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ESDS. Socially Constructed Scarcity.

3

IMPROVED SEEDS AND CONSTRUCTED SCARCITY

Lakshman Yapa

It is widely believed that poverty is caused by economic underdevelopment, and that the problem can be solved through economic development – increasing investment, creating jobs, raising incomes, and improving the general standard of living. I shall refer to this as the "axiom of economic development" – "axiom" because these claims seem so obviously true they have become an integral part of "common sense." The principal purpose of this chapter is to contest the validity of this axiomatic belief. I argue that poverty is not the result of lack of development, poor technology, or scarce resources, but a normal manifestation of the very process of economic development that is supposed to cure it; development causes modern poverty through "socially constructed scarcity." The argument for development-induced scarcity is made by narrating a story about the Green Revolution – how "improved seeds" are implicated in the social construction of scarcity.

Criticisms of "solutions," such as high-yielding seeds, are usually countered by questions like, "Hasn't the Green Revolution staved off massive hunger in the Third World?" It is not possible to provide objective "intelligent" answers to such questions because they presume a certain way of knowing the world. As I show later in the chapter such questions have little meaning outside that epistemology. "If development is not the answer, what is the solution to hunger and poverty?" Over the years, as I became increasingly skeptical about the promise of development, I looked to "other models of development" – socialist, sustainable, authentic, and so on – as possible solutions to poverty. Eventually I concluded that it was impossible to describe such a space in the pages of an article or as a chapter in a book; the search for solutions is a discursive convention stemming from the same epistemology of development that I find so problematic. That still leaves the question unresolved of how one should address issues of hunger, malnutrition, and poverty.

The usual answer, Green Revolution, is not just a matter of producing more food with improved seeds. It embodies a particular epistemology of development, a way of seeing food, technology, nature, culture, and society, an epistemology I wish critically to engage through my narrative of seeds. In this story there is no circumscribed space called "the alternative" to the Green Revolution; in fact there

are thousands of site-specific alternatives that emerge in the substantive details of the story. It is not possible to jump ahead for a sneak preview because there is no "solution" to be unveiled at the end of this critique. The "solution" lies within an understanding of the detailed structure of the critique; the critique is the solution.

By "poverty," is meant a situation in which households are unable to satisfy their basic needs for food, clothing, shelter, health care, and functional literacy. "Economic development" refers to efforts to improve "standards of living" through ever-higher levels of production and consumption of material goods and services – that is, through an accelerated growth in GNP. The term "development" is also used to cover all institutions, values, and economic theories that conceive, support, and implement this process. In this chapter I refrain from producing a precise definition of the term "development" because that would not do justice to its many meanings. My plan is to deal with a specific meaning of the term emerging from a story about improved seeds and modern agriculture. A full exposition of the argument of modern poverty as development-induced scarcity would require many other analyses – of nutrition, health care, housing, clothing, literacy, transport, and so on.

There are three principal paradigms within the discourse on economic development: (1) neo-classical economic theories of underdevelopment concerning overpopulation, transfer of technology, and diffusion of innovations; (2) neo-Marxist theories of uneven development concerned with imperialism, dependency, and world systems; and (3) the environmentalist conception of sustainable development. There are two other strands of thought – political ecology and new social movements – that have not wielded much influence in policy circles as yet. Political ecology combines ecological concerns with political economy (Bryant 1992; Peet and Watts 1993; Pickles and Watts 1992). Political ecology in the 1980s has produced, in my judgment, some of the most sophisticated theoretical analyses in development by combining insights from ecology, history, class analysis, the theory of the state, global capital, gender, and local knowledge systems (Blaikie 1985; Carney 1993; Hecht 1985; Richards 1985; Rocheleau 1991; Watts 1983). Despite profound differences in their world views, the major paradigms share the central belief that poverty arises from lack of development, that is underdevelopment, a condition that can be eradicated with more development. The contrary notion, that development creates scarcity, calls for a basic rethinking of the "poverty problem." We need to rethink what we mean when we say "Bangladesh is a basket-case of poverty." We need to examine the suggestive power that geographic boundaries may have on where the poverty problem is located. I argue that the "problem" should no longer be confined to the place where we see tangible, physical evidence of poverty, but should include the very intellect that helped conceptualize poverty in the first place. This leaves us in a serious predicament, because academic tools – that is, the paradigms of development and the epistemology of poverty – pose an obstacle to a solution by distorting understanding of the problem.

New seeds (once called "miracle seeds") are widely understood to be a beneficent technology dramatically increasing agricultural output – a significant technological breakthrough in the fight against hunger in the Third World. That is the official version of the Green Revolution story, inspired by the writings of neo-classical economists. However, these same seeds reveal a considerably more complex and contradictory character when viewed from other vantage points, such as political ecology. Different paradigms, each with its own "way of knowing," direct our attention to attributes of seeds other than high yields, and provide important new meanings to the question, "What are improved seeds?" By moving beyond a view of seeds as material things, to one of seeds as the embodiment of a nexus of interacting relations (social, ecological, academic, and so on), we can see how seeds are one means for dominating people and nature, and how this technology can both create and destroy use values at the same time.

The story of the epistemological transformation of the Green Revolution, from seeds of plenty to seeds of scarcity, is important in another respect. It enables a deeper understanding of the nature of the paradigms themselves – their assumptions, the origins of their language, their strengths, and limitations. Even as paradigms inform us about the nature of seeds, seeds inform us about the nature of paradigms. A seed is an indissoluble nexus of relations. It has been improved, bred, and studied through an epistemology formed by ahistorical, subject-specific disciplines and paradigms. The fragmented nature of that discourse prevents us from seeing the paradox of how improved seeds can give high yields and create scarcity at the same time. Observers of development projects in the Third World may recognize that the story of improved seeds told here is not exceptional.

THE NEXUS OF PRODUCTION RELATIONS

The principal analytical scheme used in this chapter is "the nexus of production relations." Production is an "economic" activity only in the narrowest sense of the word, because it includes far more than technology, goods, and markets. Production is determined at once within a web of relations – technical, social, ecological, cultural, political, and academic – the understanding of which is distorted by the subject-specific views of reductionist science (Figure 3.1). These relations should not be conceived as discrete, analytical categories. Nor is the list meant to be exhaustive. The relations act, interact, and react to maintain a dynamic process of production: analytically, there are no visible seams between them. In a historical sense, the relations are mutually constituted. An entity that appears technological from one perspective, may be academic or social from another. I have borrowed the term "production relations" from Marx (1989 [1869]). However, I have extended the meaning of the term "production relations" beyond the "social," its original usage. I have consciously tried to avoid the problems of the Marxian scheme of associating social relations with the economic base, and matters of culture, knowledge, and ideology with the

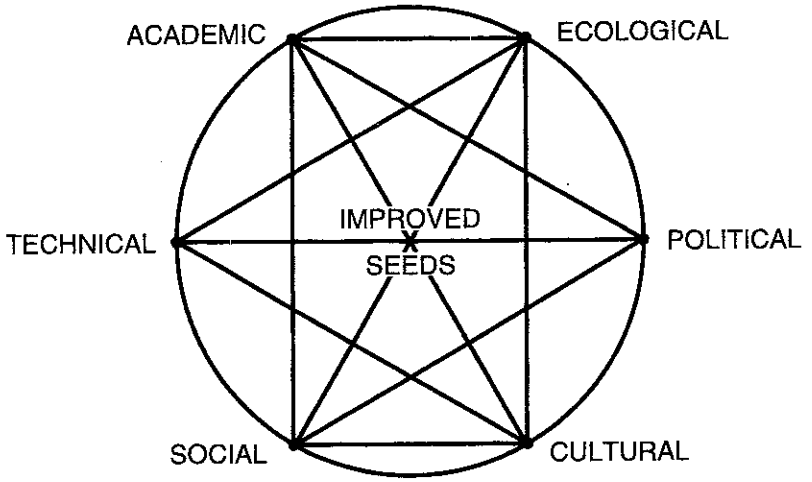

Figure 3.1 Improved seeds: the nexus of production relations

superstructure. I explore the interactions among these relations without any concern for which may be more determinate or "essential." There is no a priori assertion that one kind of relation is more important, determinant, or essential than another. Production exists in an "overdetermined" system where every aspect "is constituted – literally created – as the combined effect of all other aspects" (Wolff and Resnick 1987: 134).

The concept of "overdetermination" stands opposed to essentialism. The latter is the "presumption that complex realities of any sort are ultimately reducible to simpler, or essential, realities" (Graham 1990); under essentialism, some influences producing an outcome can be shown to be non-essential while others can be shown to be the essential causes (Graham 1992). Peet (1992) objects to non-essentialism by insisting that the refusal to separate essential from non-essential leads to indecision and weakens the base of political activism. In my judgment the academic's insistence on discovering the essential (popularly called "finding the root causes") weakens political activism by discounting a large number of "non-essential" sites at which numerous agents engage the circumstances of routine, everyday life. My story of improved seeds testifies that the non-essentialist approach of the nexus of relations can expand the scope of activism in South Asian food politics. While lack of access to land remains an important cause of hunger, the scarcity of food in South Asia is orchestrated through a bewildering array of mechanisms reaching beyond social relations of land ownership into the cultural, ecological, political, and academic realms. Each node in the nexus where scarcity is constructed provides also a site for mounting political resistance, multiplying the scope for activism; however, the agents of such activism, and the choice of strategies, may differ drastically from one node to another.

The nexus of production relations is a discursive materialist formation (Figure 3.1). Adapting a scheme from Foucault (1980) I argue that each node is a site of both discursive and non-discursive practices. Technology, culture, and nature are not only material processes but are constructed and driven by the discourses about them. For example, at the technical node, there are technical "practices" related to the use of land, labor, and capital; but these practices are informed and constituted by various discourses in neo-classical economics, engineering, banking, and so on. Similar discourses/practices occur at all other nodes of the nexus. Improved seeds are not mere material entities, distributed, grown, and eaten; they are constituted by specific social theories (discourses) of technology, culture, and nature. Improved seeds thus exist in a discursive materialist formation.

The phrase "technical relations of production" in Figure 3.1 is similar to Marx's forces of production – the raw materials, resources, labor, and technology used in production (Marx 1989 [1869]). The term "technical relations" calls attention to the determination of attributes of production forces in a larger context (i.e. by other relations). The term "social relations of production" is used in a manner identical to Marxian economics, where it refers to ownership of the means of production, the manner in which the means of production are utilized, and the rules for the social distribution of the final product (Marx 1989 [1869]). Production requires matter and energy as input and a repository to hold waste materials, chemicals, and heat, setting in motion myriad interactions with the biophysical environment – "the ecological relations of production." The phrase "cultural relations of production" refers to the interaction between economy and culture, in particular the interaction of production with "the ways of life" of social groups embodied in shared meaning, beliefs, values, and symbols. Political relations of production include interactions between the state and society in the organization of economic activity. In Third World societies the state plays an all-pervasive role in civil society through its command over development projects. However, I subsume that topic in this chapter under the heading "social relations." Academic relations are of two kinds: internal and external. Internal academic relations arise from the understanding science has of itself in the production of knowledge, that is the view of science as neutral, value-free, and non-political (Proctor 1991). External academic relations refer to the discourses produced at other sites in the nexus: technical, social, cultural, political, and ecological. Academic descriptions of production are not necessarily impartial and neutral, because values, assumptions, objectives, models, and language of representation are all thoroughly imbued by the entire nexus of production relations. This argument has important implications for the academic discourse on poverty.

THE SOCIAL CONSTRUCTION OF SCARCITY

Innumerable mechanisms create scarcity by influencing how "demand end-uses" are matched to "sources of supply." An "end-use" is the "use" to which a good is

put in the "end." Scarcity may be created by an expansion of end-uses, as with the creation of demand for new goods through advertising. Even more important is the manipulation of sources of supply. Imagine that a particular end-use is met through several different sources of supply. Through time some of these sources are neglected, "de-developed," and gradually disappear. For example, nitrogenous fertilizer can be provided to a field in a variety of ways, including inorganic commercial fertilizer, animal waste, agricultural residue, crop rotation, the growing of legumes, interplanting, and slurry from methane digesters. However, inorganic commercial fertilizer has become the principal, and often the only, means by which crop nutrients are provided. Increased demand for inorganic fertilizer, and the de-development of other methods, grew partly out of an academic discourse involving universities, national and international research institutes, the state, agribusiness, and international development agencies.

The logic of matching sources to end-uses has application in every area of technology: food, nutrition, agriculture, manufacturing, health care, housing construction, transport, and education. The adoption of this principle in the context of underdevelopment and poverty gives new meaning to the terms "resources," "technology," and "capital." End-use analysis begins with a needed use value and looks for the most direct way of satisfying it, minimizing energy, material, and transport. In fact the entire nexus of production relations can be employed in matching sources to end-uses. Thus the terms "resources," "technology," and "capital" have no universal meaning in the absence of a concrete end-use analysis in a given region. Contrary to the claims of economists "scarcity" has no context-free, universal meaning; indeed, the physical geography of a region, its ecology, cultural values, people's knowledge of plants and animals, class, and power are all essential to determining what constitutes a "resource." Resources are not things and they are not stocks; they are discursive material entities existing in a nexus of relations.

I shall turn next to a detailed consideration of individual sites in the nexus of improved seeds. The nexus has no inner logic ranking different sites according to an order of importance. The nexus is also a useful tool to get a perspective on paradigms of development; by focusing on a class of "essential" causes each paradigm highlights particular relations but fails to see how scarcity is constructed at a large number of other sites (including academia).

TECHNICAL RELATIONS

At its most basic level the Green Revolution represented a new technology to increase the production of cereals, particularly maize, wheat, and rice. It consisted of high-yielding seeds grown in association with chemical fertilizer, pesticides, and irrigation; without these inputs the new seeds yielded poorly (Shiva 1991: 46). Two principal points of this paper follow from the "technical" traits of improved seeds: first, the technical attributes of seeds are not "attributes" as such, but are *relations* that determine, and are determined by, the nature of

other relations in the nexus; second, each node of the nexus is a site at which food scarcity is constructed, notwithstanding the evidence of statistical data showing impressive gains in cereal production.

When traditional varieties of cereal are heavily fertilized they lodge (bend over) under the weight of increased yield. Plant breeders solved the problem by developing fertilizer-responsive, thick-stemmed dwarf varieties using hybridization techniques. All modern varieties are the result of hybridization techniques although the term "hybrid" is confined to the first generation progeny obtained from crossing two varieties that have been first inbred through several generations as in the case of corn (Phoehlman and Sleper 1995: 159). A seed grain performs two functions: the endosperm produces food for the germinating plant (also the source of our own food), and the embryo reproduces the plant. In recent years there has been an increasing physical separation of the sites at which these two functions are performed. The reproduction of seeds has moved into the realm of formal science, experimental plots of research institutes, gene banks, commercial seed suppliers, bureaucratic processes of seed certification, and so on. In a word, farmers have lost control over the reproduction of seeds, a tendency that will intensify with gene research in seeds (Kloppenburg 1988; Mooney 1979).

The purchase of inputs (seeds, fertilizer, pesticides, and fuel) is a significant source of expense for small peasant farmers. During the 1970s and early 1980s most governments offered inputs at subsidized rates in an effort to promote the adoption of new varieties. With increasing prices of petroleum and the cutting-back of input subsidies (under economic restructuring), farm costs sky-rocketed. Using 1961 as the base year the index of food production for the developing countries increased at the rate of 0.04 per year over the years 1961–91, with much of the increase coming from cereal production. However, the index of consumption of commercial nitrogenous fertilizer grew at a staggering rate of 0.28 per year over the same period. The quantity of nitrogenous fertilizer used per metric ton of food in the early 1990s was between 3.5 to 4 times the amount used in 1961. The cultivation of pulses, important sources of protein food for poor people and biological nitrogen for the soil showed little or no increase during the entire period (calculations were made from the FAO data diskettes – AGROSTAT-PC 1994). In India all agricultural inputs increased at an aggregate rate of 4.2 per year between the years 1970–71 and 1979–80, but real output increased at only 2.3 per year. As a result the index of productivity declined from 100 in 1970–71 to 75 in 1979–80 (Agarwal and Narain 1985: 160).

A discussion of technical relations of new seeds is a useful place to make a general remark about neo-classical economics and spatial diffusion of innovations. These paradigms assume underdevelopment is caused by an inadequate development of production forces, a situation that can be corrected by the diffusion of inputs: capital, know-how, and technological innovations. Accelerated development of production forces was the answer to underdevelopment. This was the underlying thinking in promoting high-yielding seeds. Regional prosperity would emerge from expanded food production following

the adoption of the technical package: seeds, fertilizer, pesticides, and pump-sets for irrigation; this thinking ignored social, ecological, cultural, and academic relations of innovations.

SOCIAL RELATIONS

William Gaud of the United States Agency for International Development first used the term "Green Revolution" in a speech given to the Society for International Development in March 1968 (Spitz 1987). Gaud alluded to the possibility of a green technical revolution in food production as counterposed to a red political revolution. In December 1969, Green Revolution was presented to the U.S. Congress as a major tool of American foreign policy that provided bright market prospects to the pesticide, fertilizer, seed, and tractor industries (Spitz 1987). The very term was thus a political construct. Published documents of the World Bank and the U.S. Agency for International Development during the 1960s and 1970s show the question of land reform was a significant element of the development discourse during that time (World Bank 1974). But, as the productivist logic of the Green Revolution got under way, interest in land reform disappeared from the official agenda of development. Within Third World countries the state was the most important agent promoting Green Revolution technology; the massive project involved national universities, research institutes, ministries, extension services, imports, subsidized inputs, credit and banking, and so on. The entrepreneurial spirit of the state coincided with waning interest in land reform; these state policies were adopted and executed on behalf of powerful class interests of importers and landlords (El-Ghonemy 1990; Herring 1983; Nandy 1992).

The Green Revolution was promoted without a serious consideration of social relations of production. This was a crucial mistake, because interpersonal economic differences and class play important roles in determining who adopts what in rural areas of the Third World (Blaut 1987; Griffin 1974; Yapa and Mayfield 1978). Griffin (1974) has made a persuasive argument to this effect with his model of biased innovations: capital-intensive innovations in the package of high-yielding seeds soon acquired a landlord bias in the fragmented factor markets of India. A large number of studies have shown an increase in income inequality and asset distribution as a result of the Green Revolution (Frankel 1971; Griffin 1974; Harriss 1977; Hewitt de Alcantara 1976; Pearse 1980; Shiva 1991); these claims have been strongly contested in a study of rice growing areas of South India (Hazell and Ramasamy 1991). I shall not intervene in this debate here as it is not possible to evaluate "results" of income and asset distribution studies without detailed attention to specific methodologies employed in each case.

Concern with social relations of Green Revolution technology came out of the academic tradition of political economy. That critique focused on the role of capitalist farming in the exacerbation of class and regional income inequalities

through the uneven adoption of high-yielding seeds (Griffin 1974; Hewitt de Alcantara 1976; Yapa and Mayfield 1978). Political economy provides a new answer to the question, "What are improved seeds?" They are a technology that produce higher yields, but they confer benefits unequally to different classes. The state-sponsored productivist logic of the Green Revolution marginalized those concerns. However, missing from the political economy critique were other important questions: Why does technology follow a particular path and not another? What are the ecological and cultural relations of different kinds of technologies?

ECOLOGICAL RELATIONS

Production involves the transformation of materials into use values through the application of information, energy, and labor using the ecosystem as a source of energy and matter and as repository of waste products. This defines myriad interactions within the biophysical environment: these are ecological relations of production. Scarcity is constructed in the ecological realm through two modes: (1) by replacing the "reproductive capacity" of nature with the "productive capacity" of industrial inputs, and (2) by degrading conditions of production (Shiva 1991). I shall illustrate these points by looking at improved seeds from the viewpoint of genetic diversity, required inputs, and so-called economic "externalities."

A serious effect of the introduction of new seeds is the accelerated loss of genetic diversity (Mooney 1979). According to Erlich, a noted biologist, "Aside from nuclear war, there is probably no more serious environmental threat than the continued decay of the genetic variability of crops" (Erlich *et al.* 1977: 344). Genetically uniform varieties of rice, wheat, and corn grown in monocultural stands are more vulnerable to pests and pathogens than older varieties which have co-evolved with the local environment, necessitating the use of pesticides, another example of social construction of scarcity (Bull 1982: 13). Pesticides cause the large-scale destruction of non-target populations, the genetic evolution of pesticide-resistant organisms, the contamination of water and agricultural produce, and the reduction of soil organisms that maintain the quality of humus in the soil (van den Bosch 1978; National Research Council 1989); moreover, they pose health risks to agricultural workers (Wright 1990). Apart from serious environmental hazards, chemicals are also expensive; their use has increased the dependence of Third World farmers on international capital. The pesticide industry – that is, its research, development, and marketing – underdevelops alternative techniques, which include: biological control through prey–predator relationships; cultural methods, such as crop rotation, multiple cropping, and companion planting, that alter the environment by making it less suitable for pests; and crop breeding programs that develop disease-resistant plants. Of all these techniques the chemical ones receive the most support, because they create most exchange value. Even though more than 20,000 serious pests are known,

natural enemies are known for less than 10 percent of these. Entomologist Debach (quoted in Nebel 1981: 428–9) believes this research is underfunded because biological methods do not generate profits the way synthetic chemicals do

The world production of nitrogen fertilizer rose from about 6.5 million metric tons in 1955 to 67.5 million metric tons in 1984. In that year developing countries consumed more than 40 percent of the world's nitrogen fertilizer (Food and Agriculture Organization 1984). Apart from increasing costs the use of chemical nitrogen contributed to increasing scarcity by reducing the supply of naturally available organic nitrogen. It had the effect of underdeveloping knowledge of biological sources of nitrogen related to crop rotation, multiple cropping, incorporation of nitrogen rich legumes in agricultural production, use of agricultural and plant remains, and application of animal manure.

In South Asia, there is widespread evidence that fertilizer and pesticide runoff contaminate groundwater and streams. The fish and crab populations living in rice paddies, an important source of protein for the poor, have declined, or are unsafe to eat (Bull 1982: 63–4). Poor farmers working knee-deep in the rice paddy mud do not wear protective clothing. Moreover, in regions without indoor plumbing or water purification plants, farmers wash themselves in water from the fields, streams, and irrigation channels, which now carry unsafe levels of chemical contaminants. In the context of South Asian farming the very use of the word "environment" can be misleading, because, physically speaking, farmers are an integral part of "the environment"; it is quite harmful to describe the condition of contaminated water as an "externality." One may well ask in what sense is contaminated water an "externality" when farmers have to drink, wash, bathe, and work in it. Thus hybrid seeds are not simply a technique of increasing food production, but represent the emergence of a mode of production that is destroying the productive base of subsistence.

CULTURAL RELATIONS

The term "cultural relations of production" refers to the interaction between culture and economy. Rhodes (1984: 43) describes "culture" as follows:

> Cross-cutting and underlying . . . all anthropological studies is the notion of "culture." A dynamic blueprint or design for living, culture is learned behavior handed down through generations so that each new cohort of babies in a society does not have to start again from scratch. To some degree, what agricultural scientists call tradition is the anthropologist's culture.

Rhodes's remarks about agricultural scientists' conception of culture as tradition are crucial to understanding the cultural relations of the Green Revolution. Improved seeds arrived in the villages of India carrying the authority of science and modernity. The new seeds – sponsored by international aid agencies, developed by crop-breeding science, backed by multinational agribusiness

capital, approved by the Government of India, and promoted by an army of trained extension workers – presented a formidable power that confronted peasant farmers living in their "traditional culture of poverty."

Chambers (1983: 76) describes this unequal encounter of modernity and tradition in an essay entitled "Whose knowledge?":

> From rich-country professionals and urban-based professionals in the third world countries right down to the lowliest extension workers it is a common assumption that the modern scientific knowledge of the centre is sophisticated, advanced and valid, and conversely, that whatever rural people may know will be unsystematic, imprecise, superficial and often plain wrong.

To the centuries-long colonial view of peasant agriculture as primitive was added the "modernization" literature of the 1960s and 1970s, which set out to transform "backward" traditional culture, the principal obstacle to adoption of innovations and the diffusion of development (Rogers 1969; Rostow 1960). The concept of traditional culture as backward is an elaborate academic representation of "the other," an intellectual construction which actually reflects the values of sociologists immersed in the dominant world-view of capitalist culture. There is no objective referent in the external world called "backward traditional culture" that is independent of the intellect that constructed it (Said 1979).

Several prominent students of "traditional" agriculture have written persuasively about the complexity and longevity of mixed farming that incorporates animals, manure, and crop rotation – for example, F.H. King (1973 [1911]) of the U.S. Department of Agriculture and Sir Albert Howard (1973 [1940]). Among geographers the pre-eminent student of traditional agriculture was Sauer (1952, 1963 [1938]) who was quite emphatic in his condemnation of the Rockefeller Foundation proposal in the early 1940s to modernize Mexican agriculture (Jennings 1988: 50–5). Based on surveys of traditional farming conducted at several sites in southern Mexico and Central America, Wilken (1987) described traditional resource management techniques in energy supply, soil classification, and the management of soil, water, slope, and space. Wilken adds that traditional tools and techniques are not easily duplicated, because most traditional technology requires understanding local conditions and ways of managing local energy and materials. Other writing describing the importance of indigenous knowledge includes: Altieri (1987); Brokensha *et al.* (1980); Chambers (1983); Harrison (1987); and Richards (1985.

A good example of the implications of modernization of traditional agriculture comes from the Andean Highlands of Peru. The Andes are the richest gene pool for potatoes, estimated by geneticists to contain 2,000–3,000 varieties. The farmers possess highly developed systems for classifying potatoes that have enabled them to observe, select, and propagate many varieties over large, diverse, mountainous areas. There are also well-developed trading networks for exchange and sale of seed potatoes. Often in a single locality as many as 50–70 varieties

may be found, adapted to local conditions. Since 1950, systematic efforts have been made to modernize the potato culture of the Andean Highlands; with the increased adoption of improved varieties, has come an increased demand for external inputs, including seeds. The modernization of the Andean potato culture parallels what we saw in Asia, where there has been a break in the connection in knowledge of local ecology and of the practice of matching native varieties to particular places to minimize losses from frost, drought, and disease (Brush 1986).

The modernization literature on diffusion in the Third World profoundly misrepresented and misinterpreted traditional societies as backward and non-innovative. This cultural bias, abetted in part by academics, affected public policy and the course of diffusion of agricultural innovations. It has also been a bearer of the hegemonic culture of science, capital, and authority that subjugates tradition and the keepers of that knowledge. By doing so the architects of the Green Revolution robbed culture of its power as a problem-solving agency in the everyday life of poor people.

ACADEMIC RELATIONS

The expression "academic relations of production" refers to the work of agricultural scientists who conceived and bred improved seeds, and the work of social scientists who conceived the social theory that facilitated the diffusion of that technology. The story of improved seeds provides an excellent example of the claim made by critical social theorists that science and technology are in fact "social processes" directed by power relations in underlying society, serving to strengthen and reproduce those power relations (Aronowitz 1988; Foucault 1980).

I argued earlier that improved seeds were not just a technology to feed people better by increasing food production, but that they were also an instrument designed to serve the economic interests of particular classes of people. Such claims are usually dismissed as being a naive subscription to conspiracy theory. One resolution to the debate lies in critical social theory which shows how knowledge is constructed to serve the needs of a particular world view, and how this can happen through "internal academic relations," without that intellect being centrally directed by particular agents (Aronowitz 1988; see also *Monthly Review*, July–August 1986). In his critique of "value-free science," Proctor (1991: 268) expressed this in the following way:

> The simplest and perhaps the oldest version of the ideal of neutrality is that science may be used for good or for evil. The problem with this view, though, is that it ignores the fact that science has both social origins and social consequences. Who, one can ask, does science serve, and how? Who has gained from "miracle wheat" and who has lost? . . . Science is not different from other aspects of culture in this sense.

Wheat and corn improvement research conducted by Norman Borlaug is cited as the beginning of the Green Revolution in Mexico. The Mexican story goes further back, however, to the 1930s, when the Ministry of Agriculture in Mexico during the progressive years of President Cardenas (1935–40) initiated a program of scientific research to improve corn, the main staple of the peasantry. The years of Cardenas saw sweeping land reforms, the expropriation of Standard Oil, and the threat of take-over of other U.S. investments in Mexico. With the installation of Camacho as president, the program for the improvement of peasant crops was disbanded. During the 1940s, with help from the Rockefeller Foundation, a new program of agricultural research was started, focusing on hybrid varieties of irrigated wheat for large-scale commercial growers of northwest Mexico. The idea was to reverse the agrarian radicalism of Cardenas and replace it with a model of scientific, industrial agriculture to produce food surpluses for urban areas using industrial inputs. This program later came to be known as the Green Revolution; it did much for agribusiness of pumps, machines, fertilizer, and pesticides and little for the nutrition and welfare of Mexican peasants (Hewitt de Alcantara 1973–4). Drawing on Rockefeller archives, Jennings (1988) reports that Carl Sauer, who was a strong critic of the model of industrial agriculture, believed that the agricultural and nutritional practices of Mexican peasantry were quite sound, but that they needed support and strengthening. Sauer's advice went unheeded at the foundation. Borlaug's work also marginalized the research on rain-fed corn done by Mexican scientists in the Institute of Agricultural Investigations. Hewitt de Alcantara (1973–4: 32) has suggested that Camacho and his advisors specifically reached for a pro-industrial program as a substitute for the agrarian programs of Cardenas.

The International Rice Research Institute (IRRI) was founded in Los Baños, the Philippines in 1960 with funding from the Ford and Rockefeller Foundations. The conception of agricultural research at IRRI was simple, centralized, and productivist; according to Anderson *et al.* (1980: 7–8) it assumed:

> that a single international center would be able to design and breed a small set of new varieties of rice plants that would displace the thousands of locally cultivated plants in the irrigated rice lands of Asia. . . . Although by the commonly accepted standards of academic research the IRRI scientists and technologists were well qualified in their specialties, few had a deep understanding . . of indigenous practices . . . or the socio-economic contexts in which Asian cultivators operated

The social theory of the Green Revolution came out of the work of modernization theorists. The promotion of high-yielding varieties spawned a whole new vocabulary that included terms and expressions such as "progressive farmers," "backward farmers," "betting on the fittest," and so on. Capitalist farmers with access to large areas of irrigated land who could purchase the expensive inputs were culturally and linguistically transformed into "progressive farmers." Poor farmers who could not afford to respond, and intelligent farmers who actively

rejected the new seeds for ecological reasons, were transformed into "backward farmers," or "laggards," in the language of the sociology of innovation diffusion. In India, the strategy of "betting on the fittest" was a social rationalization of agrarian policies that had nothing to offer the marginal farmers, the landless laborers, or those who cultivated coarse grains in areas of rain-fed agriculture (Frankel 1971)

And so we return again to the question: "What are improved seeds?" The conception of seeds as academic relations shows that what had earlier been called technological, social, ecological, and cultural is in fact constructed through academic processes of research and social theory – "external academic relations." Therefore, it is through academic "deconstruction" that we can begin to understand how improved seeds are actually constituted as a discursive material entity. The question "Hasn't the Green Revolution staved off massive hunger in the Third World?" makes sense only within a particular epistemology; the same inquiry makes little sense when viewed in the context of a nexus

CONCLUSION

This chapter was partly an exercise in understanding how social problems are defined and solutions are proposed. Since poverty is a serious problem, development was the solution, for example, the Green Revolution. But such solutions are in fact part of the problem, because poverty is a form of scarcity induced by the very process of economic development. That argument was illustrated by narrating a story of improved seeds. In this paper I explored the question "What are improved seeds?" The answer that it is a technology that increased yields, is a reductionist description that ignores how scarcity was constructed in the nexus of relations. Scarcity is not a general condition; it is always socially specific. The Green Revolution created a technology which required poor farmers to buy inputs; it ignored other appropriate technologies of food production such as rain-fed farming, multiple cropping, growing of legumes, and so on. Its productivist logic marginalized political economists' concerns for people's access to land and productive resources. It devalued the "reproductive power" of nature by substituting the "productive power" of industrial inputs. Further, the ecological degradation caused by the use of these inputs reduced the subsistence capacity of land. By marginalizing traditional knowledge it robbed the culture of poor people of its power/agency to address problems of everyday life. It produced an academic discourse that concealed how production can also destroy use values, creating social scarcity at each node of the nexus; thus it disempowered poor people and misled people of goodwill. The problem of poverty must, therefore, be expanded to include not only concrete places and people that experience scarcity, but also the epistemology of how we know scarcity and poverty.

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