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Balancing on a Planet: Toward an Agricultural Anthropology for the Twenty-First Century

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Robert Netting had a central role in establishing agricultural anthropology. Many people rightly remember him as an astute ethnographer of farming communities, focused on analyzing the empirical details of changing patterns of household composition, land holding size and labor use. Yet, during his career he was increasingly concerned about the sustainability of smallholder vs. conventional industrial agriculture models on a global scale. Thus, Netting also had an important role in laying the foundation for the development of an agricultural anthropology for the twenty-first century, an anthropology that shows how smallholders "balancing on an Alp" can help us to understand how we might balance on this planet. This paper analyzes Netting's contribution to the future of agricultural anthropology in three key areas: the environment, population, and agriculture relationship; farmer knowledge and epistemology; and models for global sustainability.

KEY WORDS: agricultural intensification; sustainable agriculture; population and agriculture; indigenous knowledge; ecological economics; Africa.

INTRODUCTION

Robert McC. Netting had a central role in establishing the disciplinary focus of agricultural anthropology through his 1974 review essay on "agrarian ecology" (Netting, 1974), and two editions of *Cultural Ecology*, first published in 1977 (Netting, 1986). In his teaching and fieldwork he always emphasized the importance of "counting potatoes," exhorting students and colleagues to "measure, map and weigh" (Netting, 1974, p. 43), and he championed the adaptive "common sense" innovation of smallholder farmers in concert with Ester Boserup's formulations. Many people, therefore,

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rightly remember him as an astute ethnographer of farming communities, focused on analyzing the empirical details of changing patterns of household composition, land holding size and labor use. Thus, Netting's larger message about the misguidedness of applying the industrial agriculture model to the Third World may not often be fully understood. However, in his final book, *Smallholders, Householders*, Netting's goal was to reach a wider audience of policymakers outside of anthropology and academia (Netting, 1993, p. vii), to let people know that small-scale, intensive agriculture "may be more vital and necessary to *our* future than we realize" (Netting, 1993, p. 334, emphasis in original). In this article, I consider Bob Netting's contribution to the development of agricultural anthropology into the twenty-first century, an anthropology that addresses the issues of sustainability at the global level, while remaining rooted in the understanding of the local—how smallholders "balancing on an Alp" (Netting, 1981) can help us to understand how we might balance on this planet.

Increasing understanding of the negative environmental and social effects of a human population of unprecedented size growing at unprecedented rates, the finiteness of Earth's resource base, and the rising cost of agricultural inputs, suggests that the challenge of balancing on our planet has never been greater (Cohen, 1995; Vitousek *et al.*, 1997). I accept the hypothesis, supported by many data, that there are physical limits to agricultural growth which means that "population stability is essential to reduce the need for growth everywhere" (Goodland, 1995, p. 10). Both large-scale, high-input, and small-scale, low-input agriculture can have negative social, environmental and economic impacts (Arrow *et al.*, 1995), and "sustainability" has become the focus of most discussions of agriculture and agricultural development (Matson *et al.*, 1997).

Netting anticipated the challenge that sustainability in the twenty-first century holds for smallholder farming, and he explicitly invoked the theme of "sustainable agriculture" in the subtitle of *Smallholders*, even while he struggled with the rest of us to infuse practical meaning into this overused and abused term. Sustainability is, of course, a relative concept, and depends on the subjective values of the definer, as Netting well recognized (Netting, 1993, p. 143–145), and therefore definitions must be socially and culturally negotiated.[2] Sustainable agriculture commonly includes environ-

[2]Some NGOs have become so frustrated with the opportunistic use of the term "sustainability" that they have made a decision to avoid using it altogether. For example, at the ISA-Net (Industrial Shrimp Action Network) meeting in October 1997 a decision was made to avoid using the term in group documents (Cissna and Cleveland, in press). It might be better to think of the "goal" of a given agricultural system, since this term has a more widely accepted meaning, and makes it clear that we are referring to values, and then measuring how well the system is meeting these goals (cf. Thompson, 1995, p. 158). Pearce *et al.* define sustainable development as a vector of "desirable social objectives" or "goals" "open to ethical debate" (Pearce *et al.*, 1990, pp. 2–3).

mental, economic, and sociocultural aspects, but the interpretation of the sustainability of a given agriculture based on objective measurements of variables in these three areas will always be subject to the particular definition of sustainability used. Thus, while the relative importance given to the various components of sustainability and the values for specific variables that are considered sustainable vary widely, most definitions do in general agree that a *more* sustainable agriculture is one which is *relatively* more conservative of natural resources, more economically profitable for the farmer and society, and in which access to resources and benefits are more equitably shared by women and men, ethnic minorities, and the poor (e.g., Francis and Callaway, 1993). This is the broad sense in which Netting used the concept, and the one which I follow in this paper.

Ecological, economic, and legal globalization and growing competition for resources mean increasing conflict over who controls the definition and discourse of "sustainable agriculture." Sustainable agriculture is both a physical human necessity and a hotly contested cultural construct. Achieving it depends in part on a greater understanding of how different agricultural systems affect the environment, how humans perceive the environment and environmental feedback in response to their agricultural systems, and how these perceptions affect values, knowledge, and behavior. Therefore, an agricultural anthropology for the twenty-first century needs to draw on the strengths of anthropological theory and method in ecological, economic, and sociocultural anthropology, and must bridge the persistent and intellectually counterproductive divide between theory and practice, and between relativist and objectivist approaches. In addition, agricultural anthropologists will increasingly be drawn into interaction with other disciplines (e.g., economics, soil science, plant science, and hydrology) in ways that demand the development of synthetic theory that does not respect traditional disciplinary boundaries.

In this paper, I analyze Netting's contribution to agricultural anthropology for the twenty-first century in three key areas that were important, in varying degrees of explicitness, in his own work: the environment, population, and agriculture; farmer knowledge and epistemology; and models for global sustainability.

ENVIRONMENT, POPULATION, AND AGRICULTURE

The debate about the relationships among environment, population, and agriculture is usually cast in terms of "optimists" or Boserupians, who see increasing population causing changes in the agricultural system that increase carrying capacity, and the "pessimists" or Malthusians who see increasing population limited by, or even decreasing, human carrying capacity[3] (e.g., Myers and Simon, 1994). Lee sees the Boserupian and Malthusian viewpoints as the "two grand themes in macro-demographic theory" (Lee, 1986, p. 96), and the Malthusian or neo-Malthusian view is often set out in strong contrast to the Boserupian, as Boserup first did herself (Boserup, 1965).

Netting introduced Boserup to anthropologists, carefully laying out supporting theory and evidence, and addressing her critics (Netting, 1974, pp. 37–42), and continued to support her hypothesis as "the most adequate intellectual framework for understanding the distinctive and cross-culturally recurrent smallholder adaptation" (Netting, 1993, p. 261). Yet, more than many other followers of Boserup (e.g., Tiffen *et al.*, 1994), he moved beyond the "brilliant reductionism" of her model to consider population as both a dependent and independent variable, both "caused and causal," and went on to ask about the environmental limits to agricultural intensification, emphasizing the importance of local demographic controls and of change over time (Netting, 1981; Netting, 1993).

Boserup and Environmental Limits

Many Boserupians emphasize economic sustainability, rather than environmental sustainability, so that sustainable agriculture may be defined as an increasing slope of net production (e.g., Lynam and Herdt, 1992). As Netting points out, Boserup denied that "natural fertility of the soil and other environmental parameters decisively limited human exploitation of any given land area" (Netting, 1993, p. 263), and believed that "increasing populations must substitute resources such as labor for the natural resources which have become scarce" (Boserup, 1981, p. 5). This implies an economic carrying capacity that can be expanded indefinitely, as opposed to an environmental carrying capacity (Zaba and Scoones, 1994), generally defined as the maximum number of humans that can be maintained indefinitely in a given area (ultimately the Earth), which has finite limits (Daily and Ehrlich, 1992).

The belief that the factors of production (land, labor, and capital) are interchangeable is a key assumption of conventional neoclassical economics, the corollary of which is that there are no or only weak limits to physical growth (Daly and Cobb, 1989). This means that resource flows determine resource stocks, and, therefore, that increased consumption or population

[3]Like sustainability, the concept of human carrying capacity is not easily defined, since it too depends on the subjective values of the definer. Cohen provides a historical review of a number of different definitions of carrying capacity (Cohen, 1995).

growth will lead to increased production, with labor or capital capable of substituting for land (Daly and Cobb, 1989), so that, for example, "cropland can usually be rehabilitated if it is judged to be economically or politically worthwhile" (Dyson, 1996, p. 149). While there are limits to the economic efficiency of a given technology, overall economic efficiency is unlimited, because technical efficiency can always be increased by the invention of new technology, e.g., eliminating any "yield plateaus" in agricultural production (Evans, 1993, pp. 29–30).

Therefore, indigenous farmers' capacity for sustainable intensification is sometimes thought of as incompatible with the idea of an environmental human carrying capacity. Thus, Netting rejected the idea of "a definable agrarian ceiling or 'carrying capacity' " because it "denies the potential for intensification of production" (Netting, 1993, p. 274), and he reacted strongly against ideological positions that "sustainable production and economic growth are incompatible goals . . . or that a market economy, population increase, and the new technologies of capitalism are *inevitably* at odds with sustainable systems" (Netting, 1993, p. 145, emphasis added). However, he also recognized that "the statistical relationship between population density and intensity is strongest in those cases where environmental constraints on land quality are moderate" (Netting, 1993, p. 275), and further suggested that there may be a limited range within which intensification is possible (at least without exogenous technology). He also noted that Boserup's more recent writings recognize negative feedbacks to human fertility in intensive systems (Netting, 1993, pp. 269–270), and emphasized this in analysis of his Swiss data (Netting, 1981). Netting departed even further from the reductionism of Boserup's original model, by following Lee (Lee, 1986) in suggesting that Malthus and Boserup are complementary rather than conflictive (Netting, 1993, pp. 276–282).

From the perspective of environmental sustainability, Boserup's theory of linear change may have explanatory power within a certain range of parameters, the ones that Netting focused on, and for which he documented the ingenuity of smallholders in increasing environmental and economic carrying capacities. Where Boserup's scheme is inadequate is in addressing what happens outside of these parameters, viz. when increasing population density cannot induce higher levels of sustainable production, when the human carrying capacity is limiting. At the global level the human–environment relationship is in new territory, and the relationships which Boserup documented may not often hold. Boserup's own dictum that "it makes little sense to extrapolate past trends into the future" (Boserup, 1965, p. 22), must be extended beyond her original meaning.

Thus, Netting's position that whether smallholder intensive agriculture is sustainable or nonsustainable "depends on where the limits to growth lie and the direction of the causal arrows" (Netting, 1993, p. 276), provides the basis for a non-ideological agricultural anthropology that deals with environment–population interactions, when the limits to growth may be very close, and when reconciling the need for more food production with protection of the environment "presents a major challenge for science in the 21st century" (Chapin *et al.*, 1997, p. 504).

With global integration and physical limits, the growth rates of the human population and its consumption must reach zero (or even be negative for a while). The biophysical boundaries of local farming systems are permeable, and ultimately become the same: the planet Earth. In a limited world, migration or increasing imports of food or production inputs from outside the local system are not sustainable ways to deal with local population increase that is approaching or exceeding carrying capacity, and "at the global level, if birth rates do not fall, death rates must rise" (Cohen, 1995, p. 11). This means striving to "combine theoretical principles that operate locally with understanding of global population and resources" (Hammel and Howell, 1987, p. 142)—the local adaptations that raise carrying capacity in response to increasing population pressure must be evaluated in terms of an ultimate limit to resources, beyond the power of technology to avoid. We need to understand not only a farming community's sustainability at a given point in time, but the potential for reducing population growth in response to environmental and technological limits.

When Is Small-Scale Intensive Agriculture Sustainable?

Netting of course did not focus on environmental limits, choosing instead to investigate and write about situations that illustrate farmers' tremendous ability for overcoming local constraints with "sustainable" technologies. Along with others he amassed the data supporting the sustainability of smallholder intensive agriculture across diverse environments and cultures. Agricultural anthropology in the twenty-first century needs to build on this foundation by elucidating the demographic and environmental factors that determine when smallholder agriculture is *not* sustainable, as well as when it *is*. As Wilk states, "Without denigrating the creativity, originality, and appropriateness of local and indigenous technologies, it is still necessary to openly discuss the limitations of those technologies, if only to challenge the increasingly common perspective that only local and indigenous technologies can be sustainable, appropriate, and suited to indigenous social and economic environments" (Wilk, 1996).

It may be more productive in generating theory for practical application to explore the possibility that neither Malthusian or Boserupian paradigms are adequate for explaining local situations heavily influenced by historical, cultural, and geographical contingencies. This is not, however, to abandon the search for general principles governing the environment–population–agriculture relationship, but merely to suggest that they may lie at deeper levels (c.f., Uphoff, 1992).

The potential importance of historical, geographical, and sociocultural contexts in explaining the agriculture–population–environment relationship, and the need to look beyond Boserup's "brilliant reductionism" for understanding at a deeper level, were first brought home to me in the contrast between the results of my own dissertation field work with the Kusasi of northeast Ghana in the late 1970s, and Netting's with the Kofyar of north central Nigeria beginning in the 1960s. Both groups practice intensive agriculture in savanna West Africa, have high population densities and growth rates, and have been partially integrated into local markets that are linked to national and global ones. For the Kofyar (Netting, 1993) and other groups such as the Akamba of Machakos District, Kenya (Tiffen *et al.*, 1994) this has been accompanied by technological and social change that has increased carrying capacity, whereas for the Kusasi over the last 50 years and more (Cleveland, 1986, 1991; Roncoli, 1994; Webber, 1996), and for other groups (Clay and Lewis, 1990; Cleaver and Schreiber, 1994) this has been accompanied by environmental degradation and decreasing carrying capacity.

The Kusasi have been intensive farmers in what is now northeast Ghana and southern Burkina Faso for many generations. Their farming system appears have been adapted to supporting high population densities through such techniques as collecting and applying manure composted with other organic matter, burying green weeds in the fields during cultivation, terracing slopes, and use of many different crops and crop varieties, especially of millet and sorghum. Demand for labor, and thus for children, was undoubtedly high, with children net producers by the age of 8–10. Traditional demographic mechanisms also linked population size to the resource base. Postpartum sexual abstinence is universally and consciously used to regulate fertility to maximize the survival of children, increasing reproductive efficiency; and age at marriage is regulated by the need for men to obtain the bridewealth of four cattle, the supply of which varies according to the resource base.

Since World War II, the Kusasi, like many other African and Third World populations, have experienced rapidly declining mortality rates, because of improved public health measures, and to a lesser extent the availability of modern medical care and improved transportation, which stabilized food supplies. This has led to increases in population growth rates and rapidly rising local population densities. Colonialism also greatly increased regional violence, but also reduced local hostilities and encouraged emigration from villages, at first through forced labor recruitment, and later through integration with the regional and global economy.

In response to increasing population density Kusasis have adopted new crops and crop varieties, decreased fallow periods, increased production and marketing of cash crops. In spite of this, there has been increased soil erosion and irreversible "laterization" of large areas of crop land, loss of vegetation resources, and a reduction in the human carrying capacity. Demographically , the response has been to *increase* fertility rates, not to reduce them. There has been an increase of 1.48 live births per woman between 1948 and 1973, with 0.67 live births resulting from increase in the proportion married, with age at marriage dropping from 19.5 to 18.0 years. The reduction in age at marriage appears to be the result primarily of the breakdown of the bridewealth system. Traditionally men had to obtain the four bridewealth cows from his own extended family (fathers, uncles, grandfathers). But dramatic increases in migration (rates per 100 males more than doubled, from 37 to 76) gave young men independent access to resources through the regional and global economy, which they could use to purchase cattle, and which further reduced elders' authority over them. Reproduction was delinked from local resources.

The increase in the remaining 0.81 live births resulted from a decrease in the period of postpartum sexual abstinence, leading to a decrease in birth intervals from 43 to 39 months. Major causal factors appear to be the decrease in mortality rates for the 0–5 year age group from 30 to 20 per hundred, and the decreased need for mothers' mobility with a decrease in local hostilities. Couples could now respond to the unlimited demand for labor by decreasing birth intervals to increase the numbers of surviving children. This was reinforced by lowered productivity, which increased labor demand even more.

Examples of nonsustainable smallholder intensive agriculture such as the Kusasi suggest that in order to understand the determinants of smallholder sustainability we must:

1. Expand our consideration of local farming systems in time. Was the system sustainable before being affected by exogenous changes? We should not assume linear relationships (see Myers, 1995). Rather we must consider not only how systems adjust to incremental changes, but how they adjust to limits, it is not enough to know that a local farming system is sustainable without knowing how its average population growth rate will reach zero. Can the system adapt to these changes in ways that result in sustainable agriculture?

2. Expand our consideration of local farming systems in space, to understand the local farming system in larger political, economic, and environmental contexts. Exporting people through emigration may make a local

farming system sustainable, but on average all communities must have a zero population growth rate, and we need to understand how larger economic and political systems affect local decision making.

3. Look for generalities at deeper levels, by asking how farmers understand and respond to environmental changes, discussed in the following section.

FARMER KNOWLEDGE AND EPISTEMOLOGY

Netting's agricultural anthropology was posited on the assumption of decision making that is "intelligible in rational, utilitarian terms" (Netting, 1993, p. 2), an accounting for "systematic commonalties of behavior and institutions that make a kind of sense according to the plebeian, but still powerful, canons of practical reason" (Netting, 1993, p. 3), and that cut across differences in culture. His outlook was eclectic, and based on the belief that a full understanding of human–environment relationships necessitated elucidating the links between culture, society, biology and the environment (Netting, 1974, p. 46; see also Netting, 1993, p. 7). He focused, however, primarily on behavior and the environment, seeing culture as the most complex variable, and the link between culture, behavior and the environment as a possible "distant object of ecological anthropology." The twenty-first century will bring this distant object into close range as an important topic for agricultural anthropology.

Beyond Modernization

Netting contributed to an alternative view of small-scale farmer rationality promoted in the 1960s by economists such as Boserup (1965) and Schultz (1964). This was a reaction against the then popular belief among agricultural economists and agricultural development professionals that small-scale farmers were economically "irrational." Instead, evidence cited by Schultz and Boserup suggested that farmers are capable of responding in economically rational ways to forces generated by the marketplace and population pressure. However, these alternative views continued to accept a core principle of conventional neoclassical economics: individuals' behavior is primarily motivated by their desire to maximize short-term personal utility.

While Netting tended to share the assumption about individual utility maximization (Netting, 1993, p. 17), his attention to local ethnographic detail and inductive analysis led him to challenge the reification of this principle in conventional economics. He saw that self-interest was limited by the "complexity of long-term environmental problems" and "culturally valued behavior" (Netting, 1993, p. 267). For him, utility maximization was modified by the tendency for individual farmers to (1) extend their utility in time, thus challenging the conventional economic assumption that rational people discount future value, and (2) extend their utility in space to the family and wider community, thus agreeing to manage resources for the common good.

Netting saw intensive cultivators modifying their pursuit of short-term returns because of concern for future generations, calculating their interests "over long spans of time" and "forgoing immediate benefit," making investments to "secure the interests of future generations and of the elderly" (Netting, 1993, p. 17). However, in his analysis of the dynamic interaction between private and common property regimes in the Swiss Alps (Netting, 1981), he emphasized "maximizing the present value" (Netting, 1993, p. 173), and he agreed with Wade's conclusions, cast in conventional economic terms of individual utility maximization, about community irrigation organization in southern India (Wade, 1988), that deliberate corporate action will take place only when "net material benefits to all or most cultivators are high" (Netting, 1993, pp. 184–185).

Netting made important contributions to understanding how farmers manage common pool resources (CPRs) communally in ways that increase the sustainability of farming. CPRs are resources that are large enough that it is costly to exclude other users, and for which use is subtractive (resources are finite and depleted or degraded by use) (see Ostrom, 1992).[4]

When agricultural production generates negative "externalities" (costs that are not borne by the individual farmer or household), these are passed along to the local, national, or global community. This means that the optimal level of investment (or intensification) for the individual will be higher than for the community, and the difference in returns represents the subsidy to the individual borne by society of this extra level of production.

According to conventional economics, market forces will adjust resource use to maintain sustainbility. When more than one individual is using a CPR independently, each individual will seek to extract production to optimize her/his own utility. However, this will necessarily push the total exploitation beyond the economic optimum for the resource as a whole, and even past the technical maximum output, to the point where overall

[4]CPRs can be distinguished from collective or public goods that share a high cost of exclusion, but that are not subtractive, and from private goods that are also subtractive but for which exclusion has low costs (see Oakerson, 1992; Ostrom, 1992, pp. 295–296). Whether a resource is to be classified as a "public," "private," or "common pool" resource, is to some extent arbitrary (Ostrom, 1992; Becker and Ostrom, 1995); what matters is the "structure of incentives and the efficiency and distributional implications of the various feasible structures" (Cornes and Sandler, 1996, p. 10).

returns are diminishing, as in the well-known fisheries example (Cohen, 1995, pp. 251–255), with the result that the resource may be eliminated. This is Hardin's classic (but misnamed) tragedy of the commons (Hardin, 1968; see Netting, 1993, pp. 173–174). Thus, the importance of common property resource management organization for common pool resources (Becker and Ostrom, 1995; Ostrum, 1992).

Ostrom and others have provided convincing evidence that irrigation water and other CPRs tend to be managed by common property institutions when decision-making costs are less than benefits and when local organizations are nested in a hierarchy of organizations in which they are protected from externalities such as government interference, demand (markets), and population pressure. But also important are a common understanding of the problems and the alternative solutions, and a perception of mutual trust (Ostrom, 1992). This means that to understand the conditions for sustainable agriculture, we must look for variables that are positively correlated with farmers valuing the welfare of future generations and other members of the community. The most important feature of successful common property organizations may be their ability to unite individual utilities in a common group utility. The result is limitation of the optimization of individual short term gain in favor of community gain over the long run.

Beyond the Ideology of Indigenous Sustainability

While championing farmers' "practical reasoning," Netting was also aware of the danger of creating an "ideology of indigenous sustainability" (Cleveland, 1994). Much of the writing on indigenous farmers tends to assume a synergy between environmental conservation and social justice (Gadgil and Guha, 1992; Allen and Sachs, 1993). Increasing evidence supporting the economic and ecological "rationality" of indigenous farming, has sometimes led to the assumption that farmers' indigenous and traditionally-based knowledge and technologies are *always* well-adapted to their environments, that farmers are *always* capable of adjusting to changes, and therefore that indigenous agriculture serves as the model for sustainable agricultural development. This conflation of assumptions about farmers' ecological and economic rationality is increasingly common in programs to improve agricultural sustainability in the Third World, including those of major development agencies, such as the World Bank (Srivastava *et al.*, 1996).[5]

[5]Seeking out and emphasizing areas of epistemological overlap between indigenous farmers and modern agricultural science has been called the "populist" approach, (Scoones and Thompson, 1993).

As Netting recognized early on (Netting, 1974), there is no reason to assume that there is a positive correlation between indigenous farmers' ecological knowledge and the sustainability of their farming system. He pointed out that there is often an *assumption* that "traditional cultivators" are more sustainable than "commercial and industrial agriculture" that is unjustified without supporting data (Netting, 1993, p. 144), and he abjured simplistic adaptationist or equilibrium models (Netting, 1993, p. 267). It is important not to assume the validity of farmers' knowledge or models from their ability to generate farming behavior that is sustainable. In cases where inaccurate models generate functional behavior, they may not adapt well to a changing environment.

Understanding the conditions that lead to sustainable smallholder agriculture requires understanding the basis for farmer decision making in farmers' knowledge and epistemology (see Sillitoe, 1998). Indeed, it is likely that farmer epistemology will be a complex combination of theory, empiricism, and improvisation (Scoones and Thompson, 1993).[6]

While there is evidence for example, that farmers conceive of independent causal variables and experiment carefully to discover the objective nature of the interaction between their crop varieties and their growing environments that determines yield and yield variance (Ashby *et al.*, 1995; Richards, 1986), their ability to see things at much larger scales (for example changing climate) or much smaller scales (for example nematodes or bacteria) than themselves is limited by the tools they have (see Bentley, 1989). Their knowledge is also limited by the particular context, for example it is impossible to discriminate the effects of genotype, environment, and genotype-by-environment interaction on crop phenotypes if the range of genetic or environmental diversity is too small (Cleveland *et al.*, n.d.).

MODELS FOR GLOBAL SUSTAINABILITY

Bob Netting emphatically rejected the conventional, unilineal evolutionist vision of the ultimate transformation of traditional smallholder agriculture to large-scale industrial agriculture that is still promoted by many (e.g., Todaro, 1994). He critiqued conventional thinking that sees monolithic global solutions to global problems, emphasizing instead that we need to look to the innovations and genius of local smallholders, who have time and time again proven the superiority of their wisdom. He documented

[6]It is important to consider music, for example and how its effect on farmers subjective feelings might have important effects on farmers' observable behavior. Richard's limited data suggest that drumming may have about the same result in increased yields as new "improved" varieties (20%) (Richards, 1993, p. 65).

the many different ways of being an intensive cultivator (Netting, 1993, pp. 3–7), and abjured technological determinism (Netting, 1993, pp. 56–57) and social evolutionary schemes of both the modern capitalist and world systems varieties (Netting, 1993, pp. 18–19), as well as those of deep ecology (Netting, 1993, p. 115) and energy capture (Netting, 1993, p. 125). He emphasized the eclectic and practical way in which intensive smallholders reach their goals, often adopting modern technology while continuing long-standing practices, as have the Kofyar and Torbel Swiss.

Farmers must craft "hybrid technologies" to adapt to changing circumstances (Wilk, 1996), or they will no longer be able to remain farmers. Traditionally-based farmers may define "indigenous agriculture" in ways that include industrial agriculture technologies such as fertilizers or tractors, in part because it serves their larger goal of maintaining their physical and cultural identity (e.g., Bebbington, 1993). Zuni farmers have learned how to use global positioning system (GPS) technology to map their family farm fields, and this has become a powerful force in resolving land disputes that have impeded the revitalization of indigenous agriculture (Cleveland *et al.*, 1995). Most indigenous farmers appear to be more than willing to experiment with modern crop varieties, and will adopt them when they fulfill a set of complex criteria that include not only local adaptation and cultural value, but increased yield as well (Soleri and Cleveland, 1993).

Indeed, the acid test of agricultural development projects, and by implication agricultural anthropology, may more and more be the modification of local procedures, or the adoption of new ones (see Sillitoe, 1998). This can mean "improvement" in terms of outsiders' and local peoples' objective and subjective criteria. However, success depends in a broader sense *not* on adoption or modification, but what the long-term results in social, cultural, economic, and environmental terms are for both the local people and the world. This challenges the concept of cultural relativism (Cleveland, 1994). In an increasingly crowded and interconnected world, moral codes and natural resource management regimes can no longer be judged only subjectively from the local perspective, because all activities affect other groups with different moral codes and different management strategies. In other words, we need to evaluate local solutions in global contexts of social, economic, and environmental sustainability. Rights to intellectual or biophysical agricultural resources, for example, are likely to be defined contingently, based on environmental sustainability, and not intrinsically, based on local peoples' myths or values (Cleveland and Murray, 1997). As a concept based on values, "sustainability" requires social negotiation and consensus on a definition before objectives measures of farming system to determine sustainability will be meaningful or useful.

If the Earth is a common pool resource to be managed as common property, sustainable agriculture will depend to an important extent on the ability of our species to see that a balancing act of this magnitude demands the recognition of a common interest in agricultural resources, demanding practical application of anthropological theory with legal and ecological theory (Cleveland and Murray, 1997). How is this to come about at a global scale? Many thoughtful scholars have suggested the need for “political will and institutional capacity” (Goodland, 1995, p. 20), a “combination of institutions that restrain shortsighted and selfish behavior” (Becker and Ostrom, 1995, p. 129), perhaps in the form of “stakeholder panels” to mediate between free marketers and environmentalists (Collins and Barkdull, 1995). It may also demand a radical transformation in human values that greatly increases “caring capacity” (Cohen, 1995) and “loving” (Meadows *et al.*, 1992).

CONCLUSION

Based on my many discussions with Bob Netting over the years, I know that he would not agree with all the directions that I see his work pointing in. Rather, I have freely used his data and ideas to bring the Swiss Alp and the West African sorghum plot together into the same field of vision as our planet Earth—to suggest ways that Netting’s agricultural anthropology can help us to envision and achieve the difficult balancing act that the next century will demand.

Netting was well aware that the study of agriculture in anthropology was considered, as he wrote in 1974, “infra-dig” (1974, p. 21). Though agricultural anthropologists like Netting have done much to counter this attitude, it persists to this day and is an impediment to the development of a theory and praxis of agricultural anthropology. On the other hand, we as agricultural anthropologists have often been ignorant of the natural science and engineering of agriculture, and have been reduced either to promoting the technical changes recommended by natural scientists and engineers, or to critiquing the results of these changes. This has not helped in building a positive image of agricultural anthropology outside of anthropology. More than ever, agricultural anthropology in the twenty-first century will need to approach agricultural science not from an internalist perspective, or from a postmodernist perspective that rejects its ontology and epistemology from the start, but with the same empathy and objectivity with which anthropologists have traditionally approached local communities and cultural groups. We also need to participate in that science. Agricultural anthropology must actively seek to build on its traditions by using the perspectives of the humanities, social sciences and natural sciences in understanding the integration of the local with the global.

This will require a combination of cultural analysis, empirical research, hypothesis testing, and theory building. Because competition for agricultural resources will surely increase in the future with a growing human population, anthropology can also play a critical role in strengthening farmers' voices in negotiating definitions and implementation of sustainable agricultural development by helping those who hold more power to understand these lessons. I believe that such an approach will increase recognition of the practical necessity and ethical imperative for an agricultural anthropology that participates with farmers, formal agricultural scientists, and national and international policy makers in the search for sustainable agriculture for the twenty-first century. This is an agricultural anthropology for which Bob Netting did much to lay the foundation, and one which I strongly believe that he would welcome.

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