Sowing the Seeds: Anthropological Contributions to Agrobiodiversity Studies

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Abstract

Agrobiodiversity studies have been a longstanding and current research focus of anthropological inquiry. This article gives an overview of important ongoing anthropological topics of agrobiodiversity research including conservation, cultural memory, farmer decision making, and homegarden studies. It also points to future directions in agrobiodiversity research that have been understudied to date including agrobiodiversity and its relationship to climate change and migration, the potential marriage of agrobiodiversity and food studies, agrobiodiversity in the Global North, and the incorporation of agrobiodiversity into emergent sustainable/alternative agriculture systems. Agricultural anthropology is suggested as a potential holistic subdiscipline for incorporating anthropological studies of agrobiodiversity, which are currently not unified by any theoretical framework. [Keywords: agricultural anthropology, agrobiodiversity, food studies, sustainable agriculture]

Introduction

Agrobiodiversity has been defined as ''the genetic variation existing among the species, breeds, cultivars and individuals of animal, plant, and microbial species that have been domesticated, often including their immediate wild relatives'' (Heywood 1995:6). The study of agrobiodiversity has been an interdisciplinary undertaking from its inception. Naturalists, crop scientists, geographers, anthropologists, agroecologists, botanists, and numerous other specialists in a wide range of disciplines have committed in-depth research into understanding agrobiodiversity. Excellent overviews by Brush (2004) and Orlove and Brush (1996) have outlined the intellectual history of the study of plant genetic resources from ancient times through the ages of exploration and globalization. They have divided these studies into relevant disciplinary and subdisciplinary areas: ecology of crop diversity, ethnobotany, economic botany, human ecology of crop diversity, the ethnobiology of agricultural diversity, the cultural ecology of plant genetic resources, participatory conservation, and the politics of genetic resources. Our review differs in that it focuses on an in-depth analysis of anthropological contributions to agrobiodiversity studies. Relevant areas of inquiry such as conservation, cultural memory and memory banking, farmer decision making and the maintenance of agrobiodiversity, and homegarden studies will be reviewed. In addition, new and ongoing research trajectories such as agrobiodiversity and climate change, agrobiodiversity and migration, agrobiodiversity and food studies, agrobiodiversity in the Global North, and sustainable agriculture will be explored. We argue that agrobiodiversity studies within anthropology can be better utilized if they are connected to a broader agricultural framework, leading to a more holistic understanding of farming systems and providing greater opportunities for application to sustainable agriculture. The longstanding but underutilized subdisciplinary framework of agricultural anthropology is identified as a way for agrobiodiversity studies to connect to the larger agricultural systems in which they are embedded.

Plant Genetic Resources: Anthropological Studies of Agrobiodiversity

Though agrobiodiversity in its technical sense refers to the overall genetic variation in agroecosystems,

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anthropologists have generally narrowed their domain of inquiry to the investigation of crop biodiversity. Notable exceptions to this trend include studies of local soil knowledge and soil classification systems (e.g., Sillitoe 1996) and a limited number of studies on animal biodiversity (Hoffman 2007). These and other aspects of agrobiodiversity such as ethnoentomology and local perceptions of agricultural diseases (Bentley 1992) provide fruitful areas of future study. For purposes of this review, however, we will limit our analysis to anthropological studies of plant genetic resources for food and agriculture.

Anthropologists have been interested in studying crop biodiversity for much of the discipline's history. Early ethnographers such as Harrington (1947) made the economic uses of agrobiodiversity the main focus of ethnobotany from the 19th century until the 1950s. An early definition of the new field of ethnobiology defined it as the study of the "utilization of plant and animal life by primitive peoples" (Castetter 1944 qtd. in Berlin 1992:4). These early ethnobotanical works were often cast within the general framework of Boasian salvage ethnography and contained long lists of plants used by native peoples with some notes about their economic utilization; they rarely contained anything that contributed to theory (Ellen 2006).

The first phase of anthropological studies of agrobiodiversity (along with larger ethnobotanical systems) came to a close when Harold Conklin's lengthy Ph.D. dissertation became available in 1954. As Conklin made clear in subsequent publications, local and indigenous people in the Philippines had an intricate understanding of their natural environment, including an agrobiodiversity complex that contained 430 names for folk crop varieties among the Hanunóo in their tropical swidden gardens (Conklin 1954). Conklin's work ushered in the second phase of agrobiodiversity studies situated within the larger framework of ethnoecology, which moved beyond simple economic approaches and into more theoretical questions about how humans conceptualized and classified the natural world (Ellen 2006). Nazarea (2006) has described this phase as the "ethnoscientific wave" that was split into two main camps: the structural/intellectualist and utilitarian/adaptationist. Probably more important to agrobiodiversity studies during this period, however, was the framework of cultural ecology (Orlove and Brush 1996). Cultural ecologists studied the relationship between behavior and the biophysical realm (e.g., Brush et al. 1981), largely ignored by early ethnoecologists and ethnobiologists (Rhoades and Harlan 1999). In addition to and directly following the "ethnoscientific wave" and the peak of the cultural ecology paradigm, Nazarea (2006) has identified two more "waves" of change in indigenous knowledge studies: (1) appropriate technology—beginning in the mid-1970s and peaking in the 1980s anthropologists were able to show that local knowledge could influence and inform scientific and development work in agriculture (e.g., Rhoades and Booth 1982) and (2) postmodern—in the 1990s anthropologists and other social scientists began to turn their attention critically to the ways in which local knowledge had been romanticized, essentialized, extracted, and "scientised" apart from its local context by practitioners of western science (e.g., Agrawal 2002).

Through each of these phases anthropological interest in agrobiodiversity studies has remained strong. The overarching framework for studying agrobiodiversity is perhaps more holistic today than at any time in its history, learning from each step in its intellectual and applied trajectory. Ethnobiology, one of the subdisciplinary approaches to studying agrobiodiversity (Orlove and Brush 1996), which was once solely focused on economic uses of plants by "primitive" people, has recently been redefined by Ellen in a much more comprehensive way:

> ethnobiology is, first and foremost, the study of how people of all, and of any, cultural tradition interpret, conceptualize, represent, cope with, utilize, and generally manage their knowledge of those domains of environmental experience which encompass living organisms . . . [2006:2].

Beyond the study of agrobiodiversity, applied anthropologists have also examined the opportunities and ethics that accompany the incorporation of local knowledge into agricultural development projects in the age of globalization (Cleveland and Murray 1997; Sillitoe 1998).

Agrobiodiversity Conservation

Concern about the disappearance of agrobiodiversity from farmers' fields—genetic erosion—dates back to the 1930s (Harlan and Martini 1936), an era where pioneering scientists began collecting plant material from regions across the world to be stored and exchanged for breeding purposes (Hawkes et al. 2000). As the Green Revolution spurred mass conversion to monocultures, new alarms were issued (Frankel 1970).

The replacement of traditional varieties with modern ones was seen as an inevitable outcome of modernization (Harlan 1975). Fear of losing the genetic basis of the world's food supply intensified *ex situ* conservation efforts, resulting in a worldwide gene bank system collectively holding over 6 million accessions (Food and Agriculture Organization of the United Nations 1998). In the following decades it was demonstrated that agrobiodiversity was more resilient than first believed—even in regions where modern varieties had been adopted some diversity still persisted (Brush et al. 1992). Researchers found that traditional varieties were valued for a variety of reasons, including risk management, heterogeneous environments, and their embeddedness in local cultures and lifeworlds; but still worried that economic, cultural, or environmental change could threaten this diversity (Bellon 1991). They called for projects to ensure incentives for the continuing cultivation of diverse varieties on-farm, an approach presented to complement *ex situ* collections (Brush 1995) as well as to ensure the continued presence of diversity in farmer's fields throughout the Global South (Altieri and Merrick 1987). During the past two decades *in situ* conservation has emerged as a new paradigm in conservation (Brush 2000; Maxted et al. 1997).

The farms of the world have a much greater capacity to maintain genetic resources than do gene banks (Brown 1999). The *in situ* approach is also more dynamic than its counterpart—it captures the continued evolution of genetic combinations as well as sociocultural systems of knowledge and practices (Nazarea 1998). The two strategies also differ in terms of access; *ex situ* collections are easier points of entry for breeders, while *in situ* diversity is most readily available for farmers (Brush 1995). Although many agree that *in situ* conservation should be used to complement *ex situ* collections, successful ways to promote diversity on farms are still in their infancy. Incentives can be designed to enhance demand or supply (Bellon 2001), and include the development of markets for diverse crops and their products (Gauchan et al. 2005), the raising of awareness in the form of education or diversity fairs (Tapia 2000), community seed banks (Nazarea 1998), participatory crop improvement (Bellon et al. 2003), and the removal of policies adversely decreasing diversity (Maxted et al. 2002). Recently, the repatriation of diversity from *ex situ* collections has been proposed as another way to promote diversity on farm (Nazarea 2006). Anthropologists will likely continue to play an important role in interdisciplinary efforts to ensure the continued maintenance and availability of agrobiodiversity for farmers across the world.

Cultural Memory and Memory Banking

The importance of cultural memory for the selection and maintenance of agrobiodiversity has been an increasingly important theme to anthropologists and other researchers (Nazarea 2006). Farmers that have grown certain crops and varieties throughout many seasons and years possess multifaceted memories about them. These memories are characterized by intimate impressions and understandings of the properties contained in seeds, combined with what individual farmers have learned from empirical experience, sensory embodiment, and social learning from others. Cultural memories can run parallel to the genetic codes contained in cultivated plants—they are the apex of millennia of experiments and inventions in fields and hearths (Nazarea 1998).

The intricate relationship between biological and cultural diversity is captured in the term *biocultural diversity*, reflecting not only that biodiversity has sustained all the cultures of the world, but also that farmers have cultivated the development of the world's plethora of crop varieties through their cultural practices and traditions. It follows from this that forces affecting one domain are likely to have ripple effects in the other. Homogenizing forces pushing forth monocultures of minds or meadows thus threaten the existence of both biological and cultural diversity (Shiva 1993). Factors fostering the maintenance and development of biological and cultural diversity are also linked. Research has shown that agrobiodiversity is most resilient on the *margins*—among those who grow their own food in mostly sovereign spaces that escape food systems based on large scales and long distances (Nazarea 2005). In her research in Luzon, Philippines, Nazarea (1998) showed that heterogeneity and "fuzziness" in evaluation criteria, beliefs, and practices among farmers were important factors in maintaining agrobiodiversity in sweet potato fields.

Nazarea's emphasis on the importance of cultural memory to agrobiodiversity conservation led her to develop the "memory banking" strategy. This approach complements the relatively basic and sparse "passport data" traditionally collected by plant scientists for conservation at *ex situ* genebanks with in-depth cultural information about folk crop varieties (Nazarea

1998). Cultural and agroecological information gathered through memory banking methods can include technology, knowledge, beliefs, rituals, and uses. Memory banking protocols include life history interviews, benchmark socioeconomic surveys, and cognitive methods such as triads tests and pile sorts. Memory banking was developed by Nazarea while working in the Philippines with the International Potato Center (CIP), but its methodology has not been widely adopted at other international agricultural institutes. However, it has been highly successful in adding a strong cultural component to agrobiodiversity projects in local and regional settings. Memory banking is central to longstanding conservation programs in the United States such as The Southern Seed Legacy Project (Nazarea 2005), Native Seeds/SEARCH (2008), has also been employed successfully in the Ecuadorian Andes (Rhoades 2006).

Farmer Decision Making and the Maintenance of Agrobiodiversity

Why do local farmers choose to maintain local folk crop varieties, even when seemingly overwhelming social and economic pressures threaten their continuance? This has been a question that has interested agrobiodiversity researchers for several decades but remains largely unanswered. Agricultural decision making was a key paradigm in agricultural anthropology in the 1980s (e.g., Barlett 1982) and has been an important topic for agrobiodiversity researchers since the 1970s. Not content with descriptions of what folk crop varieties local farmers were growing or how they perceived and classified them, anthropologists began to ask questions about why agriculturalists continued to grow traditional varieties. This was a particularly important question for anthropologists working at the Consultative Group on International Agricultural Research (CGIAR) centers such as the International Potato Center (CIP) in Lima, Peru, and in other applied contexts. It provided an approach to understand what motivated local farmers to select and maintain crop varieties, thereby helping researchers introduce modern varieties. Brush and other early anthropologists working at CIP came to the conclusion that Peruvian farmers usually selected folk crop varieties for home consumption based on culinary tastes and preferences and modern varieties for sale at the market (Rhoades 1984). This provided evidence that farmers maintained folk crop varieties for reasons that were at least as prominently cultural as they were ecological or economical.

Since that time several more complex models have been put forth to explain farmer selection and maintenance of folk crop varieties. Bellon (1991, 1996) grouped selection and maintenance criteria into three major categories: (1) agroecological—performance of a variety in respect to variables such as soil quality and topography, rainfall, temperature, and disease resistance; (2) technological—performance of a variety in relation to inputs and management; and (3) use—performance of a variety in relation to its output purposes and uses including taste/texture, quality, yield, marketability, and straw/fodder production. Brush (2004) has also grouped selection criteria into three categories: (1) yield; (2) quality—including taste, processing and cooking qualities, storability, and market demand; and (3) perceived risk—of crop failure or yield instability. Perreault (2005), in analyzing motivations for chacra (swidden) agrobiodiversity maintenance in the Ecuadorian Amazon, proposed a simpler model in which two main factors are responsible for crop variety maintenance and selection: household food security and symbolic importance as a key marker of Kichwa cultural identity. Studies of homegardens have also produced models related to farmer variety selection and maintenance. Angel-Pérez and Martin Alfonso (2004) identified three functions of agrobiodiversity in homegardens for Totonac farmers in Veracruz, Mexico: (1) ecological—insuring a continuous supply of organic matter to the soil and creating a multistrate vegetation cover; (2) economic—a living storehouse where a diversity of products are produced; and (3) social—performing various social roles that support beliefs and cultural continuity. The investigation of farmer selection and maintenance of agrobiodiversity is likely to remain an active topic of inquiry for agricultural anthropologists.

Homegarden Studies

Homegardens have garnered interest from anthropologists studying agrobiodiversity in recent years for several key reasons. Homegardens have proven to be microclimates within farming systems that contain high levels of biodiversity, with different crop species and varieties, than are found in the surrounding agroecosystem. They serve both as reservoirs and experimental breeding grounds for agrobiodiversity. Homegardens are socially constructed spaces that exist close to the household and are managed by

various household members, thereby contributing not only to subsistence and commercial production, but also to the continuance and reproduction of cultural identity (Eyzaguirre and Linares 2004). The term "homegarden" is preferred to other terms used to describe these garden production systems because it emphasizes the close interrelationship between the social group living at home and the garden (Eyzaguirre and Linares 2004). Tree species within homegardens make them a multifunctional agroforestry system that contributes toward maintaining the sustainability of ecosystems through reducing erosion and evaporation, adding nutrients, and regulating soil temperature. Homegardens vary in structure and size according to a variety of cultural, socioeconomic, and ecological factors but comparative studies have shown that they average between 0.1 and 0.5 ha in size. Empirical studies have also shown that homegardens in remote villages tend to be cultivated for subsistence needs, whereas villages closer to urban centers plant them more for commercial production (Eyzaguirre and Linares 2004). Studies of the high levels of agrobiodiversity in homegardens have in recent years become a priority within the CGIAR system.

Anthropologists have studied homegardens and agrobiodiversity from a variety of approaches. Cleveland and Soleri (1987) have pointed out the usefulness of homegardens to sustainable development strategies by improving household food production, nutritional status, and income. Several studies have investigated the role and importance of homegardens as a strategy for subsistence and natural resources management (e.g., Ali 2005; Angel-Pérez and Martin Alfonso 2004). The importance of gender in the maintenance of homegardens, both materially and symbolically, has also been recognized (Tapia and De la Torre 1998). Homegardens as a site of cultural salience, memory, and identity, in both the Global South and North, has also been an emerging research theme (Nazarea 2005; Veteto 2008). Anthropological research on homegardens and agrobiodiversity gained prominence in the 1990s and is now an established strategy that seems likely to continue.

New Directions in Agrobiodiversity Research

This section will review several new and ongoing research trajectories that have either not been explored by anthropologists or have received insufficient attention to date.

Agrobiodiversity and Climate Change

Anthropologists who study climate change issues have used a variety of approaches, including local perceptions of climate and agriculture (Vedwan and Rhoades 2001), historical case studies (Orlove 2005), and climate change policy and the political ecology of climate change (Magistro and Roncoli 2001). Despite the plethora of anthropological studies on agrobiodiversity, very few have dealt with its relationship to climate change. In fact, little attention has been focused on the subject in any discipline and is virtually absent from discussion in the major international institutions that deal with crop agrobiodiversity issues (Kotschi 2007)—a situation that may quickly change (Brandeland 2007).

Agrobiodiversity is of crucial importance for human adaptation to climate change for several reasons. Traditional crop varieties frequently provide a buffer against environmental variation, change, and catastrophe. In the face of environmental extremes such as climate change, one or several folk crop varieties may survive while others die out. Once resilient varieties are identified, they may be exchanged with other groups within a region (or beyond), diversifying the existing resource base and facilitating better adaptation strategies. Folk crop variety complexes and planting techniques can then begin a process of change to try and mitigate and keep up with climate variability. An exchange of germplasm between agricultural zones may be a useful strategy for adapting traditional varieties to new climate regimes or a change of planting locations according to local microclimates may also be attempted. The high levels of genetic and cultural diversity that are associated with folk crop varieties and traditional agricultural systems provide a more variable range of responses to climate change than is normally thought to be the case with more modern and less diverse commercial varieties and farming systems (Kotschi 2007).

While large-scale scientific models of climate change can be useful in identifying and describing global patterns, they have been considerably less appropriate in describing or understanding climate variation at the local level (Salick and Byg 2007). Individual, community, village, or regionally based studies to get at local indicators and perceptions of climate change are particularly well suited to the qualitative in-depth research methods of anthropologists (Magistro and Roncoli 2001). Recent anthropological studies are providing local and regionally based data that can

complement and improve larger-scale earth systems modeling (West et al. 2007). Ethnoecological techniques of studying local agrobiodiversity and farming systems can provide useful and essential tools for understanding agricultural adaptations to climate change.

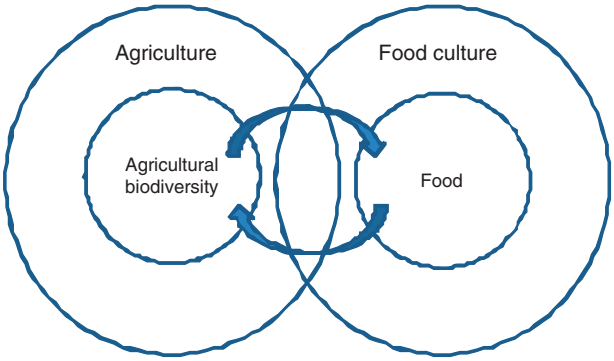
Migration and Agrobiodiversity

Few anthropological studies have focused on the role that migration plays in the loss, maintenance, or persistence of folk crop varieties. Vogl et al. (2002) noted that most studies of agrobiodiversity within homegardens focus on the adaptation of gardeners to one place over a long period of time. However the gardens of immigrants are increasingly becoming an area of interest to anthropologists and other scholars (e.g., Nguyen 2003). Several characteristics of immigrant gardens have been suggested in the emerging literature, including the importance of recreating homeland landscapes (Nazarea 2005). This includes the importation of crop species indigenous to the homeland, and in the case of emigration from one area to another in the same country, the loss of crop species can be almost nonexistent (Vogl et al. 2002). The recreation of the internalized homeland garden landscape in the foreign soil of an adopted country or region has been highly correlated with the reproduction of cultural and socioeconomic traits that were practiced in the homeland (Airriess and Clawson 1994). However the importance placed on the retention of cultural, agricultural, and culinary identity has been seen as decreasing over time, especially as immigrant homegardens become oriented toward market production. This trend, coupled with the increasing acculturation of younger generations, is a threat to the retention of gardening traditions and folk crop varieties (Vogl et al. 2002). These suggestive characteristics of the few studies to date highlight the fact that the application of agrobiodiversity studies to immigrant populations in an increasingly globalized world is a necessary step in furthering our understanding of global crop biodiversity loss and gain.

Agrobiodiversity and Food

Agrobiodiversity is inextricably linked to food; most of the plants cultivated by humans are grown for subsistence purposes. Domesticated crops require human intervention in order to reproduce and human food security depends upon the renewal of seed supplies (Harlan 1992). Nonetheless, anthropological research on agrobiodiversity and food is often carried out in isolation. We suggest that any consideration of agrobiodiversity will benefit from an analysis of the food culture/system in which it is embedded (Figure 1).

Figure 1
Interrelationships between food and agrobiodiversity



Since the dawn of agriculture decisions and selection regarding what crop varieties to plant have been largely guided by culinary needs and desires—conditioned by economic, technological, and agroecological factors. In most anthropological agrobiodiversity studies to date, it is these latter three factors that have been the main foci of researchers. Although a number of papers acknowledge the importance of end-use qualities for seed selection, this factor is often regarded as residual, referred to when other measured variables cannot account for variation in diversity (e.g., Perales et al. 2003). This trend is starting to change, and analyses that consider consumption and end-use factors are increasing in number. For example, Brush (2004) and Zimmerer (1996) argue that consumption criteria are important for potato maintenance in Peru; Nazarea (1998) shows how variation in consumption purposes and preferences sustains sweet potato diversity in the Philippines; and Smale et al. (1998) demonstrate that one of the factors underlying demand for diverse landraces[1] in Mexico is that different maize varieties are valued for different culinary dishes. Several more studies also address the role of food as an incentive for maintaining diversity as the central research concern, including Tsegaye and Berg's (2007) study of durum wheat in Ethiopia and Rana et al.'s (2007) paper on rice in Nepal.

Recognizing the role of food culture in maintaining diversity, agrobiodiversity researchers have subsequently identified social and cultural change as threats to diversity (Harlan 1992). For example, Birol et al. (2006) find that high levels of diversity in Hun-

garian home gardens have survived shifting political regimes and agricultural arrangements, but warn that incipient sociocultural changes stemming from outmigration and reduced dependency on home gardens for food may cause reductions in biodiversity during the coming years. In Mexico, Bellon et al. (2003) similarly note cultural change as a potential future cause of diminishing maize diversity. The extent and directions in which food cultures are changing and the relation between these changes and agrobiodiversity are important future areas of research. Several studies identify food cultures as particularly robust and thus resulting in resilience of diversity despite changes in production systems and integration into markets (Brush 2004; Zimmerer 1996). However even if food cultural traditions remain, this does not guarantee the continued cultivation of the varietal diversity on which they are currently based. From Ethiopia, Tsegaye and Berg (2007) report that although food practices did not change significantly during the 1980s, agrobiodiversity did. Farming households continued to produce most of their own food, while traditional wheat varieties were substituted for modern varieties with similar culinary properties in local cuisine. However when traditional varieties were reintroduced from *ex situ* collections in the late 1990s, they were welcomed and reincorporated into local food systems by farmers. Such renewed interest in native biodiversity is also observed elsewhere as part of growing cultural revitalization and indigenous movements (Nabhan 2007; Nazarea 2006).

As noted above most landrace diversity maintained by farmers is destined for their own consumption. What is marketed represents only a small portion of crop varieties and is often derived from modern varieties grown in monoculture (Skarbø 2006). The demands and changing desires of farm families thus represent primary causal agents for further development and proliferation of diversity. On the other hand, market demand is also dynamic and may represent opportunities for more diversified commercial production. For instance, ancient varieties of emmer wheat have become commercially popular in Italy (Brush 2004), Andean crops are entering new urban markets (Andinotas 2007), and heirloom vegetable varieties are experiencing a renaissance in the United States (Nabhan 2008). However the commercialization of particular heirloom varieties may have a variety of effects, including a loss of overall diversity, if marketed landraces replace other heirloom crops that have less commercial appeal.

Further insight into the dynamics of changes in food cultures can be drawn from the burgeoning anthropological literature on food. Weismantel's (1988) classic study from a parish in highland Ecuador demonstrates the deeply held and often contrasting values attached to different crops and food products by women, children, and men. She demonstrates how food is tied to identity negotiations that take place among individuals who migrate between urban and rural worlds. Paulson's (2006) research in Bolivia discusses the changing symbolic role of food in festive rituals as well as in the national political arena and shows that foods and traditions formerly disdained by elites now feature prominently in carnival celebrations as well as political campaigns. Wilk (2006b) discusses the shifting interfaces of the global and local in Belize, the development of a national cuisine, and a recent shift in emphasis from imported canned and dried products to pride in locally derived ingredients. A number of studies examine the emergence of social movements and related commercial strategies involving food production and consumption, including those concerned with environmentally sound production methods (Guthman 2003), socially just trade systems (Raynolds 2000), and the revival of local foods (Nabhan 2002). Common to all of these trends is a renewed interest in tracking food items to their production origins, which may present new opportunities for agrobiodiversity utilization and conservation.

This brief overview reflects only a fraction of the recent academic interest in food; further relevant overviews can be found on anthropology and food (Mintz and DuBois 2002), globalization and food (Phillips 2006), and food and memory (Holtzman 2006). Lentz (1999) provides a collection of studies specifically examining changes in food habits, and Wilk (2006a) a set of studies discussing contradictions and connections between global and local food systems. However, most food studies do not provide an in-depth assessment of agrobiodiversity complexes. Nonetheless, they can provide crucial insight into the general cultural system in which biodiversity is embedded, inspire robust methodologies, and provide possibilities for collaborative research.

Agrobiodiversity in the Global North

Up to this point, along with many other areas of inquiry within anthropology, agrobiodiversity studies have been largely situated in ''developing'' countries of the Global South. The assumption of plant genetic

resource experts worldwide has been that modern, developed countries in the North have largely replaced traditional folk crop varieties with modern high-yielding varieties characteristic of industrial agriculture. In the United States, for example, Fowler and Mooney (1990) provided evidence based on analysis of commercially available seeds that up to 93% of folk crop varieties in the United States have been lost and other experts (McDonald 2001) argue that the rate of disappearance is rapidly increasing. However, since Fowler and Mooney only analyzed commercially available seeds, and most folk crop varieties in the United States are not available commercially, more work is needed to understand the disappearance of agrobiodiversity in the United States at the margins. Though it is true that with the overall decline in the US farming population in the past seventy years that much agrobiodiversity has been lost, it has also been observed that ''heirloom seeds are especially prevalent in isolated mountain areas, such as the Ozarks, Smokies, and Appalachians, and also among traditional peoples such as the Mennonites, Amish, and Native Americans'' (Whealey 1998:7). The prevalence of higher agrobiodiversity levels in marginal areas and groups in the United States is consistent with the correlation between marginality and agrobiodiversity found worldwide (Rhoades and Nazarea 1999).

The American Indian groups of the southwest have received more attention in anthropological studies of US agrobiodiversity than any other region or people. Nabhan (1989, 1985) has shown that southwestern Native Americans maintain a high diversity of folk crop varieties, traditional farming techniques, and associated cultural knowledge. Another study by Soleri and Cleveland (1993) among the Hopi Indians of northeast Arizona showed high levels of agrobiodiversity that had been remarkably resilient over the last fifty years and were being maintained for both biophysical and sociocultural reasons. They point out that diversified crop complexes such as that of the Hopi can be important references as the development of sustainable agriculture becomes more important in industrialized nations.

Outside of the southwest and Native America, very little work has been done on US agrobiodiversity. A recent study by Veteto (2008) showed that agrobiodiversity levels in southern Appalachia may be as high as or exceed that of many comparable regions in the Global South (e.g., Skarbø 2006). In 4 months of fieldwork, Veteto found that southern Appalachian farmers and gardeners were maintaining 134 different folk crop varieties. Among this diversity, beans were conspicuously dominant, accounting for 83 of the 134 varieties (61.9%). Bill Best's long-term bean collecting at The Sustainable Mountain Agriculture Center Inc. in Appalachian Kentucky has resulted in 400 distinct varieties (Best 2005). The results from Veteto and Best suggest that, when compared with results Sperling and Scheidegger (1997) have obtained in Rwanda, southern Appalachia may be a secondary center of world bean diversity. Other areas of the US South (many of which have been historically marginalized) also provide pockets of individuals, seeds, and memories that are highly diverse. In a decade of research, The Southern Seed Legacy Project (2008) at The University of Georgia has collected 600 folk crop varieties from southern US farmers. Much more agrobiodiversity research and conservation could be done in other areas of the Global North. For example, a study by Negri (2003) reports that homegardeners in Italy are maintaining very high levels of agrobiodiversity but are an aging population that is struggling to interest younger generations in continuing their biocultural seed legacy.

Sustainable Agriculture

Anthropologists have been increasingly turning their attention to the study of sustainable agriculture in both academic and applied settings. Organic agriculture movements in the United States and other related phenomena have been areas of study in recent years. Community Supported Agriculture (Durrenberger 2002), the relationship between the university and organic agriculture (Delind and Bingen 2005) and oncampus sustainability movements (Barlett and Chase 2004), organic marketing strategies (Andreatta 2000), community and school gardens (Thorp 2005), and local farmers markets (Andreatta and Wickliffe II 2002) have been important topics of scholarly interest. Applied projects led by anthropologists have been instrumental in promoting sustainable agriculture oncampus and in local US communities. However, cross-linkages between these areas of study and agrobiodiversity are minimal.

Research on sustainable agriculture in the Global South has also been an ongoing research interest for anthropologists. The Sustainable Agriculture and Natural Resource Management Collaborative Research Program (SANREM) funded by USAID has been involved in major research projects in various parts of

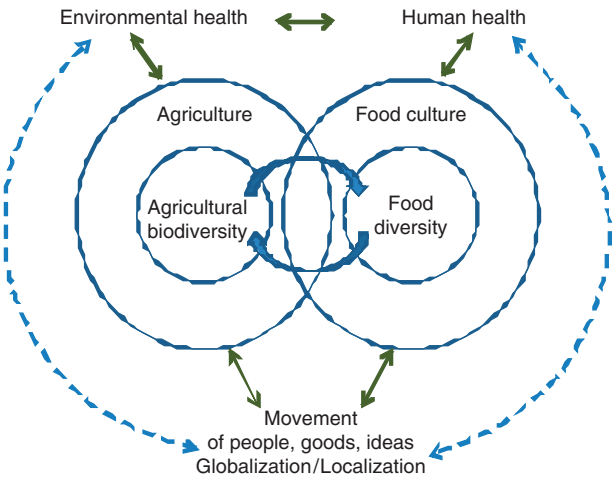
the developing world for the better part of the last two decades (Rhoades 2001, 2006). SANREM has investigated sustainable agriculture from an interdisciplinary perspective incorporating anthropology, agrobiodiversity, sociology, history, soil science, ecology, climatology, hydrology, watershed management, migration, and sustainability science with the concerns of local communities (Rhoades 2006). Other current research foci for anthropologists studying sustainable agriculture in the Global South include organic certification in Mexico (González and Nigh 2005), the study of ancient Mayan farming practices for current applications (Fedick and Morrison 2004), and the transition from Green Revolution to ecological farming technologies in the Phillipines (Carpenter 2003).

Despite the importance of sustainable agriculture as a topic for anthropology, little has been done to investigate the importance or challenges of incorporating agrobiodiversity into emergent sustainable/alternative systems. This is surprising considering the widespread scientific agreement on the importance of agrobiodiversity to agroecosystems. Historical examples such as the Irish potato famine and the Southern US corn blight have demonstrated that a lack of biodiversity in crop systems can result in enormous losses to both human lives and agricultural production (Rhoades 1994). Given the reality that agrobiodiversity is an important element of sustainable agriculture, it would follow that agricultural anthropologists increasingly incorporate it into their research projects.

Conclusion

Agrobiodiversity studies have a rich legacy within anthropology and continue to branch out into relevant and dynamic topics. However, it has become apparent that to connect to broader issues within food systems such as sustainable agriculture, food studies, or climate change, agrobiodiversity studies cannot maintain the isolated niche in which they are often embedded. This is not to say that studies of particular agrobiodiversity complexes within regions, populations, groups, villages, or ethnic groups are not still needed, but that they should perhaps be conducted with a broader framework in mind. To draw an analogy from the biological sciences, it is doubtful that an agroecologist who studies agrobiodiversity would do so without either implicitly or explicitly connecting their study to the broader agricultural ecosystem. Biodiversity would be considered an import link to all other ecological processes. Thus, within agroecology, agrobiodiversity is one component of a broader system. It is doubtless that anthropological researchers of agrobiodiversity are also aware of the embeddedness of their subject matter into larger systems, both agroecological and otherwise, but too often studies are conducted as if they are not or at least lack explicit connections. With the waning of the Farming Systems Research paradigm in the 1990s this trend has become even more prominent. We suggest a potential direction to address this problem (see Figure 2).

Figure 2
Conceptual framework for anthropological approaches to agrobiodiversity



Agricultural anthropology was a term that was first coined by Robert Rhoades in the late 1970s to explain the work he was doing to biological scientists at the CIP in Peru. It was further codified and given a concrete definition in the early 1980s by Rhoades:

> Agricultural anthropology is the comparative, holistic, and temporal study of the human element in agricultural activity, focusing on the interactions of environment, technology, and culture within local and global food systems, and it has the practical goal of responsibly applying this knowledge to improve the efficiency and sustainability of food and fiber production. Agricultural anthropology views agriculture neither as a mere technical process nor even as techno-economic combination, but as a complex human creation and evolutionary process that includes equally important sociocultural and ideological components in interaction with each one another and the natural environment. Agricultural anthropology is broader in

scope than other agricultural disciplines which focus, and rightly so, on specialized and limited problems in agriculture [1984:46].

Thus, agricultural anthropology focuses the full holistic gaze of anthropology upon what is one of the most important acts of humanity—agriculture. Agricultural anthropology reached its apex in the 1980s and then took a back seat as the sustainability paradigm took hold in the 1990s (Rhoades 2005). However recent concerns about food shortages around the world have again thrust agriculture into the world spotlight (UN News Centre 2008). The two-panel session at the 2007 AAA meetings, ''Agricultural Anthropology: Formative Engagements and Emerging Themes,'' and the formation of a twelve member task force appointed by the presidents of Culture and Agriculture and the Anthropology of Food and Nutrition (at the request of the President of the AAA) headed by Sol Katz to look into global food security issues provide evidence that agricultural anthropology is still a vibrant subdiscipline with a dedicated group of proponents and researchers.

Agrobiodiversity studies have always been an important component within agricultural anthropology. Emerging themes and globalization trends only highlight the need for agrobiodiversity studies to be included within a broader and more holistic framework. We believe that agricultural anthropology can provide that framework and help push forward the relevance and importance of an agrobiodiversity which continues to be threatened by global monocultures of minds and fields.

Note

1. A *landrace* is ''a population of plants, typically genetically heterogeneous, commonly developed in traditional agriculture for many years—even centuries—of farmer-directed selection, and which is specifically adapted to local conditions'' (National Research Council 1991:152). Concepts sometimes used interchangeably include farmer variety, folk crop variety, and traditional variety.

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