Cuéllar-Padilla and Calle-Collado 2011). Since the 1980s, some agroecologists have been valued and sought to better understand the experiential agroecological knowledge of farmers as a necessary component to develop a more sustainable agriculture. This was clearly illustrated in Stephen Gliessman's work in the Mexican tropics, in the 1970s and 1980s, which focused on understanding the ecological bases of traditional Mexican agriculture (Gliessman 1980, 1982, 1978; Gliessman et al. 1981), and which drew from the scholarship of Efraím Hernández-Xolocotzi. This empirical information, based on observation and practice, and which also integrates cultural aspects, was viewed as a source of knowledge to conceptualize and apply agroecology. More recently, the Universidad Intercultural Maya de Quintana Roo, Mexico, has institutionalized agroecological teaching and research through the concept of interculturality (<http://www.uimqroo.edu.mx/>). This approach is based on a platform for knowledge exchange and collaboration under conditions of mutual respect among cultures and knowledge systems (i.e., Maya and Western-based) that are crucial for applying both participatory and transdisciplinary approaches (see Chapter 8 in this volume). The incorporation of local and/or farmer-generated knowledge is an important component of this particular type of agroecological thought and practice.

1.4.2 Participatory and Principles-based Approaches in Agroecology

An increasing interest in participatory and action-oriented research is evident in a variety of fields, such as ecology (Whitmer et al. 2010) and several disciplines in the social sciences (Fals-Borda and Rahman 1991; Greenwood and Levin 1998; Stringer 1999), health (Minkler and Wallerstein 2008), natural resources (Castellanet and Jordan 2002; Fortmann 2008), geography (Kendon et al. 2007b), and agroecology (Guzmán-Casado et al. 1999; Snapp and Pound 2008; Uphoff 2002). Participatory action research (PAR) and related approaches seek to involve a diversity of actors as active participants in a cyclical, iterative process that integrates research, reflection, and action, and which seeks to include or amplify those voices that have been traditionally excluded from the research process (Figure 1.2; Bacon et al. 2005; Kendon et al. 2007b).

Agroecological approaches that have sought to integrate farmer knowledge into research and outreach fit well with the PAR approach. In the last decade, an increasing number of studies have combined agroecology with participatory approaches in different ways. For example, graduate students and professors at the University of California at Santa Cruz collaborated in a participatory project involving coffee farming communities of Mexico and Central America, which yielded a variety of outcomes. These ranged from direct actions in coffee cooperatives to research studies and academic publications. A key academic product of this work was an edited book on the coffee

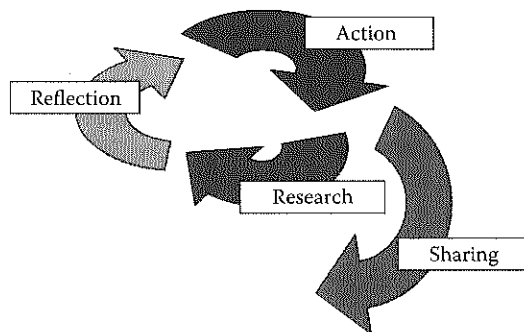


Figure 1.2 Participatory action research cycle. (Adapted from Bacon, C., et al., *Participatory Action-Research and Support for Community Development and Conservation: Examples From Shade Coffee Landscapes of El Salvador and Nicaragua*, Center for Agroecology and Sustainable Food Systems [CASFS], University of California, Santa Cruz, CA, 2005.)

price crisis (Bacon et al. 2008), while action-oriented projects and outreach were mostly channeled through the Community Agroecology Network (CAN, <http://www.canunite.org/>). A similar trajectory can be observed in Andalucía, Spain, where researchers, professors, and extension agents associated with the International University of Andalucía's graduate program in agroecology have worked with a diversity of family farmers in southern Spain (Cuéllar-Padilla and Calle-Collado 2011; Guzmán-Casado et al. 1999; Guzmán-Casado and Alonso-Mielgo 2007, 2008; Sevilla-Guzmán 2006a, b). Likewise, in Brazil, agroecologists have worked with the Landless Peasant Movement (MST) and La Via Campesina to support the incorporation of agroecology into these social movements (Altieri and Toledo 2011).

Participatory approaches in agroecology tend to adhere to a common set of principles associated with PAR. Not surprisingly, these principles share substantial overlap with an evolving set of agroecological principles that help define the field and unite different perspectives (Altieri 2000; Gliessman 2015). Table 1.1 summarizes selected and overlapping principles from both PAR and agroecology. A more complete list of the principles of agroecology and sustainability can be found at http://agroecology.org/Principles_List.html.

Table 1.1 Comparison of Selected Participatory Action Research and Agroecological Principles

Participatory Action Research Principles	Agroecology Principles
PAR prioritizes empowerment as community-based partners contribute to define the research agenda.	Agroecologists work with farmers, eaters, communities, agricultural ministries, food advocates, and others to support empowering people.
PAR processes are context dependent as they bring together trans/interdisciplinary teams responding to stakeholder aspirations.	Agroecology establishes farming and food systems that adjust to local environments.
PAR research processes inform action at multiple scales for positive social change.	Agroecology offers principles and analysis toward the creation of more sustainable agriculture and food systems.
PAR processes deepen as long-term relationships are formed and multiple iterations of the cycle occur.	Agroecology seeks to develop strategies to maximize long-term benefits.
PAR processes listen to a diversity of voices and knowledge systems to democratize the research and social change processes.	Agroecology incorporates farmer voices and knowledge into the research process and seeks to diversify biota, landscapes, markets, and institutions.

Sources: Modified from Bacon, C., et al., *Participatory Action-Research and Support for Community Development and Conservation: Examples From Shade Coffee Landscapes of El Salvador and Nicaragua*, Center for Agroecology and Sustainable Food Systems (CASFS), University of California, Santa Cruz, CA, 2005 and http://www.agroecology.org/Principles_List.html.

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Like agroecology, PAR approaches in agriculture often involve researchers, farmers, and other organizations (e.g., governmental or nongovernmental organizations [NGOs]). The process values the collaborative definition, implementation, and interpretation of research that includes different forms of knowledge, as well as people's diverse aspirations in the design of research agendas and transitions toward collectively defined goals. Processes of empowerment are complex, uneven, and require attention to the formal and informal exercise of power, as well as critical reflections about the intersection of access to resources, privileges, and identities (Fox 2005; Minkler and Wallerstein 2008). The PAR projects tend to be highly negotiated processes, and it is unlikely that actors will continue to participate if they are not perceiving benefits or advancing their interests.

The final two principles listed in Table 1.1, for both agroecology and PAR, concern temporal- and diversity-related issues. Although researchers are aware of their own professional needs and pressing theoretical questions within their academic fields, these priorities do not often align with the needs of farmers and other social actors (Fox 2006). Instead of predetermining a project and then asking nonresearch partners to sign off, PAR collaboration should begin at the earliest stages of the research process. Ideally, partners work through a mutual, iterative dialogue to arrive at a project proposal that harmonizes stakeholder needs, capacities, and methods. However, it is also common for PAR processes to develop from different starting points. For example, a PAR process can emerge from a more conventional research project when the partners shift to a more inclusive dialogue and more even power relations (Bacon et al. 2005). The iterative nature of PAR results in shifts between the emphases placed on research, reflection, or action. This usually occurs through a negotiated dialogue, where each actor advocates for his/her interests, but is also willing to reach compromises for the benefit of all partners. Through this exchange, the researcher and other participants have a clear understanding of project expectations and potential challenges and benefits. The conversation must also be linked to action, thus creating a praxis—or an ongoing iterative process of reflection and action (Freire 2000). After an action is taken, the context may shift, and this is when the longer-term partnership often becomes more important, as both the researcher and the other partners have learned from the first cycle and may decide to continue in a different or similar direction in future iterations. The agroecological principle of maximizing long-term benefits suggests multiple considerations, such as efforts to:

- Maximize intergenerational benefits, not just annual profits.
- Maximize livelihoods and quality of life.
- Facilitate intergenerational transfers.
- Use long-term strategies, such as developing plans that can be adjusted and reevaluated through time.
- Incorporate long-term sustainability into overall agroecosystem design and management.
- Build soil fertility over the long term.

The principle of recognizing, learning from, and engaging social and ecological diversity is among the most important for linking PAR with an action-oriented agroecology. The PAR approach calls for greater attention to a wider diversity of voices, especially those that are frequently marginalized by mainstream society (e.g., farm workers, smallholder farmers, indigenous groups, and rural women). This suggests the need to create the time and space for deeper listening and identification of strategies that use human diversity as a source of innovation. The principle of diversity, as seen through an agroecological lens, is no less profound as it directs analytic attention to the domains of biota, landscapes, and social institutions. Examples of farm- and plot-level management of diversity include intercrops, crop rotations, polycultures, and the integration of animals, cultivars, and genetic diversity. At the landscape scale, one must consider issues such as buffer zones, forest fragments, rotational grazing, and contour and strip tillage. The important point is not simply the presence of a wide diversity of species or agricultural practices, but the way they interact to provide critical ecosystem services (e.g., pollination, pest control, and nutrient cycling) that

support agricultural production and farmer livelihoods (Kremen et al. 2012). The social domains of diversity encourage agroecologists to consider multiple forms of farmer organization, government regulation, identities, and the many different types of markets and alternative networks that constitute agri-food systems (Goodman et al. 2011). The presence of alternative distribution systems and the diversity of social institutions and economic relations in agriculture, such as farmer's markets, community-supported agriculture, cooperatives, and production for both subsistence and sale, offer several important incentives that could be coupled with an enabling policy environment (Iles and Marsh 2012). Together, these related strategies could contribute to a transformation of current agri-food systems into ones that prioritize ecological and human health at all stages and integration among the multiple, interacting system components.

1.4.3 Toward Transformative Agroecology

A transformative agroecology incorporates a critique of the political economic structures that shape the current agri-food system (see Holt-Giménez and Altieri, this issue and González de Molina, this issue). It is explicitly committed to a more socially just and sustainable future by reshaping power relations from farm to table. This view requires that agroecologists move beyond the farm scale to consider the broader forces—such as market and government institutions—that undermine farmers' cultural practices, economic self-sufficiency, and the ecological resource base. In part, agroecology as a field of study emerged in response to concerns about the social and ecological impacts generated by the industrialization of agriculture and the implementation of Green Revolution technologies (Patel 2013). Narrow approaches that reduce agroecology to an ecologically sensitive agronomic science have disregarded the influence of critical social science research and theory, as well as broader social concerns, as part of the field's development. An "agroecology as natural science" perspective tends to privilege positivist science and Cartesian reductionism over other ways of knowing (e.g., holistic, indigenous, or local knowledge), and thus risks producing research that is not appropriate to local contexts and which ignores the larger power structures that impact farmer livelihood strategies.

The transformative agroecology that we propose has continued to develop a more holistic approach to the science and practice of agroecology in close dialogue with critiques of rural development put forth by academics, practitioners, and social movements. Political ecologists, in particular, have analyzed how power-laden relationships operating at the international, national, and regional level influence local agricultural practices, livelihoods, and landscapes. For instance, Blaikie and Brookfield's landmark study on soil degradation demonstrated how social marginalization, rather than maladaptation (i.e., in need of modernization), shaped farmers' land management practices (Blaikie and Brookfield 1987). This was a crucial shift in perspective that emphasized a multiscale analysis to articulate local social and ecological phenomena to regional and global forces (Paulson et al. 2003). In short, political ecologists draw attention to the power relations that govern natural resources, often leaving farmers, due to their class, gender, or ethnic position, with a lack of access to productive assets (Peet and Watts 2004; Rocheleau et al. 1996). If farmers cannot access the resources they need, often dispersed within a surrounding territory and governed by overlapping power structures, they cannot continue to maintain or develop sustainable agroecosystems. A politically engaged agroecology considers the complex challenges, both social and ecological, that smallholders face in their efforts to transition toward sustainability (see González de Molina, in this issue).

The connection between agroecological practice, equitable distribution of resources, and self-determination has been made explicit by marginalized communities demanding justice through food sovereignty (Holt-Giménez and Altieri, in this issue). Ecological sustainability has become central to demands made in defense of rural livelihoods and culturally specific ways of life. These ways of living are increasingly at risk owing to the deepening of capitalist relations that turn people into labor and nature into resources (Carruthers 1996; Grueso et al. 2003). Agroecologists are aptly positioned to contribute to these struggles by participating in a creative process of knowledge

production with farmers and other agri-food system actors. This requires a broader understanding of knowledge and learning as a community of practice that involves farmer scientists, university-trained researchers, and other members of civil society (Kloppenborg 1991; Thomas-Slayter et al. 1996). Agroecology, through its parallel development as a science and social movement, provides an apt space to construct relevant research and practice that addresses asymmetrical power relations.

1.4.4 Challenges

Developing and applying transdisciplinary, participatory, and action-oriented approaches for research and practice presents a series of challenges that we would like to discuss. First, the two inspirations for our work, transdisciplinary approaches to agroecology and PAR are emerging and dynamic frameworks of research and *praxis*. Most of the individuals and collaborative groups seeking to apply these approaches are only recently starting to do so, and hence face a set of new and emerging challenges. In addition, although interesting to many established academic and funding institutions, support for transdisciplinary research and PAR (and agroecology for that matter) is still severely limited. Partly, this is due to the nature of these approaches, which integrate a variety of activities that have traditionally operated and been funded separately (i.e., research, extension, and direct applications or actions). Hence, many institutions and funders are structured to treat them independently; even when they are interested in supporting the integration of these initiatives, many times they do not know how to do it. The same applies for research and nonresearch partners who are interested in participating in both transdisciplinary and PAR processes. Many of these actors and institutions have developed around disciplinary and professional norms and find it difficult to cross into other disciplines, knowledge systems, timelines, and other dynamics that are different from their own. These points are further illustrated in the case studies presented in the next section. We believe it is important to emphasize that doing the work we are proposing requires facing serious institutional, funding, and individual challenges. However, we are also convinced that these challenges can be overcome and that the “tide is changing” in terms of finding broader institutional and funding support for agroecological work that is transdisciplinary, participatory, and action oriented.

1.5 EXAMPLES OF AGROECOLOGICAL INITIATIVES SEEKING A TRANSDISCIPLINARY, PARTICIPATORY, AND ACTION-ORIENTED APPROACH

In this section, we present two distinct case studies of agroecological initiatives that apply transdisciplinarity and PAR. We emphasize advances, challenges, and lessons learned so that they can be useful cases for others interested in pursuing similar approaches.

1.5.1 The Vermont Agricultural Resilience in a Changing Climate Initiative

The Vermont Agricultural Resilience in a Changing Climate Initiative (VAR) has explicitly incorporated transdisciplinary agroecology and PAR to address the effects and potential responses to climate change by Vermont farmers and other agri-food actors. Vermont, a state located in the northeastern United States, has a long and continuing agricultural history that has recently been strengthened by an energetic interest and support for alternative agri-food systems (e.g., the Vermont Farm to Plate initiative). VAR is inclusive of multiple partners, including researchers with a wide range of foci, a professional advisory committee that includes farmers and other collaborators, and farmers who cultivate a wide range of products. Its research approach is to work with a diversity of actors to identify on-farm management practices or climate change best management practices (CCBMPs) that could (1) best help farmers adapt to climate change now and in the future; (2) provide information on how farmers can contribute to greenhouse gas (GHG) emissions mitigation; (3) work with

outreach professionals to deliver information about these practices to a broad community of farmers and other professionals; (4) assess the future needs related to climate change of a diversity of actors in the Vermont agri-food system; and (5) create and utilize tools to inform policy and governance that are specifically related to climate change and agriculture. In this section, we focus on objectives 1–3 of the broader VAR initiative as a way to illustrate the opportunities, challenges, and lessons of applying a transdisciplinary and PAR-oriented approach to this particular project.

1.5.2 Application of a Transdisciplinary and PAR Approach

The VAR initiative brought together eight faculty members from the following University of Vermont (UVM) units: Plant and Soil Science Department; Community Development and Applied Economics Department; the Rubenstein School of Environment and Natural Resources; and the Center for Sustainable Agriculture and the Northwest Crops and Soils Program, both from UVM Extension. Figure 1.3 shows the VAR phases, activities, and actors as well as illustrates the focus on transdisciplinarity and participation of a diversity of actors, including researchers, farmers, extensionists, and private agricultural service providers. The figure shows the wide diversity of methods used for the research, such as a random mail survey of about 1000 farmers (with 76 responses), key informant interviews, and on-farm research.

Transdisciplinarity was viewed in the same vein as previously discussed in this chapter; as an approach seeking to integrate academic disciplines (i.e., agroecology, agricultural economics, ecology, and public policy) with nonacademic knowledge (farmer experience), to address a specific issue (the impacts of and responses to climate change by Vermont farmers).

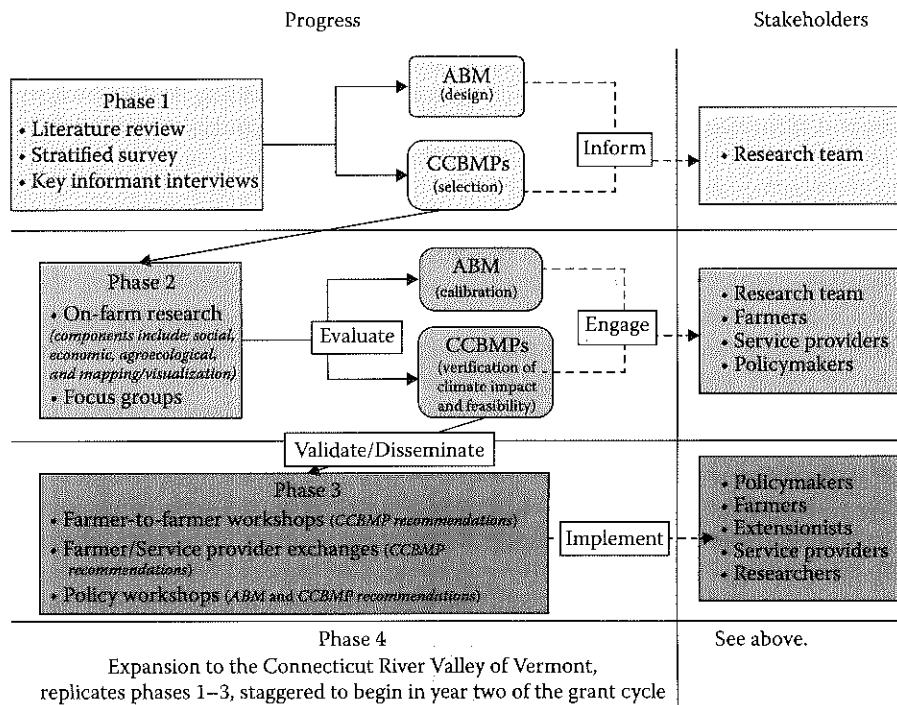


Figure 1.3 Planned phases and activities of the VAR Initiative. (From Méndez, V.E., et al., “Climate change adaptation and mitigation in the Lake Champlain Basin of Vermont,” In Climate change adaptation and mitigation in the Lake Champlain Basin of Vermont,” Grant proposal submitted to the University of Vermont Food Systems Initiative, 2012.)

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1.5.3 Discussion of Selected Results

Although this project is still in progress, there are several key preliminary results worth mentioning that can be linked to the PAR and transdisciplinary approach. Rather than presenting the results themselves, which can be found in Schattman et al. (2015), we focus on describing the type of information that was collected:

- **Farmer perceptions and knowledge:** In staying true to both PAR and transdisciplinary tenets of including diverse voices and forms of knowledge, we sought to collect farmer perceptions and knowledge of management practices associated with climate change in four ways: (1) through written responses in a random mail survey; (2) analyzing text from farmer "Reports from the Field," which is an online newsletter managed by UVM Extension Professor Vern Grubinger posting farmer commentary on various issues related to vegetable and berry farming in Vermont (see <http://www.uvm.edu/vtvegandberry/newsletter/datenavbar.htm>); (3) through semistructured interviews with farmers and key informants (mostly extensionists and other service providers); and (4) by sharing and discussing with farmers landscape visualization posters with "before and after" scenarios of implementation of best management practices.
- **Establishment of an advisory committee:** This was done to keep our process accountable. The advisory committee consists of selected farmers, extensionists, staff from government and non-government organizations, and researchers. We periodically present project results and issues and request feedback, both in terms of potential impact for the groups they represent and general input in terms of the direction of the process.
- **On-farm research:** On going data collection with the participation of farmers on 12 farms, to produce results relevant to their farm contexts.
- **Farmer-to-farmer exchanges:** This phase is still pending, since it will take place once the on-farm research is concluded. It will include farmer-to-farmer knowledge exchanges related to the research on the 12 participating farms. We will invite farmers and service providers to attend these events in order to share our process. Although researchers may present some of their results, the idea is that these events will be led by farmer partners, with the research team taking a facilitating role.

1.5.4 Challenges, Opportunities, and Lessons

The experience of the VAR initiative has elucidated important opportunities, challenges, and lessons related to conducting transdisciplinary and PAR processes.

First, one of the most daunting challenges was keeping true to a meaningful transdisciplinary research endeavor. From the beginning, the complexity of bringing teammates together was evident. As the project progressed, each subteam went to work on their particular areas, and this occurred mostly in isolation from the rest. Although communications, full team meetings, and facilitation were kept frequent and consistent, there was little active interdisciplinary integration during the data collection process. Hence, those working on GHGs and costs of CCBMP implementation conducted their research without direct participation from other team members. At the current phase of the process, which focuses mostly on data analysis and developing publications, the team is intentionally seeking to do data integration, although it was mostly lacking during the data collection phase.

Second, even though the team was committed to engaging in a PAR process, we were limited in terms of farmer engagement in the following two ways: (1) the initial stages of design and fundraising for the project were led by researchers, since getting the team together required considerable effort and proposals had to be prepared with a deadline. However, we did engage extension partners as coinvestigators who work closely with farmers. (2) On-farm partners and farmers in the advisory committee have pointed out the need for the on-farm trials to be extended to several years. This is needed to account for climate change variability and better assess costs of maintaining adaptive practices over time. We were not able to secure funding for multiple year trials, but we are starting to develop proposals to do it in the next few years.

Third, leadership and facilitation are key components to move the process forward. In terms of leadership, it was evident that a strong presence from the project leader was necessary frequently and consistently. However, given the administrative demands of the project, shared or coleadership may be desirable. This has to occur from the onset, as trying to implement it after the project had started proved difficult in our particular case. Similarly, strong and effective facilitation of meetings, communications, and networking is essential for the success of these types of processes. In particular, deepening the transdisciplinary approach requires collaborators to share and better understand their multiple fields, as well as receive timely and synthesized information that they can use.

1.5.5 Food Security and Sovereignty with Smallholder Coffee Cooperatives and Farmers in Nicaragua

A team including researchers and staff affiliated with the nonprofit CAN, a faculty member at Santa Clara University, staff and farmers affiliated with the Promoter of Cooperative Development in the Segovias (PRODECOOP), a coffee-exporting cooperative union, and The Center for Information and Innovation within the Association for Development in northern Nicaragua (CII-ASDENIC), a local Nicaraguan NGO, designed the "Food Security and Sovereignty in the Segovias" project using the principles of transdisciplinarity, agroecology, and PAR. The project sought to address the persistence of seasonal hunger among the smallholder coffee producers of northern Nicaragua and develop options for reducing this situation. The relationships of trust and solidarity that established the initial context that would develop into a long-term partnership to eliminate hunger and create more sustainable food systems in the Segovias, started with research focused on the impacts of Fair Trade and organic coffee production in northern Nicaragua (Bacon 2005). This initiative also benefitted from strategic advice and targeted research conducted by UVM faculty and a graduate student, as well as insight and funding from Green Mountain Coffee Roasting Company (GMCR, now Keurig Green Mountain). The partnership focused on the shared production of knowledge, local capacity building, and the design of strategies to reduce seasonal hunger, increase access to healthy food, and promote sustainable agriculture among more than 1500 families affiliated with the PRODECOOP cooperative.

The study area incorporates coffee producing areas of Estelí, Madriz, and Nueva Segovia, commonly known as the Segovias region of Northern Nicaragua. The nested case study focuses on a primary level cooperative, consisting of about 100 families living in close proximity in the highlands of Condega, Estelí. Elevations range from 700 to 1550 m above sea level. The rainy season last from May through October followed by a dry season. The vegetation consists primarily of tropical dry forests at lower altitudes and semihumid and mixed oak and pine forests at higher altitudes. Most farmers in the study area produce a combination of cash crops (coffee), subsistence crops (corn and beans), fruit trees, and occasionally tubers and vegetables.

1.5.6 Application of a Transdisciplinary and PAR Approach

This partnership used an approach that was started by linking University-based researchers and CAN with Nicaraguan rural development organizations and small-holder cooperatives; thus we called it as community-based participatory action research (CB-PAR). The goal was to create a partnership that develops a more democratic approach to knowledge production and community change (Fortmann 2008; Hacker 2013; Minkler and Wallerstein 2008). The aim of the CB-PAR is to link the farmers' local and experiential knowledge with agronomists' technical skills, university researchers' academic knowledge, and cross-case expertise. To encourage this dialogue among knowledge systems and create a shared vision, we used participatory facilitation techniques from the *Campesino-a-Campesino* movement (Holt-Giménez 2006). Chris Bacon, the principal investigator (PI) and professor at Santa Clara University, created a committee in which each member was given

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meaningful roles and responsibilities to facilitate participation in the CB-PAR process. The local research team consisted of PRODECOOP's agronomists working from the cooperative's central offices in the city of Estelí and a network of 24 primary cooperative level promoters (farmers who receive a small monthly stipend from CAN and PRODECOOP to coordinate a wide range of activities). CII-ASDENIC staff with training in field research methods, information technologies, and local development coordinated the reception and initial data capture from surveys. CAN and CII-ASDENIC staff drew from researcher recommendations, GMCR monitoring guidelines (developed by UVM researchers), and PRODECOOP's interest to identify indicators for project monitoring and evaluation. Additional details of the case study can be found in Bacon et al. (2014).

1.5.7 Selected Results

The multiple results that continue emerging from this initiative can be grouped under three of the four phases (i.e., action, research, and reflection) in a CB-PAR cycle (see Figure 1.2). The fourth phase is sharing, which represents an ongoing process that actually occurs simultaneously with each phase. Table 1.2 summarizes several of the more significant results. The initial project diagnostic included focus groups, interviews, participant observation, and a large baseline household survey conducted with participating farmers and rural youth. Local NGO staff also participated in community-based monitoring processes. After more than a year of data entry, quality control, and processing, preliminary results were discussed with farmers and other stakeholders. This information was then used to create local food security action plans and strategies to invest the international development funds received by the project (see Table 1.2).

This project generated a range of opportunities for research, local investment, institutional change, and follow-up international development projects. Capacity building took place through farmer-to-farmer exchanges, in workshops, and by sending staff from both PRODECOOP and CII-ASDENIC to international agroecology short courses organized by the CAN network in Chiapas and Quintana Roo, Mexico, and Estelí, and Nicaragua (hosted by project members). Furthermore, farmers learned about sustainable agriculture technologies from exchanges with neighbors within their own region and through experimentation on their plots. Several of the action steps implemented by CAN and PRODECOOP in this cycle (see Table 1.2) include (1) the development of community-based seed banks after an exchange suggested by the project PI and organized by leadership within Nicaragua's *Campesino-a-Campesino* program (see Holt-Gimenez 2006 for more on the history of this social movement); (2) workshops focused on using surface soil from surrounding forests, as

Table 1.2 Summary of CB-PAR Cycle from 2009 to 2013 in Northern Nicaragua

Research

Participatory baseline and diagnostic study
 Participatory monitoring
 Farmer exchanges with *Campesino-a-Campesino*
 Best practices inventoried

Reflection and Planning

Agronomists and local staff train in workshops and International Agroecology Short courses with CAN
 Diagnostic study results inform the creation of 11 Food Security Action Plans
 Project scales-up to reach 1500 farm families

Selected Actions

Farmers plant 18,000 fruit trees on their land
 Pilot project to change local corn and bean food system
 Pilot project on community-based seed banks

an inoculant of beneficial microorganisms, for improved soil fertility management (learned following an exchange at an organic coffee producers' cooperative in Honduras); and (3) the cooperatives piloted an institutional innovation focused on relocalizing the local corn and beans distribution systems by using cooperative funds and infrastructure to purchase corn from affiliated members and local markets when prices were low during the harvest time and redistributing it at accessible prices during the lean months (June, July, and August), when corn prices generally spike.

The final published results from the household survey, focus groups, and interviews conducted in 2010 contributed to a second iteration of the CB-PAR cycle. The statistical analysis of the surveys revealed several anticipated patterns, finding that farmers with higher incomes and larger farms generally lived through shorter periods of seasonal hunger. However, we also found that farmers with larger corn yield and more fruit trees reported shorter periods of seasonal hunger (Bacon et al. 2014), which contributed to CAN and PRODECOOP's decision to support the planting of an additional 18,000 fruit trees and launch a series of experiments focused on the agroecological management of corn fields or *milpas*.

1.5.8 Opportunities, Challenges, and Lessons

Many opportunities emerged out of the necessity for tangible strategies that leverage direct investment and training in support of farmer-led sustainable agricultural actions and cooperative-led sustainable community development efforts. These were supported through adherence to a CB-PAR and agroecological approach from the inception of the project. The idea to create a broader coalition working to end seasonal hunger in northern Nicaragua, increase access to healthy food, and facilitate the transition to more resilient and sustainable food systems, leveraged resources and goodwill far beyond the constraints of this initial project. There are too many examples to summarize here. However, several specifics include the way that agroecology has been incorporated as a core transversal organizational strategy and programmatic area within both PRODECOOP and CII-ASDENIC. After the initial local diagnostic, it became evident that more direct investment was also needed to increase access to clean drinking water, and this project has moved forward at a significant scale. Finally, the researchers shared the results widely among interested academics and other stakeholders.

Like all initiatives there were also challenges and lessons learned. The detailed vision building, organizational, and administrative work associated with forming this coalition among staff from two highly capable local organizations in northern Nicaragua, the US-based CAN, and at least one university, with collaborating scholars from two additional universities, was not fully accounted for in planning timelines and budgets. The work invested in creating this collective effort and vision can be diminished, when new opportunities for international development research and local project funding emerge. Local development NGOs and cooperative leaders and/or well-positioned academics can request external funding directly from donor agencies without first doing the hard work of negotiating an agreement and a strategy with the key stakeholders who have created and started to implement the changing vision of this project. Given the current incentive systems for international funding and academic advancement (Fox 2006), there is no question that such dominant structures encourage this approach; yet the principles of generating an authentic PAR approach are clear and ask for transformational change from all participants. Another challenge is coordinating the timing and agendas of multiple project partners. However, this was resolved among the core PAR team through regularly scheduled time together in Nicaragua, every year, and to some extent through periodic visits that brought the Nicaraguan team to the United States. Among the key lessons learned is that this approach holds potential for generating knowledge and social change, provided that there is a long-term commitment to a place and reflexivity among all participants. These dynamic challenges and opportunities could be useful in the consideration of the broader debates about the global processes of scaling-up agroecology.

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1.6 SCALING AGROECOLOGY OUT: OPTIMIZING PRODUCTION AND DEMOCRATIZING ACCESS

Smallholder farmers (less than 2 ha) represent 90% of farms worldwide, producing a substantial amount of the world's food supply (IAASTD 2009). Paradoxically, many of these farmers form part of the 842 million people who suffer from food insecurity (Parmentier 2014). The food riots of 2008 engendered a global discussion about the failures of our corporate-controlled industrial food system and the best way to feed the world's growing population (see Altieri and Holt, in this volume, on "corporate food regimes"). agroecology has gained traction as a possible solution among both peasant movements and multilateral institutions (De Schutter 2010; Rosset and Tores 2013). On the basis of social and environmental sustainability, agroecology's multidimensional approach offers a set of design principles particularly suited to the context of vulnerable small- and medium-scale farmers. However, can agroecology scale-up to meet the demand? Or more specifically, how can agroecology revitalize the small-farm sector, creating dignified livelihoods and vibrant local food economies that result in food access for all sectors of society?

Agroecology's tremendous potential lies in its capacity to address the root causes of environmental degradation and hunger. It is a context-specific approach that optimizes productivity of agricultural resources while enhancing local control over these resources throughout the agricultural value chain. Agroecology's engagement with the local ecology and culture is its cornerstone, yet has led to misconceptions about its scalability. Rather than a set of context-specific technologies, agroecology uses a set of principles that can be locally disseminated and adapted to multiple contexts. Farmer-to-farmer exchanges, based on the methodology of *campesino-a-campesino*, have proven to be one of the most useful tools for sharing agroecological practices. This form of horizontal exchange can be referred to as *scaling-out* (Parmentier 2014). Scaling-out centers the scaling process (or an "agroecological transition") on democratizing knowledge and practice by empowering farmers to be the experts and teachers of traditional and innovative approaches. For us, scaling-out also emphasizes democratizing the governance of resources and decision-making about agricultural development. Although policy change at the national and international level will be a crucial part in achieving an agroecological transition, consolidation of resource control and/or decision-making at this level undermines agroecology's very capacity to change the agri-food system.

We have identified three priorities for scaling-out agroecology: (1) shifting normative understandings of agricultural development toward optimization rather than maximization; (2) developing participatory and transdisciplinary research agendas to consolidate evidence supporting agroecology; and (3) supporting smallholder farmer, labor, and consumer movements focused on challenging corporate control over productive resources and food supplies.

Agroecology increases productivity through optimization by diversifying production systems, generating a variety of agricultural products tailored to farmers' practices and needs, as well as natural ecosystem processes. Research shows that small diversified systems have higher yields than large industrialized monocultures, if all output and externalities are measured. Furthermore, diversified systems produce an array of additional benefits—increased nutrient recycling, reduced dependency on chemical inputs, more robust food supply for local consumption, stronger rural economies, and farmers connected through exchange networks (Altieri and Nicholls 2008; Gliessman 1998; Parmentier 2014). However, farmers, agronomists, and development agencies tend to measure the success of agricultural development mostly in terms of single crop yields or income. Indeed, the Green Revolution succeeded in vastly increasing the yields of basic grains and increasing their availability at a lower cost to consumers (Evenson and Gollin 2003). This narrow notion of productivity externalizes social and environmental consequences, such as increased inequality among farmers, rising debt, rural–urban migration, environmental contamination, and low dietary diversity (Parmentier 2014). To scale out agroecology, we need to shift

normative understandings of productivity away from maximization of yield and develop metrics for a multidimensional analysis of the benefits flowing from optimized agroecological production systems (Silici 2014).

Strong case study evidence demonstrates the multiple benefits of agroecology. However, further research is needed to consolidate the data and identify the most beneficial, context-specific agroecological strategies, and practices that contribute to scaling agroecology (Silici 2014). A participatory and transdisciplinary research agenda that includes the knowledge, experiences, and aspirations of the small-farm sector will best identify metrics for multidimensional analyses and identify barriers to adoption. Although agroecology may be particularly suited to the capacities of small farmers, investing labor and resources into an agroecological transition may not be feasible for farmers without secure land tenure, where disease or outmigration has vastly reduced available labor, or where farmers cannot afford to invest time in learning and experimentation (Silici 2014). Consolidated evidence regarding the challenges and opportunities of agroecological adoption can be a tool for advocating toward the creation of policies that shift greater resources toward agroecological research and development, while also incentivizing its implementation. To do this, it is necessary to shift policies that favor conventional chemical-intensive agriculture to those supporting agroecology (Altieri and Nichols 2008).

A shift in governance that incentivizes agroecology and jeopardizes the privileges of the corporate food regime will require political pressure (for specific examples of corporate influence over policies that shape the food system, see Parmentier 2014). Peasant movements, such as “*Via Campesina*” have embraced agroecology as a strategy to achieve food sovereignty (Rosset and Torres 2013). The Declaration of the International Forum for Agroecology (27 February 2015, Nyéléni, Mali) states that “Families, communities, collectives, organizations, and movements are the fertile soil in which agroecology flourishes. Collective self-organization and action are what make it possible to scale-up agroecology, build local food systems, and challenge corporate control of our food system.” Scaling-out agroecology, as we understand it—as a science, practice, and movement—coincides with political demands for farmer control over productive resources and inclusive decision-making that values the perspectives of women, youth, and indigenous communities. The privileged scale of agroecology remains at the local level. To build an agri-food system based on agroecology, the adaptation and innovation of sustainable technologies must remain in the hands of many, not just a powerful few.

1.7 DISCUSSION OF THE CONTENTS OF THE EDITED VOLUME

This volume presents 14 diverse contributions that share a commitment to integrating transdisciplinarity, participatory, and/or action-oriented approaches within an agroecological framework. In this introductory chapter, we have sought to discuss the evolution of the field of agroecology and examine some of the contemporary debates that surround it. More specifically, we revisit the existence of different “agroecologies,” a concept that we introduced two years ago (Méndez et al. 2013), as a key to understand how this dynamic field is constantly evolving. We also describe in-depth how we understand agroecology as a transdisciplinary, participatory, and action-oriented approach. To illustrate this, we present the opportunities and challenges of two case studies where we have tried to implement this particular agroecological approach. We finalize the chapter with a discussion of key issues surrounding the “scaling-out” of agroecology, a subject that is garnering increasing attention in research and policy circles. The subsequent seven chapters represent conceptual contributions that, in different ways, embrace the perspectives of transdisciplinary and participatory agroecology. These contributions are followed by six case studies that, in one way or another, have grappled with the integration of transdisciplinarity and PAR in agroecological work within different geographic and socioecological contexts.

Our introductory article is followed by a contribution from Steve Gliessman, which undertakes a historical analysis of his role in the development of agroecology, and his role in resisting industrialized agriculture. Through his work on traditional Mexican agriculture in the 1970s and 1980s, Gliessman examines the development of the "agroecosystem" concept, which drew from the work of Efraím Hernández Xolocotzi and the emergence of the field of agroecology. At this time, governments and international agencies were fully supporting the implementation of the Green Revolution in developing countries. The following chapter, by Sevilla-Guzmán and Woodgate, explores several social, political, and economic processes, such as agricultural modernization and environmentalism, as part of the foundations from where agroecology developed as both a "scientific discipline" and a transformative "agrarian social movement." The next piece by González de Molina proposes a stronger integration of political ecology into agroecology and the explicit development of a "political agroecology." González de Molina argues for the need to develop instruments and actions that interact with the political and institutional aspects of agroecological research and practice. In the following chapter, Francis and coauthors discuss the importance of involvement and reflection as key aspects of agroecological education. Their work is firmly grounded on a problem based, transdisciplinary agroecology program at the Norwegian University of Life Sciences (UMB), which engages students in real-world situations with rural communities. This article offers conceptual insights and an example of an innovative pedagogical model for agroecological teaching and learning. Subsequently, Vandermeer and Perfecto explore the potential for integration of ecological science with farmer knowledge to contribute to agroecological research and practice. Building on their experience analyzing ecological processes in agroecosystems, they argue that this integration could lead to the "generation of knowledge that is simultaneously deep and broad." This is followed by Holt-Giménez and Altieri's piece, which critiques what they term as the "new Green Revolution," discussed as a "re-ignition" of the previous green revolution with a slightly more environmental perspective, but replicating the socioeconomic and political approach that so severely damaged millions of smallholder farmers in the 1970s and 1980s. They emphasized the need for strengthening smallholders and their organizations as the backbone of alternative food systems, and caution of the danger of agroecology being coopted to strengthen the existing powers behind the new Green Revolution. The last of the conceptual chapters, by Francisco Rosado-May, introduces the reader to the interactions between agroecology and interculturality. The intercultural approach values and seeks out different forms of knowledge, links them together in a participatory process, and provides opportunity to generate new forms of action. As an example of an intercultural process, Rosado-May presents an in-depth historical perspective on the key role of agroecological work undertaken in Mexico and argues for the need to more explicitly integrate an intercultural perspective in current agroecological applications.

The following seven chapters of this volume present case studies, which were chosen for their alignment with agroecological, transdisciplinary, and participatory approaches. Chapter 9, by Guzmán-Casado and coauthors, discusses the need for an agroecological approach that goes beyond technological change. They propose PAR as the means to "collaborate with local communities and advance in the restructuring of physical flows, economies, and information that support local farming." These arguments are explored through an in-depth analysis of a case study with farmers in Andalusia, Spain. The authors conclude that despite some challenges associated with resources and longer time periods, PAR proved to be an adequate approach to foster an agroecological transition by farmers and other actors. The next chapter, by Fernandez and coauthors, undertakes a similar exercise as Rosado-May by analyzing the evolution of agroecology and its interactions with food sovereignty and urban agriculture in the United States. The authors find that although principles have been shared among the academic, agroecological perspective, and on-the-ground movements, an explicit collaboration is still elusive. The chapter concludes by providing specific recommendations for partnerships that can better integrate the strengths of agroecology as a participatory research approach and the experiences of alternative agri-food movements in the

United States. In Chapter 11, Heleba and coauthors share their in-depth and long-standing experience working closely with farmers through the UVMS Extension system. These highly respected Extension faculty and staff demonstrate the effectiveness and the need to have strong farmer involvement and collaboration in our efforts to more effectively implement a transition toward agroecology. Subsequently, Putnam and coauthors examine the application of the agroecological approach to implement a food security and sovereignty project in a coffee region of Nicaragua. Their findings support some of the themes discussed in this introductory chapter, as they demonstrate the efficacy of agroecology as a food security and sovereignty strategy, largely through farm diversification and farmer-to-farmer knowledge coproduction. The following chapter, by Gutiérrez and Ramírez, presents an example of a large international development initiative—the Mesoamerican Agroenvironmental Program (MAP) that sought to implement an integrated and multisectoral approach to “sustainable land management.” MAP succeeded in incorporating a diversity of participatory and interdisciplinary approaches rarely seen in projects of this nature and stands as an example for similar future initiatives. The last chapter, by Alba Gonzalez Jacome, integrates perspectives from agroecology and ecological anthropology to analyze tropical agroforestry homegardens in Mexico. The author presents an in-depth historical analysis of this complex and traditional agroecosystem, which has inspired many agroecologists for its sustainability characteristics, and potential.

We selected the contributions in this edited volume as part of our efforts to support an engagement with an agroecology that is transdisciplinary, participatory, and action oriented. Both the conceptual and the empirical chapters provide insight into the opportunities, challenges, and lessons learned of applying this particular type of agroecology. We hope that this book will continue to encourage and advance critical and constructive “agroecological” debates, as well as provide inspiration for others seeking to embrace this challenging, yet promising, agroecological approach.

REFERENCES

- Aeberhard, A. and S. Rist. “Transdisciplinary co-production of knowledge in the development of organic agriculture in Switzerland.” *Ecological Economics* 68 no. 4 (2009): 1171–1181.
- Altieri, M.A. *Agroecology: Principles and strategies for designing sustainable farming systems*. (2000). http://nature.berkeley.edu/~miguel-alt/principles_and_strategies. Accessed January 20, 2012.
- Altieri, M.A. *Agroecology: The scientific basis of alternative agriculture*. Boulder, CO: Westview Press, 1987.
- Altieri, M.A. and C.I. Nicholls. “Scaling up agroecological approaches for food sovereignty in Latin America.” *Development* 51 no. 4 (2008): 472–480.
- Altieri, M.A. and V.M. Toledo. “The agroecological revolution in Latin America: Rescuing nature, ensuring food sovereignty and empowering peasants.” *Journal of Peasant Studies* 38 no. 3 (2011): 587–612.
- Bacon, C. “Confronting the coffee crisis: Can fair trade, organic and specialty coffees reduce small-scale farmer vulnerability in northern Nicaragua?” *World Development* 33 no. 3 (2005): 497–511.
- Bacon, C., V.E. Méndez, and M. Brown. “Participatory action research and support for community development and conservation: Examples from shade coffee landscapes of El Salvador and Nicaragua.” Santa Cruz, CA: Center for Agroecology and Sustainable Food Systems (CASFS), University of California, 2005.
- Bacon, C., W.A. Sundstrom, M.A. Flores-Gomez, et al. “Explaining the ‘hungry farmer paradox’: Smallholders and fair trade cooperatives navigate seasonality and change in Nicaragua’s corn and coffee markets.” *Global Environmental Change* 25 (2014): 133–149.
- Bacon, C.M., V.E. Méndez, S.R. Gliessman, et al. (eds.). *Confronting the coffee crisis: Fair trade, sustainable livelihoods and ecosystems in Mexico and Central America*. Cambridge, MA: MIT Press, 2008.
- Belsky, J.M. “Beyond the natural resource and environmental sociology divide: Insights from a transdisciplinary perspective.” *Society & Natural Resources* 15 no. 3 (2002): 269–280.
- Blaikie, P. and H. Brookfield. *Land degradation and society*. London: Longman Press, 1987.
- Carruthers, D.V. “Indigenous ecology and the politics of linkage in Mexican social movements.” *Third World Quarterly* 17 no. 5 (1996): 1007–1028.

- Castellanet, C. and C.F. Jordan. *Participatory action research in natural resource management: A critique of the method based on five years' experience in the Transamazonica region of Brazil*. New York & Sussex: Taylor and Francis, 2002.
- Cuéllar-Padilla, M. and Á. Calle-Collado. "Can we find solutions with people? Participatory action research with small organic producers in Andalusia." *Journal of Rural Studies* 27 no. 4 (2011): 372–383.
- De Schutter, O. "Agroecology and the right to food." In *Agroecology and the right to food: United Nations Special Rapporteur on the Right to Food*. (2010) United Nations General Assembly. http://www.srfood.org/images/stories/pdf/officialreports/20110308_a-hrc-16-49_agroecology_en.pdf. Accessed April 1, 2015.
- De Schutter, O. and G. Vanloqueren. "The new green revolution: How twenty-first-century science can feed the world." *Solutions* 2 no. 4 (2011): 33–44.
- Evenson, R.E. and D. Gollin. "Assessing the impact of the green revolution, 1960 to 2000." *Science* 300 no. 5620 (2003): 758–762.
- Fals-Borda, O. and M.A. Rahman (eds.). *Action and knowledge: Breaking the monopoly with participatory action-research*. New York, NY: Apex Press, 1991.
- Fortmann, L. (ed.) *Participatory research in conservation and rural livelihoods: Doing science together*. Hoboken, NJ: Wiley-Blackwell, 2008.
- Fox, J.A. "Empowerment and institutional change: Mapping 'virtuous circles' of state-society interaction." In *Power, rights, and poverty: Concepts and connections*. Alsop, R. (ed.). (Washington, DC: The World Bank, 2005), 68–92.
- Fox, J.A. "Lessons from action research partnerships." *Development in Practice* 16 no. 1 (2006): 27–38.
- Francis, C.A., G. Lieblein, T.A. Breland, et al. "Transdisciplinary research for a sustainable agriculture and food sector." *Agronomy Journal* 100 no. 3 (2008): 771–776.
- Francis, C., G. Lieblein, S. Gliessman, et al. "Agroecology: The ecology of food systems." *Journal of Sustainable Agriculture* 22 no. 3 (2003): 99–118.
- Freire, P. *Pedagogy of the oppressed*. London and New York: Continuum, 2000.
- Gliessman, S.R. *Agroecology: Ecological processes in sustainable agriculture*. Ann Arbor, MI: Ann Arbor Press, 1998.
- Gliessman, S.R. (ed.). *Agroecology: Researching the ecological basis for sustainable agriculture*. New York, NY: Springer-Verlag, 1990.
- Gliessman, S.R. *Agroecology: The ecology of sustainable food systems*. 2nd Edition. Boca Raton, FL: CRC Press/Taylor & Francis, 2006.
- Gliessman, S.R. *Agroecology: The ecology of sustainable food systems*. 3rd Edition. Boca Raton, FL: CRC Press/Taylor & Francis, 2015.
- Gliessman, S.R. "Aspectos ecologicos de las practicas agricolas tradicionales en Tabasco, Mexico: Aplicaciones para la produccion." *Biotica* 5 (1980): 93–101.
- Gliessman, S.R. "Nitrogen distribution in several traditional agroecosystems in the humid tropical lowlands of southeastern Mexico." *Plant and Soil* 67 (1982): 105–117.
- Gliessman, S.R. (ed.). *Seminarios regionales sobre agroecosistemas con énfasis en el estudio de tecnología agrícola tradicional*. H. Cardenas, Tabasco: Colegio Superior de Agricultura Tropical, 1978.
- Gliessman, S.R., R. Garcia-Espinosa, and M. Amador. "The ecological basis for the application of traditional agricultural technology in the management of tropical agro-ecosystems." *Agro-Ecosystems* 7 (1981): 173–185.
- Godemann, J. "Knowledge integration: A key challenge for transdisciplinary cooperation." *Environmental Education Research* 14 no. 6 (2008): 625–641.
- Goodman, D., M. DuPuis, and M.K. Goodman. *Alternative food networks: Knowledge, place and politics*. London: Routledge, 2011.
- Greenwood, D.J. and M. Levin. *Introduction to action research: Social research for social change*. Thousand Oaks, CA: Sage Publications, 1998.
- Grueso, L., C. Roscro, and A. Escobar. "The process of black community organizing in the Southern Pacific coast region of Colombia." In *Perspectives on Las Américas: A reader in culture, history, and representation*. Gutmann, M.C, Rodríguez, F.V., Stephen L, and Zavella P. (eds.). (Malden: Wiley-Blackwell, 2003).
- Guzmán-Casado, G.I., M. González de Molina, and E. Sevilla-Guzmán. *Introducción a la agroecología como desarrollo rural sostenible*. Madrid: Ediciones Mundi-Prensa, 1999.

- Guzmán-Casado, G.I. and A.M. Alonso-Mielgo. "La investigación participativa en agroecología: una herramienta para el desarrollo sustentable." *Ecosistemas (Spain)* 16 no. 1 (2007): 24–36.
- Guzmán-Casado, G.I. and A.M. Alonso-Mielgo. "A comparison of energy use in conventional and organic olive oil production in Spain." *Agricultural Systems* 98 no. 3 (2008): 167–176.
- Hacker, K. *Community-based participatory research*. Thousand Oaks, CA: SAGE Publications, 2013.
- Hecht, S.B. "The evolution of agroecological thought." In *Agroecology: The science of sustainable agriculture*. Altieri, M.A. (ed.). (Boulder, CO: Westview Press, 1995), 1–20.
- Holt-Gimenez, E. *Campesino a campesino: Voices from Latin America's farmer to farmer movement for sustainable agriculture*. Oakland, CA: Food First Books, 2006.
- IAASTD. *Agriculture at a crossroads: Global report by the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD)*. Washington, DC: Island Press, 2009.
- Iles, A. and R. Marsh. "Nurturing diversified farming systems in industrialized countries: How public policy can contribute." *Ecology and Society* 17 no. 4 (2012): 42.
- Kindon, S., R. Pain, and M. Kesby. "Introduction: Connecting people, participation and place." In *Participatory action research: origins, approaches and methods*. Kindon, S., Pain, R., and Kesby, M. (eds.). (Oxon: Routledge, 2007a), 1–7.
- Kindon, S., R. Pain, and M. Kesby (eds.). *Participatory action research approaches and methods*. Oxon: Routledge, 2007b.
- Kloppenborg, J. "Social theory and the reconstruction of agricultural science: Local knowledge for an alternative agriculture." *Rural Sociology* 56 no. 4 (1991): 519–548.
- Kremen, C., A. Iles, and C.M. Bacon. "Diversified farming systems: an agroecological, systems-based alternative to modern industrial agriculture." *Ecology and Society* 17 no. 4 (2012): 44.
- Martin, K. and J. Sauerborn. *Agroecology*. Dordrecht, the Netherlands: Springer, 2013.
- Méndez, V.E. "Agroecology." In *Encyclopedia of Geography*. Warf, B. (ed.). (Thousand Oaks, CA: Sage Publications, 2010), 55–59.
- Méndez, V.E., C. Adair, L. Berlin, et al. "Climate change adaptation and mitigation in the Lake Champlain Basin of Vermont." In *Climate change adaptation and mitigation in the Lake Champlain Basin of Vermont*. Grant proposal submitted to the University of Vermont Food Systems Initiative (2012).
- Méndez, V.E., C.M. Bacon, and R. Cohen. "Agroecology as a transdisciplinary, participatory, and action-oriented approach". *Agroecology and Sustainable Food Systems* 37 no. 1 (2013): 3–18.
- Minkler, M. and N. Wallerstein (eds.). *Community-based participatory research for health: From process to outcomes*. New York, NY: Jossey Bass, 2008.
- Parmentier, S. *Scaling up agroecological approaches: What, why and how*. Belgium: Oxfam-Solidarity, 2014.
- Patel, R. "The long green revolution." *Journal of Peasant Studies* 40 no. 1 (2013): 1–63.
- Paulson, S., G. Lisa, and M. Watts. "Locating the political in political ecology: An introduction." *Human Organization* 62 (2003): 205–217.
- Peet, R. and M.J. Watts (eds.). *Liberation ecologies: Environment, development, social movements*. London: Routledge, 2004.
- Perfecto, I., J. Vandermeer, and A. Wright. *Nature's matrix: Linking agriculture, conservation and food sovereignty*. London, UK: Earthscan, 2009.
- Rocheleau, D., B. Thomas-Slayter, and E. Wangari (eds.). *Feminist political ecology: Global issues and local experiences*. London: Routledge, 1996.
- Rosset, P. and M.E. Torres. "La vía campesina and agroecology." In *La Vía Campesina's open book: Celebrating 20 years of struggle*. La Vía Campesina, 2013. <http://viacampesina.org/downloads/pdf/openbooks/EN-12.pdf>. Accessed April 11, 2015.
- Schattman, R., V.E. Méndez, K. Westdijk, et al. "Vermont agricultural resilience in a changing climate: A transdisciplinary and participatory action research (PAR) process." In *Agroecology, ecosystems, and sustainability*. Benkeblia, N. (ed.). (Boca Raton, FL: CRC Press/Taylor and Francis, 2015), 326–343.
- Sevilla-Guzmán, E. "Agroecología y agricultura ecológica: Hacia una 're'construcción de la soberanía alimentaria." *Agroecología (Spain)* 1 (2006a): 7–18.
- Sevilla-Guzmán, E. *De la sociología rural a la agroecología*. Barcelona: Icaria Editorial, 2006b.
- Silici, L. "Agroecology: What it is and what it has to offer." In *Agroecology: What it is and what it has to offer*, IIED Issue Paper. London: International Institute for Environment and Development (IIED), 2014.
- Snapp, S. and B. Pound (eds.). *Agricultural systems: Agroecology and rural innovation for development*. Amsterdam: Academic Press, 2008.

- Stringer, E.T. *Action research*. Thousand Oaks, CA: Sage Publications, 1999.
- Thomas-Slayter, B., E. Wangari, and D. Rocheleau. "Feminist political ecology: Crosscutting themes, theoretical insights, policy implications." In *Feminist political ecology: Global issues and local experiences*. Rocheleau, D. (ed.). London: Routledge, 1996.
- Tomich, T.P., Brodt, S, Ferris, H, et al. "Agroecology: A review from a global-change perspective." *Annual Review of Environment and Resources* 36 no. 1 (2011): 193–222.
- Uphoff, N. (ed.). *Agroecological innovations: Increasing food production with participatory development*. London: Earthscan, 2002.
- Vandermeer, J.H. *The ecology of agroecosystems*. Sudbury, MA: Jones & Bartlett Publishers, 2009.
- Wezel, A., S. Bellon, T. Dore, et al. "Agroecology as a science, a movement and a practice. A review." *Agronomy for Sustainable Development* 29 no. 4 (2009): 503–515.
- Wezel, A. and V. Soldat. "A quantitative and qualitative historical analysis of the scientific discipline of agroecology." *International Journal of Agricultural Sustainability* 7 no. 1 (2009): 3–18.
- Whitmer, A, L. Ogden, J. Lawton, et al. "The engaged university: providing a platform for research that transforms society." *Frontiers in Ecology and the Environment* 8 no. 6 (2010): 314–321.