BETWEEN THE MARKET AND THE *MILPA*: MARKET ENGAGEMENTS, PEASANT LIVELIHOOD STRATEGIES, AND THE ON-FARM CONSERVATION OF CROP GENETIC DIVERSITY IN THE GUATEMALAN HIGHLANDS

A Dissertation Presented

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DEDICATION

In memory of James C. and Marilyn “Cork” Hawthorne

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ABSTRACT

BETWEEN THE MARKET AND THE *MILPA*: MARKET ENGAGEMENTS, PEASANT LIVELIHOOD STRATEGIES, AND THE ON-FARM CONSERVATION OF CROP GENETIC DIVERSITY IN THE GUATEMALAN HIGHLANDS

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In this dissertation I investigate the impact of market expansion upon peasant livelihood strategies and the on-farm conservation of crop genetic resources in the Guatemalan highlands. In particular, I explore how the formation and reconfiguration of different types of market activities in the Mesoamerican "megacenter" of agricultural biodiversity have shaped the relevance and practice of cultivating *milpa* – a peasant agricultural practice where maize is intercropped with beans, squash, medicinal herbs and other useful plants for direct household consumption. I focus upon the diversity of the three principal *milpa* crops – maize, legumes, and squash – during the current era of globalization (1980 – 2005).

On the macroeconomic level, I find that the neo-liberal restructuring of the Guatemalan economy that began in the 1980s has undermined the country's long history of maize self-sufficiency and contributed to the loss of crop genetic resources, ultimately threatening local and global food security. Economic liberalization is associated with a substantial reduction in the share of agricultural land allocated to maize – including many

genetic hotspots – and an influx of imported grain. Additionally, neo-liberal agricultural policies have pushed farmers in many centers of maize genetic diversity to abandon the crop in favor of non-traditional agricultural exports.

Drawing upon quantitative and qualitative fieldwork in two highland communities, I also investigate the processes that shape peasant livelihood strategies and the cultivation of *milpa* diversity at the household level. Four variables are consistently linked to the level of diversity maintained on the farm: (1) agricultural biodiversity is positively associated with the size of farmers' arable landholdings; (2) peasant households maintain diversity as a means for hedging against the risks of environmental uncertainty and the caprices of market-based income sources; (3) cultivating diversity is a form of recreation and a means for expressing cultural identity; and (4) reliance upon hired field hands is negatively associated with diversity management.

In contrast to the predictions of many economic theorists, I find that most forms of market participation are complementary to the cultivation of crop genetic resources. The complementarity is attributable to the structure of Guatemala's rural economy and several non-market entailments generated by *milpa* agriculture.

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CHAPTER 1

PEASANT LIVELIHOODS, FOOD SECURITY, AND THE *IN SITU* CONSERVATION OF CROP GENETIC DIVERSITY

1.1 Introduction

As it embarks upon a new millennium, the global community is slowly awakening to the potential of a historic yet heretofore largely unheralded environmental crisis: the erosion of genetic diversity in humankind's major food crops. The ramifications of this crisis are far-reaching. The genetic diversity in crops provides the raw material that allows our staple foods to evolve with changing environmental conditions; without it our food crops are dangerously susceptible to new pests, emerging plant diseases, and climate change.

Ironically, peasant farmers from the Global South are responsible for cultivating the vast majority of crop genetic diversity. Long characterized as "backward" and an impediment to "development," subsistence-oriented farmers in many areas of the developing world are, in fact, the providers of an invaluable ecological service. As their economic lives become increasingly integrated into global markets, however, the future of peasant farmers – and, ultimately, global food security – are thought to be in jeopardy.

The concern that market development will undermine the conservation of crop genetic resources is rooted in the belief that subsistence-oriented agricultural practices are an inferior means of fulfilling economic needs. If given a choice, the theory continues, peasants will inevitably reorient all aspects of their economic life – both production and consumption – to the market economy. In their self-interested rush to maximize their personal welfare, it is assumed that peasants will abandon traditional agriculture and, ultimately, the practices that guarantee the long-term evolutionary capabilities of humankind's principal food crops. The paradoxical implication is that the welfare of peasant farmers can only be improved at the risk of destabilizing a cornerstone of global food security.

Drawing upon field research conducted in the northwestern highlands Guatemala, my dissertation contributes to the unraveling of the paradox. I find that the impact of market activities upon the on-farm conservation of crop genetic resources is contingent upon the broader social framework that governs market outcomes. If creatively implemented, markets can, in fact, play a positive role in helping farmers' to achieve their development goals in a way that is consistent with the *in situ* conservation of crop genetic diversity.

1.2 The Contribution of Crop Genetic Diversity to Global Food Security

Genetic diversity in humankind's major food crops is crucial to long-term global food security. A broad pool of germplasm enables domesticated plants to adapt to environmental change; the loss of crop genetic diversity renders our food supply vulnerable to evolving pests, emerging plant diseases, and climate change.

Most of the genetic diversity for humankind's principal crops is concentrated in the Global South. The centers of genetic diversity for rice, for example, lie in the Indian subcontinent and southwestern China and in the southeastern Asia region of Malaysia, Thailand, the Philippines, and Indonesia. The genetic diversity for wheat is concentrated in the Fertile Crescent region of Turkey, Iraq, and Syria. In the Americas, the Mesoamerican region of south-central Mexico and northern Guatemala is the center of genetic diversity for maize while potato diversity is concentrated on the slopes of the Peruvian Andes.

In the 1920s, Russian botanist N.I. Vavilov observed that there is a strong correlation between these modern centers of crop genetic diversity and the ancient centers of crop domestication (Vavilov, 1992). Over the last 10,000 years, the story of agriculture in each of these independent "Vavilovian Centers" has been virtually identical (Wilkes, 1992). First, there was human selection for desired traits among the indigenous vegetation. Through artificial selection and close inbreeding, farmers were able to bring hidden recessive genes to the surface and bring the plants across the threshold of domestication. Second, the local environment was restructured or rearranged, making it possible for the survival of the new crop varieties. Despite an initial period of isolation that allowed for the emergence of each domesticated species, expanded cultivation brought the crop back into the territory of its wild and weedy relatives, allowing the plants to interbreed. Along with mutations, this introgressive—or back and forth—hybridization process between interrelated species has allowed for the continual introduction of new raw material into the each crop's genetic profile. Employing some 10,000 years of accumulated ancestral knowledge, the present-day farmers in the Vavilovian Centers continue to develop a constant flow of new crop varieties.

Enabled by their knowledge of a crop's genetic traits, traditional farmers practice what is known as diversity management. Specifically, they plant different varieties of the same crop in accordance with environmental conditions (such as soil and climate) as well as desired traits (such as reliability, time of harvest, and taste). In a name that is symbolic of their richness, botanists refer to these agricultural systems where domesticated species coevolve with one another and their wild relatives as “evolutionary gardens” (Wilkes, 1992: 25). Through the combined process of human and natural selection, these evolutionary gardens facilitate the continual replenishment of the crop’s germplasm stock. Specifically, there is a constant augmentation and reorganization of the crop’s genetic profile, allowing it to adapt to changing environmental conditions such as newly emerging pathogens, evolving pests, and abiotic stress.

The different types of seed varieties that have emerged from evolutionary gardens are known as landraces. Sometimes referred to as traditional varieties or indigenous varieties, landraces are locally grown crop populations that are the product of farmer selection and management over several generations. They are geographically and ecologically distinctive populations that vary in soil adaptability, time of seeding, water requirements, date of maturation, height, cooking qualities, and nutritive value, among other characteristics. Although landraces have certain morphological features that allow farmers to distinguish them by name, there is usually a great deal of genetic variation within a given landrace population (Qualset et al, 1997: 165). Biologists praise landraces for the extraordinary diversity within and between populations. “Landraces,” writes biologist Garrison Wilkes, “are the real treasure house because they are the largest depository of genes for a crop” (Wilkes, 1992: 19).

The predominantly subsistence-oriented farmers in “Vavilovian Centers” maintain multiple dimensions of diversity. As mentioned, they not only manage multiple varieties of a particular crop species, but the genetic diversity latent within their landrace varieties is extraordinarily rich. In short, peasant farmers in many areas of the Global South maintain a great deal of intra-crop (or within species) diversity. Given that they often intercrop multiple species of plants on a given agricultural plot, peasant farmers also maintain a great deal of infra-crop (or across species) diversity. Maintaining a variety of fully domesticated crops, incipient domesticates, and wild plants in their farming plots, there is often no clear boundary between the native and cultivated vegetation. To the western eye, these intercrop systems appear like "gardens of chaos," but they are reflective of a complex and ingenious understanding of the local environment and agronomic complementarily (Anderson, 1969; Wilkes, 1992).

In contrast to the rich genetic diversity found in many peasant agricultural systems, modern agriculture is characterized by a high degree of genetic uniformity. In addition to its limited use of intercropping, industrial agricultural systems tend to be dominated by a small number of seed varieties (Pingali and Smale, 2001). In the United States, for example, maize is the most widely grown crop, accounting for 80 million acres of arable land (FAPRI, 2006), yet six varieties account for nearly half of the total maize area (Boyce, 1996: 274).

Virtually all of the seeds that are used in industrialized countries are so-called "improved" or "modern" seed varieties (Pingali and Smale, 2001). Developed by scientific plant breeders, modern seed varieties are designed to maximize yields, that is the short run output per unit of land area. In the process of isolating desired traits for improved seeds, however, plant breeders eliminate the supposedly "less desirable" genes. The result is high yielding – or at least highly fertilizer responsive – seed varieties with a narrow genetic base. With a handful of improved seed varieties distributed across the majority of the agricultural landscape, modern agriculture is particularly susceptible insect and disease epidemics (Pingali and Smale, 2001).[1] This risk was dramatically illustrated in 1970 when a mildew leaf blight destroyed one-fifth of the U.S. maize harvest (National Academy of Sciences, 1972). More recently, though on a much smaller scale in terms of its immediate impact, once-robust potato fields in the Peruvian Andes were decimated after the farmers there adopted a genetically uniform package that was encouraged by national development policies (Ortega, 1997). To combat the vulnerability of modern agriculture, plant breeders must release a constant stream of new varieties that incorporate genes for resistance to emerging pests and pathogens. Commercial seed varieties generally must be replaced every 5-10 years; indeed, some released varieties become obsolete in the very year that they are released (Wilkes, 1992). The genetic raw material for this "varietal relay race" (Boyce, 1996; Soleri and Smith, 1999) between plant breeders and nature is conserved in centers of crop genetic diversity.

1.2.1 The Complementarity of *Ex Situ* and *In Situ* Conservation

With the spread of modern agricultural practices in the 1960s, there emerged a growing concern that modernization would displace landraces and the traditional agricultural systems that underpin global food security.[2] Farmers in the US Corn Belt had long since replaced traditional maize varieties with modern hybrids. As a similar process unfolded with wheat in India's Punjab and rice in central Luzon in the Philippines, plant breeders and agricultural policymakers became increasingly worried

[1] Improved seed varieties are bred for superior resistance. Nonetheless, as pests and diseases evolve to overcome plant resistance, genetic uniformity increases the likelihood that such a mutation will eventually prove harmful to a crop. Uniformity of varieties across the landscape means that the evolved pest or disease can damage a greater proportion of overall crop acreage, a phenomenon known as genetic vulnerability.

[2] A few visionaries had expressed this concern decades earlier (e.g. Elgueta, 1950, c.f. van Etten, 2005; and Harlan and Martini, 1936, c.f. Brush, 2004), but their warnings were overshadowed by the Great Depression and war efforts (Wilkes, personal communication, November 2006).

that the spread of modern agricultural practices in the cradles of crop genetic diversity would result in the widespread loss of crop genetic resources. The replacement of landrace populations with improved seed varieties, it was thought, would render the food supply increasingly vulnerable to changing environmental conditions.[3]

Much of the initial response to the displacement of landraces focused upon the *ex situ* – or "off site" – preservation of crop germplasm in seed banks. With their distribution of germplasm that is often cultivated in the Global South to commercial seed companies from industrial countries, critics have accused the gene banks of being complicit in "bio-piracy," or the uncompensated transfer of genetic wealth from poor countries to rich countries (Shiva, 1997). The reality, however, is that *ex situ* conservation is a public service that benefits rich and poor countries alike. In addition to providing plant breeders (commercial and public) with convenient access to germplasm, seed banks also provide crucial insurance against the loss of cultivated genetic diversity. The importance of this service was demonstrated in Nicaragua and Cambodia, where civil wars led peasants to abandon cultivation and eat their seed stock. Fortunately, genetic material from both countries had been stored in *ex situ* collections, allowing for the recovery of lost germplasm (Wilkes, 1987).

Despite the valuable services provided by gene banks, they are not an adequate substitute for the *in situ* – or "on site" – conservation of crop genetic resources. As a growing number of crop scientists have begun to stress (Goodman, 1990; Wilkes, 1992;

[3] In fact, many of the early reports on the loss of genetic resources did not document the displacement of landraces *per se*, but simply the increased use of modern seed varieties (Brush, 2004: 159). Thus, even though high-yielding seed varieties were more widely grown, there was not necessarily a complete loss of traditional varieties. Moreover, as Qualset et al., (1997) and Bellon (1996) have observed, and as will be discussed later, the introduction of improved seed varieties can actually augment the genetic profile of crops in a given area.

Maxted et al., 1997; Brown, 2000; Brush, 2004), there are a number of distinct advantages to maintaining crop genetic diversity in the field. Perhaps the most important contribution of *in situ* conservation is that it maintains the dynamic process of crop evolution and improvement. As Major Goodman has observed, gene banks are like "morgues": they preclude the on-going process of evolution that occurs in the field (Goodman, 1990: 15). Although plant breeders can develop new crosses from the existing stock frozen in *ex situ* collections, they cannot replace the flow of new genetic combinations that emerge from *in situ* evolution.

Another limitation of *ex situ* collections is that they isolate seeds from the farmers who cultivate them. In order to be useful, crop genetic resources must be coupled with knowledge of their agronomic attributes. The farmers who cultivate crop varieties know a great deal about their resistance to pests and diseases, their ability to grow in different soils and climates, their water requirements, and so on. In contrast, the "passport" records in gene banks often record little more than when and where the accession was collected. When seeds are separated from the farmers who manage them, it is difficult to ascertain their genetic attributes without growing the plants in microhabitats with qualities similar to those in which they originated.

Finally, *in situ* conservation is less vulnerable to human error. The material held in gene banks must be stored under controlled temperature and humidity conditions, and periodically regenerated by planting new harvest seed. Human and mechanical errors are always a possibility, a possibility that is becoming increasingly more likely as gene banks are chronically under funded (Wilkes, 1992). This danger was brought home to Guatemala in 1985, when it was discovered that roughly one-fourth of its national collection of maize varieties had not been rejuvenated in a timely manner and was ultimately lost.[4] For these reasons, *ex situ* and *in situ* conservation are not substitutes. Rather, seeds “in the bank” must be complemented by seeds “in the field.”

1.2.2 Genetic Erosion

The loss of crop genetic resources in the field is known as genetic erosion. The term was originally coined to refer to the replacement of traditional landraces with modern seed varieties, as discussed in the previous section. Over the years, a number of related processes have been subsequently linked, either directly or indirectly, with genetic erosion. In addition to the adoption of modern seed varieties (Worede, 1997; Ortega, 1997), the loss of crop genetic resources has been associated with the penetration of markets into communities that traditionally fulfilled their economic needs via subsistence farming (Van Dusen, 2000; Van Dusen and Taylor, 2005; Swanson and Goeschl, 1999; Wilkes, 1992); the influx of low priced food imports (Ortega, 1997; Boyce, 1996); the practice of transnational migration in rural communities (Fitting, 2006); changing cultural values (Steinberg, 1999; Steinberg and Taylor, 2002); changes in land use, including urbanization, cattle grazing, and the adoption of new crop species (usually cash crops) (Worede, 1997; Ortega, 1997; Wilkes, 2005; Wilkes, 2007); war and political turmoil (Steinberg and Taylor, 2002; Wilkes, 1987); and natural disasters such as floods and droughts (Worede, 1997).

Despite the many processes associated with genetic erosion, Stephen Brush (2004: 160) observes that it is often a difficult process to verify. Given that the loss of

[4] Personal interview with Mario Fuentes, the principal investigator at *Instituto de Ciencia y Tecnología Agrícolas* (ICTA), Guatemala’s national agricultural research center. (Guatemala City, August 2, 1999).

genetic resources is a process that unfolds over time, its documentation is contingent upon historical inventories of crop variability in the centers of genetic diversity. Such records are practically non-existent, since concern about genetic erosion only emerged as many agricultural landscapes were already undergoing transformation from many of the aforementioned processes. Moreover, Brush maintains that when longitudinal studies of genetic erosion are performed, they often entail incompatible measures of crop diversity.

1.2.3 Genetic Replacement or Genomic Loss?

Although genetic erosion is frequently understood as the loss of landraces, Qualset et al. (1997: 163-7) maintain that it should not be conceptualized as the displacement of particular crop varieties, but rather as the loss of genes, gene combinations, or allelic forms. They note that the substitution of modern seed varieties for indigenous cultivars does not necessarily translate into the loss of genes, but rather the *replacement* of one genetic combination and frequency for another. Genetic erosion only occurs if the genetic replacement results in the loss of alleles or unique genetic combinations. Alternatively, introducing new varieties into an agricultural system might actually enhance its overall genetic profile, resulting in genetic *enrichment*.

Whether genetic replacement contributes to the loss or enhancement of genetic diversity is contingent upon the degree of replacement. Complete adoption of improved crop varieties, as occurred in the U.S. Corn Belt, is likely to be associated with genetic erosion. If, however, the adoption of improved seeds is partial, then the introduced varieties might actually augment the overall gene pool of an agricultural system, as Bellon (1996) reported for the community of Vicente Guerrero in Chiapas, Mexico. The impact of gene replacement upon the *in situ* conservation of crop genetic resources is contingent upon a variety of area-specific environmental factors and, Qualset et al. (1997) maintain, should be evaluated at the level of the individual farm, community, or region.

While there is no definitive relationship between the replacement of varieties within a crop species and genetic erosion, there is an evident link between the loss of crop genetic resources and the complete displacement of a crop. When the adoption of a new type of crop or the wholesale elimination of agriculture results in the complete abandonment of a crop species in an area, the genes and genetic combinations unique to that area are obviously lost as well. Qualset et al. (1997) refer to the sweeping loss of a crop species in an area as genomic erosion, contending that it has a potentially more devastating impact on agricultural biodiversity than genetic replacement within a species. Also known as “genetic wipeout” (Harlan, 1975), genomic erosion is typically associated with changes in land use practices. Wilkes (2005; 2007), for example, has observed that the adoption of coffee farming in Huehuetenango, Guatemala has liquidated the genetically rich *in situ* maize diversity that was formerly present in the area. The adoption of cash crops has also precipitated genomic erosion in Peru and Ethiopia (Ortega, 1997; Worede, 1997). Other processes that have contributed to genomic erosion include cattle grazing (Wilkes, 2005; Wilkes, 2007), urbanization (Wilkes, 2005; Qualset et al., 1997), natural disasters such as floods and droughts (Worede, 1997), and toxic invasions such as soil salinity (Qualset et al., 1997).

In short, a number of processes have been linked with genetic erosion. While the adoption of improved seed varieties is the most commonly cited threat to the *in situ* conservation of crop genetic resources, its overall impact on the genetic pool of an agroecosystem is uncertain. An arguably greater threat to food security is genomic erosion, or the wholesale displacement of a crop due to changing land use practices.

1.3 Peasant Livelihoods, Markets, and the Conservation of Crop Genetic Diversity

The *in situ* conservation of agricultural biodiversity cannot be separated from the social processes that govern its conservation. Unlike wild plants, crops are dependent upon humans to prepare their land, sow their seed, and ensure that they have sufficient access to nutrients and water through weeding and perhaps supplying fertilizer or irrigation. The farmers who maintain crop diversity, in turn, are subject to a variety of political, economic, and cultural forces that shape their livelihood strategies. The most diverse collections of crops are cultivated by small-scale farmers in the centers of genetic diversity; the subsistence-oriented agricultural practices of these peasant farmers play a fundamental role in the *in situ* conservation of crop genetic diversity (Hernández-Xolocotzi, 1993; Altieri et al., 1987). Despite their invaluable contributions to long-term global food security, the small-scale farmers in Vavilovian Centers are often among the poorest and most marginalized populations in the world (Altieri, 2004). They are typically cultural minorities, living in marginal environments, and on the fringes of "the" formal economy (Brush, 1989).

With the current expansion of the global market economy, there is a growing concern among crop scientists that the purported homogenizing forces of globalization will transform rural livelihood strategies and displace the peasant agricultural practices that are fundamental to the *in situ* conservation of crop genetic resources (Altieri, 2004; Altieri and Masera, 1993; Wilkes, 1992). In many respects, these concerns tap into a rich literature on the peasantry and subsistence-oriented agriculture in the social science literature. The following is an overview of two relevant traditions in the economics literature: (1) mainstream models of household decision-making and crop diversity; and (2) the political economy debate over market development and the viability of the peasantry.

1.3.1 Household Decision-making and Crop Diversity

The mainstream economics literature on the conservation of crop genetic resources is inherited from earlier writings that sought to explain the partial adoption of modern agricultural technologies. Both genres use the notion of utility-maximizing households as their unit of analysis and rely heavily upon the use of rational-actor models.

As its name suggests, the literature on partial adoption attempts to explain the incomplete adoption of modern agricultural technologies that has been observed throughout the many areas of the Global South. Given that the adoption of high-yielding seed varieties is often associated with the erosion of genetic diversity, it is often assumed that the "problems" that the models identify as discouraging agricultural modernization are, in fact, the reasons that crop genetic resources are still conserved in peasant agricultural systems, i.e. it is thought that the *in situ* conservation of agricultural biodiversity is ensured by the social processes that discourage the spread of Green Revolution agriculture. There are, however, two limitations to this reasoning: (1) as discussed in the previous section, the genetic replacement that occurs with the adoption of improved seed varieties is not synonymous with genetic erosion; and (2) like most mainstream economic models, the analysis in the partial adoption literature tends to abstract from the political and cultural processes that play an important role in governing peasant agricultural practices. Nonetheless, given the influence that the partial adoption literature has over current economic thinking about the conservation of crop genetic resources, a brief review is warranted.

1.3.1.1 Uncertainty and Risk Aversion

In its initial stage during the 1970s and 1980s, the literature on partial adoption tended to focus upon the roles of risk and uncertainty. In one of the earliest studies, for example, Dean Hiebert (1974) used a model and cursory empirical data from the Philippines to suggest that the incremental spread of improved seed varieties represented a rational response to learning under uncertainty and that, with improved information, peasants would more readily adopt modern agricultural technologies. In a subsequent model, Feder (1980) theorized that farmers' reluctance to completely abandon their traditional varieties could be attributed to their high levels of risk aversion. He also conjectured that, if risk aversion were inversely related with the size of landholdings, then farmers with larger holdings would allocate more land to improved seed varieties. Hammer (1986) came to a similar conclusion, arguing that the mixed cultivation of improved and traditional seed varieties represented a rational practice for risk-averse subsistence farmers.

1.3.1.2 Thin and Incomplete Markets

During the 1990s, the explanation for partial adoption shifted from risk-aversion and uncertainty to the influence of thin and incomplete markets. In a particularly influential piece, de Janvry *et al*. (1991) attributed the incomplete adoption of improved seeds to the high costs of conducting transactions in imperfect markets. They maintained that so long as farmers remained isolated from markets they would be discouraged from allocating certain choice variables – particularly labor and food – to market production and that "successful agrarian development" was contingent upon policies that facilitated market integration. In a similar model, Marcel Fafchamps (1992) suggested that as rural communities became more integrated into the market economy, farmers would shift from cultivating a mix of modern and traditional seed varieties for household consumption to the production of a single modern variety that could be sold in the market. His logic was that farmers operating in thin and isolated markets were subject to price swings and, due to their risk-aversion (now a stylized fact from the earlier models) they cultivated multiple varieties to weather the uncertainty of market swings. As improved infrastructure and structural changes lead to greater market integration – and, by presumption, less market volatility – he theorized that rational farmers would pursue the income-maximizing strategy of specializing in a single variety of a marketable crop.

1.3.1.3 Risk Aversion, Incomplete Markets, and Crop Genetic Resources

Many of the arguments made in the partial adoption models of an earlier generation are echoed in the current economics literature on the management of crop genetic resources. Timo Goeschl and Timothy Swanson are two mainstream economists who have been particularly active in the field (Swanson and Goeschl, 1999; Goeschl and Swanson, 2000). Like their predecessors, Goeschl and Swanson suggest that efforts to diffuse risk are "the driving force" for cultivating a diversity of crop varieties (Goeschl and Swanson, 2000: 5). As markets expand into rural areas, however, farmers will opt for less expensive forms of insurance in the financial and labor markets. The result, they conclude, is that farmers will abandon diversity management as they allocate all of their productive resources to market production and purchase their consumption needs in product markets.

Again, using another utility-maximizing household model, Eric Van Dusen and Edward Taylor (2005) offer an analysis similar to Goeschl and Swanson's. They suggest that, in the absence of perfect insurance markets, farmers faced with risk and uncertainty are likely to plant a diverse crop portfolio, even if the strategy does not maximize household income. With market expansion, they theorize, the uncertainty and other transactions costs associated with the acquisition of goods in the market decrease. Consequently, rational rural households will shift from subsistence-oriented farming to market forms of provisioning.

1.3.2 Empirical Studies on Market Participation and Crop Genetic Diversity

Although the economic studies were mostly theoretical exercises, they have helped to establish the notion among social scientists that the spread of markets necessarily contributes to the erosion of crop genetic resources. Several researchers have attempted to test this premise empirically, by using distance from market centers as a proxy for market isolation and the costs of engaging in market transactions. Many studies have supported the hypothesis that market isolation is associated with higher levels of crop diversity (Van Dusen, 2000; Van Dusen and Taylor, 2005; Winters *et al*., 2006). Some (Aguirre- Gómez *et al*., 2000) have found that market isolation may be positively associated with some measures of crop genetic diversity while negatively associated with others. Still other studies have provided evidence that challenges the predominate hypothesis (Perales *et al*., 2003), finding that farmers cultivating in close proximity to major market centers maintain relatively high levels of crop diversity. For the most part, the empirical studies suggest that market isolation – or at least distance from market centers – is associated with higher levels of crop diversity, but the relationship is not as straightforward as earlier theoretical models have suggested (Smale, 2006).

Addressing the question from another angle, several researchers have investigated how the development of grain markets affects the level of diversity cultivated on the farm. Although there are exceptions – for example, maize farmers in Guanajuato, Mexico have been found to be more interested in the consumption attributes of their crops than their commercial qualities (Smale *et al*. 2001) – market prices for agricultural output have been shown to affect the levels of crop diversity in many regions of the world. For example, Steinberg (1999) found that the Mopan Maya of Belize have stopped cultivating colored varieties of maize because they cannot be marketed, while Meng *et al*. (1998) found that wheat farmers in relatively isolated regions of Turkey are less responsive to grain prices than farmers who cultivate near market centers. Similarly, in a study of four maize farming communities in central Mexico, farmers told Perales (1998) that market factors such as high prices and strong demand were among their main reasons for cultivating certain varieties of maize; yet Perales also found that traditional maize varieties are more dominant in communities that sell a greater proportion of their maize output. These studies suggest that agricultural markets can play an important role in shaping the *in situ* conservation of crop genetic resources. Whether or not they actually encourage farmers to cultivate diversity is contingent upon the level of demand and the relative prices of different crop varieties.

While the existing research has provided valuable insights into the relationship between agricultural markets and the on-farm conservation of crop genetic diversity, it has largely ignored the impact of farmers' participation in other types of markets. Farmers from low-income countries have long relied upon wage labor and small-scale non-agricultural commodity production to supplement their agricultural production; along with the recent growth of transnational migration, these non-agricultural market activities are playing an increasingly important role in rural livelihood strategies (Reardon and German Escobar, 2001; Bebbington, 1999; Deere, 2005). Despite farmers' widespread participation in non-agricultural markets, very little research has been conducted on the impact of the phenomenon on the cultivation of crop genetic resources. In one notable exception, Fitting (2006) explains how the growing prevalence of transnational migration is undermining the institutions that support the cultivation of maize genetic diversity in Mexico, a finding that Van Dusen and Taylor (2005) support with statistical evidence. Van Dusen and Taylor (2005) also found that households located in communities where a greater percentage of agricultural tasks are performed by hired labor tend to plant fewer crop varieties; they interpret this to mean that more fully developed labor markets are associated with lower levels of diversity. The question of how different forms and dimensions of market participation relate to the on-farm conservation of crop genetic resources, however, remains understudied. My research helps to fill this gap.

1.3.3 Capitalist Development and the Viability of Peasant Agriculture

In addition to the mainstream literature on household decision-making, the work by leftist political economists on the viability of the peasantry also offers important insights on the impacts of market expansion upon the on-farm conservation of crop genetic resources. Indeed, given that the *in situ* conservation of crop genetic diversity is intrinsically linked to the agricultural practices of small-scale, subsistence-oriented farmers in the Global South (Hernández- Xolocotzi, 1993; Altieri et al., 1987), the viability of the peasantry in the face of market integration is highly topical.

The political economy debate over the future of the peasantry entails two principal phases. The first occurred around the turn of the 20th century in Revolutionary Russia, as the Bolsheviks and Narodniks debated the role of the Russian peasantry in the revolution and its fate under capitalism. During the 1970s and 1980s a second debate emerged about the impacts of capitalist development upon the peasantry in the Global South, particularly – though not exclusively – in Latin America. On the one side of the Latin American debate were the *descampesinistas* (or "depeasantists") who, like the Bolsheviks before them, maintained that the extension of market capitalism into rural areas would inevitably bifurcate the peasantry into a two-tiered society of a rural bourgeoisie and a landless proletariat. On the other side of the debate were the *campesinistas* (or "peasantists") who, like the Narodniks before them, believed in the viability of the peasantry for any combination of reasons, including the functionality of the peasantry to market capitalism and the unique logic that governs peasant economic systems and serves to insulate the peasantry from the divisive forces of the capitalist juggernaut.

Following the early writings of Lenin (1956) and Kautsky (1988), the *descampesinista* perspective is that the spread of capitalism in the Global South will inevitably result in the dissolution of the region's peasantry. Specifically, this school of thought invokes the Russian thinkers' theory of the social differentiation of the peasantry, a perspective that stresses that variations in wealth among peasant households, most notably their landholdings, will become exacerbated as linkages with industrial capitalism develop and that the growing inequality will fracture the peasantry into two non-peasant classes of non-laboring landowners and non-landowning laborers. According to the logic of the theory, an influx of low-priced consumer goods from the industrialized sectors of the capitalist economy will undercut peasant households' handicraft traditions, making them increasingly dependent upon agricultural crop sales and wage labor to fulfill their non-agricultural needs. Wealthier peasants, it is argued, will benefit from economies of scale in production and will be less susceptible to the profiteering of agricultural merchants and creditors, whereas the smaller-scale peasants will become increasingly indebted, forcing them to sell-off their landholdings to their more prosperous neighbors. The growing concentration of landholdings among the few will increase the necessity of poor peasants to sell their labor power while facilitating its purchase by the emerging class of rural bourgeoisie. Ultimately, the theory concludes, the peasantry will dissolve and subsistence-oriented agricultural practices (and, by extension, much of the on-farm conservation of crop genetic diversity) will disappear.

Whereas the *descampesinistas* knelled the inevitable dissolution of the peasantry, the *campesinistas* celebrated its vigor and resiliency to outside influences. While there are certainly many variations of the *campesinista* perspective, it is possible to identify two principal lines of reasoning for the viability of the peasantry. One perspective is that the behavioral characteristics and communal institutions of the peasantry help to ensure its viability. At the individual level, peasants are sometimes posited as being imbued with an economic logic that stresses subsistence of the household over accumulation (Schejtman, 1980); at the community level, the peasantry purportedly belongs to communities where redistributive mechanisms and economic interactions patterned upon reciprocity help to ensure the survival of all peasant families (Warman, 1980: 295). The second variant of *campesinista* thinking, one that is not necessarily incompatible with the former, is that the persistency of the peasantry is guaranteed because it is functional to the stability of the predominant capitalist mode of production. According to this perspective, the peasantry is typically portrayed as an exploited group that provides cheap food and labor to the benefit of the capitalist economy. The first strain of thought was heavily influenced by A.V. Chayanov's work on the behavior of the Russian peasantry, the later by World Systems Theory and Dependency theorists such as Samir Amin and Andre Gunder Frank.[5]

Much of the *campesinista*/*descampesinista* debate has revolved around whether or not the peasantry constitutes a particular type of economy. The appropriate use of the Marxian concept of "mode of production" has been especially contentious.[6] Some *campesinistas* (e.g. Warman, 1980) have advanced the concept of a specifically "peasant

[5] Another important line of reasoning – not unique to leftist political economists – is that the comparative advantages of family labor over hired labor give rise to an inverse relationship between farm size and land productivity, which acts as a counterweight to forces promoting land concentration (Sen, 1975; Netting, 1993).

[6] The term "mode of production" is contentious in and of itself. As used here, the term refers to the predominant form of social and economic organization. It encompasses the technological development that characterizes the dominant form of economic production in the society (i.e. the "forces of production"); the relations that describe how different groups of people in society access the means of production and the control that they exercise over what they produce, (i.e. the "social relations of production"); and the various legal, cultural, and institutional norms that govern the operation of economic practices (i.e. the "superstructure").

mode of production," a term that attempts to describe the functioning of the rural economy by emphasizing the production behavior of the family-labor enterprise. *Descampesinistas*, in contrast, have argued against the notion of a uniquely peasant mode of production, maintaining that the peasantry exists as either a class within some other mode of production (e.g. feudalism) or as a transitory fraction of a class within the capitalist mode of production (de Janvry, 1981). Still others, while sympathetic to the *campesinista* perspective, have dismissed the idea of a peasant mode of production as a deficient analytical category.[7]

For those who are unfamiliar with Marxian theory, the debate over the appropriate mode of production through which to describe the peasantry may seem trivial. Yet for those who ascribe to a traditional Marxian notion of social change, placing the peasantry in the appropriate mode of production is of utmost importance to predicting its future. If the peasantry operates within one of the more widely accepted modes of production (e.g. feudalism, communism, slavery), as the *descampesinistas* maintain, then the strengthening of the capitalist mode of production in rural areas would inevitably transform peasant households into one of two classes: capitalists or wage laborers. Alternatively, if *campesinos* could be articulated by a uniquely peasant mode production, some *campesinistas* have reasoned that the peasantry may have a permanent future, even as nearby urban areas fall under the web of global capitalism.[8]

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[7] See Deere (1990: 3-6), de Janvry (1981: 102-106) and Ellis (1988: 115-117) for discussions on the conceptual weaknesses of a specifically "peasant mode of production."

[8] As discussed in Deere (1990: 6), many scholars have abandoned the "mode of production" framework for various reasons. Some have simply wished to sidestep the debate over peasant modes of production. Others found the deterministic nature of the framework to be too formal and rigid. One attempt to describe a particular peasant type of economy while skirting the modes of production debate has been to employ the concept of a "peasant form of production."

For many *campesinistas*, peasants function within their own particular type of economy but have frequent interactions with a dominant – and dominating – capitalist mode of production. In his study of the peasantry in the Mexican state of Morelos, for example, Arturo Warman notes that "the peasant family is not in any sense self-sufficient, and it establishes multiple relations with the outside" (Warman, 1980: 284). In this framework, relations with the capitalist mode of production are rarely symmetrical. Instead, the pricing system is supposedly structured so as to transfer surplus produced by peasants to actors in the capitalist sector. This exploitation of the peasantry helps to ensure the continued dominance of capitalism: "the stability of industrial capitalism requires dominance over other, different modes of production in order to expropriate their real surpluses" (Warman, 1980: 304). Thus, according to some *campesinistas* (Warman, 1980), capitalist interests will work to sustain the peasantry since doing so contributes to the conditions of existence for their own dominant position.[9]

In addition to theories that describe peasant economies as functional to an external capitalism, *campesinistas* have also advanced a type of peasant economy that distinguishes itself by its internal logic and economic motivations. Alexander Schjetman (1980) and Warman (1980), for instance, describe a peasantry that is made-up of family farms that operate under the calculus of fulfilling subsistence needs rather than maximizing family income. Such descriptions are inspired by the influential Russian intellectual, A.V. Chayanov. Schjetman and Warman, for example allude to Chayanov's

[9] Though he was not a *campesinista* per se, Bernstein (1979) describes a "simple reproduction squeeze" for the African peasantry. The peasantry's inability to accumulate beyond its basic needs has nothing to do with a lack of motivation, he maintains, but rather due to structures that siphon away their surplus production and innovations that compete with – and lower the prices for – their petty commodity production. Deere and de Janvry (1979) describe several mechanisms for extracting surplus from the peasantry, including rents, taxes, terms of trade, usury, and the exploitation of peasants' labor power.

proposition of a “drudgery-averse peasant”: the economic behavior of peasants is driven by their desire to achieve a balance between the utility of consumption and the disutility of labor. They also invoke Chayanov’s (1977) assertion that the intensity of labor is positively correlated with the ratio of consumers per units of labor within the peasant household.

Despite their many similarities, campesinista theories are not merely a rendition of Chayanovian thinking. Contrary to the propositions of many campesinistas, for example, Chayanov did not develop a theory per se of a “peasant mode of production” (de Janvry, 1981: 100). Rather, his analysis focused on the organizational aspects of peasant farms. Moreover, Chayanov portrayed a peasantry that had little interaction with the capitalist system (Ellis, 1988: 115), the system that many *campesinistas* maintained was guilty of frequently exploiting the peasantry. Warman (1980: 296), for one, adopts the Chayanovian proposition that peasant households cease to produce once their subsistence needs have been satisfied and that this is due, at least in part, to the aforementioned Chayanovian law of labor intensity. But, unlike Chayanov, Warman maintains that the subsistence-oriented behavior of peasants is also due to their desire to avoid exploitation by capitalist interests: “integration into the capitalist market implies that every increase in income gives rise to an increase in the transfer of surpluses.”

Thus, *campesinista* theories suggest that the spread of capitalism into rural areas will not contribute to a process of depeasantization for at least one of the following reasons: 1) the stability of the capitalist system is dependent upon the surplus that it appropriates from the peasantry; and 2) the economic motivations of the peasantry are more oriented towards subsistence and egalitarianism than towards the profit-maximizing behavior that is necessary for capitalism to flourish and for social differentiation of the peasantry to occur. *Descampesinista* theories, in contrast, maintain that the integration of Latin America's rural areas into the arena of global capitalism will result in the unavoidable dissolution of the region's peasantry.

Many *descampesinistas* employ the analytical framework of classical Marxism. De Janvry (1981) explains the laws of motion of this decidedly deterministic paradigm and their implications for the peasantry. The articulation of the capitalist economy requires that all workers in the economy sell their labor power in the labor market and that they are entirely dependent upon their wage income in order to fulfill their economic needs, i.e. there is a complete proletarianization of the labor force. Not only does a full proletarianization of the labor force increase the supply of labor power, thereby helping to reduce the wage bill paid by capitalists, it also helps to expand the overall capacity for consumption in the economy. In other words, eliminating the ability of peasant households to fulfill their own consumption needs is functional to the capitalist mode of production. The inevitable expansion of capitalism that is posited by the paradigm of classical Marxism is facilitated by the dissolution of all precapitalist modes of production and the full monetization of payments to labor. As peasants are brought into the folds of the expanding capitalist mode of production and the socio-economic differences among peasant households intensify, *campesino* families would ultimately assume a new social identity in one of two social classes: the rural bourgeoisie or the rural proletariat. The rural bourgeoisie hire the rural proletariat to produce commercial crops that are sold to workers and other consumers in the capitalist economy; the rural proletarians sell their labor power to the rural bourgeoisie and purchase their consumption needs in the market.

Neither class uses family labor to produce crops for household consumption. Thus, according to the teleology of classical Marxism, the expansion of market capitalism into the rural areas of Latin America will bring about the dissolution of the peasantry and its accompanying practice of subsistence-oriented agriculture.

In an attempt to resolve the debate over the impact of capitalist development upon the Latin American peasantry, many researchers turned to empirical data. Of particular interest were the degree of economic differentiation among the peasantry and the level of peasant participation in wage labor. A 1981 study by Carmen Diana Deere and Robert Wasserstrom, for example, examined both questions. Drawing upon eight surveys that had been administered throughout Latin America in the 1970s, they found that the level of off-farm income was inversely related to farm size, thereby supporting the *descampesinista* thesis of a social differentiation among the region's peasantry. At the same time, however, they offered data that rural households in Guatemala and other Latin American countries earned the majority of their income on the farm, suggesting that although it was differentiated, the peasantry as a group had not been thoroughly proletarianized. In a follow-up study, de Janvry et al. (1989) found that when samples were restricted to the households with the smallest landholdings, wage labor was a major source of household income throughout Latin America, indicating that the region's poorest peasants were, in fact, undergoing a process of proletarianization.

The empirical evidence indicating the widespread importance of wage income to Latin America's rural poor seemed to concur with the predictions of the *descampesinistas*. For many, peasant participation in wage labor was synonymous with proletarianization and, ultimately, indicative of a process of *depeasantization*. Other scholars, however, including the *campesinista* Arturo Warman (1980), took a different approach, arguing that participation in wage labor and other income-generating activities had actually helped to forestall a complete dissolution of the peasantry. Indeed, many scholars of Latin America have since concluded that income from wage labor and other off-farm activities allows marginalized peasants to continue their trademark livelihood strategy of subsistence-oriented agricultural production. In 2001, for example, David Barkin echoed a thesis put forward by Warman more than twenty years earlier: despite discriminatory state policies, Mexican *campesinos* engage in multiple income-generating activities in order to fulfill all of their subsistence needs and defend their status as peasants. Carmen Diana Deere made a similar finding in her 1990 study of rural households in northern Peru, concluding that – in addition to repressive gender relations within the household – the persistence of the peasantry is contingent upon the income earned from various off-farm activities.

Thus, despite empirical evidence of social differentiation and significant levels of wage employment, the *descampesinista* prognosis of a dissolving peasantry has yet to play itself fully out in Latin America. Even though there is stratification and the farmers with the smallest landholdings are the most dependent upon wage labor, poor peasants continue to practice subsistence-oriented agriculture. Moreover, their income earned in off-farm activities often provides the resources necessary for small-scale farmers to continue practicing peasant agriculture. Instead of becoming fully proletarian, the peasantry has become only semi-proletarian. As Brass (2003: 11) has observed, the process in many regions of Latin America has not been one of "depeasantization," but one of "reconstitution." The peasantry has embraced multiple non-agricultural income generating activities while clinging to its trademark practice of subsistence-oriented agriculture.

As the political economy literature on the peasant livelihood strategies suggests, participation in the market economy is not necessarily incompatible with peasant agriculture and the attendant benefit of the on-farm conservation of crop genetic diversity. In addition to the economic rationality posited by mainstream economists, cultural and political processes also play an important role in shaping peasant livelihood strategies. In order to better understand the ways in which market expansion affects the on-farm conservation of crop genetic resources, much more is needed than mathematical models positing utility maximization. One should also explore the cultural and political factors that shape peasants' provisioning strategies.

1.3.4 The Post-Structural Intervention

The debate over the viability of the peasantry began to wane towards the end of the 1980s. As Bryceson (2000) recounts, much of the early focus on the politics of the peasantry was co-opted into the politically innocuous focus upon the decision-making of rationales of "smallholders." In many respects, the debate had ended in a stalemate. Markets had expanded into many rural areas and there was some evidence of peasant stratification and dependency upon wage labor, yet still the peasantry persisted in a semi-proletarian state. With its rigid focus upon all-pervasive modes of production, the traditional framework could not explain the viability of a peasantry with one foot in wage labor and the other in subsistence-oriented agriculture.

1.3.4.1 Post-Structural Economics

The rise of post-structural economic analysis in the 1980s offered an alternative means for understanding the semi-proletarianized peasantry. With its emphasis on difference within similarity, the post-structural intervention offered a framework for understanding diversified livelihood strategies (Resnick and Wolff, 1987). Deere (1990), for instance, employed a post-structural Marxian framework to demonstrate that participation in capitalist forms of wage labor, combined with patriarchal gender relations within the household, allowed the Peruvian peasantry of Cajamarca to maintain subsistence-oriented agricultural practices that would have otherwise been unsustainable. Returns from participating in other realms of the economy helped to secure the conditions of existence for a uniquely peasant form of economic provisioning.

1.3.4.2 Post-Structural Anthropology

In addition to demonstrating the possibility of difference within livelihood strategies, the post-structural framework has also helped to articulate the various motives that people hold for engaging in different forms of economic provisioning. Unlike the aforementioned rational-actor models that presume that *all* economic actions are motivated by self-interest, for example, post-structural theories contend that some forms of economic provisioning may indeed be motivated by income maximization, but others might be oriented towards expressing cultural identity, guaranteeing security, displaying affection, etc.

The economic anthropologist Stephen Gudeman offers a post-structural framework for understanding cultural economies (Gudeman, 2001; Gudeman and Rivera, 2002). He partitions economic life into two spheres: the “market” and the "community."[10] The market economy is characterized by self-interested behavior: people produce and trade with one another in order to obtain commodities that satisfy their own individual desires. It is the realm of the self-interested actions where people maximize their utility. The community economy, in contrast, is characterized by mutuality. Humans live by what they make; group activities take precedence over self-interest as people draw upon their shared traditions and holdings. While the market economy promises efficiency and "rationality," the community economy promises subsistence and the ability of the community to reproduce itself in the face of uncertainty. In truth, most practices are a mixture of the two modes. Few, if any are purely "market" or "community" driven. Nonetheless, the framework helps to demonstrate the incommensurability of market activities and subsistence-oriented agriculture. In addition to producing the direct use value of food crops and the indirect use value of crop genetic diversity, traditional forms of agriculture may also be valued for the social relations embedded within them.

A paradigm that Arturo Escobar (1999) refers to as the "problematic of alterity" offers an explanation for why certain forms of economic provisioning may be valued as cultural practices. The problematic to which Escobar refers is the difficulty in achieving a balance between economic equality and cultural difference. Historically, cultural difference has long been used to justify the economic subjugation of certain groups of society. In various contexts, ethnic, racial, religious, and gender minorities have often been perceived as inferior and therefore subjected to the less desirable – and exploited –

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[10] As with most binary models, there are limitations to this framework. Dividing economic life into one category or requires rigid distinctions. While there are obvious differences among different forms of economic provisioning, there are also many similarities.

realms of economic life. Such has been the case with the Kurds of Iraq, the Quechua of Peru, the Maya of Mexico and Guatemala, the Naga of India, the Ifugao of the Philippines, the Karen of Thailand, and the other marginalized populations who have long served as the stewards of *in situ* crop genetic diversity (Brush, 1989). In the neo-liberal era, however, many marginalized groups are being (forcefully) encouraged to join the ever-expanding global market economy, the so-called "dollar democracy" with its purported homogenizing effects. The recent push fails to recognize, however, that economies are cultural constructions (Polanyi, 1958; Gudeman, 1986; Gudeman, 2001) and that denying people the opportunity to engage in certain forms of economic provisioning is equivalent to denying them opportunities to express their cultural difference. Indeed, it may be that many of the populations that conserve crop genetic resources in the field may wish to hold on to their traditional agricultural practices as a means for connecting to their cultural heritage.[11] At the same time, however, they may be eager to engage in income-generating activities in the market economy that allow them to improve their material well-being. The challenge then, would be to create the possibility for the stewards of crop genetic diversity (and others) to engage in multiple forms of economic provisioning that, in turn, allow them to articulate and realize their various values and motivations.

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[11] This is not, however, to suggest that all traditional agricultural practices are valued. Garcia-Barrios and Garcia-Barrios (1990), for example, discuss how peasant farmers in Mexico are opting to abandon traditional agricultural practices that they associate with their political and economic subjugation in the past. Similarly, Anthony Bebbington (1996) observes that many indigenous people in Ecuador are not necessarily committed to traditional agricultural technologies, but rather to reforming, adapting, and managing modernization. But defense of place-based practices need not imply "an intransigent defense of 'tradition'," writes Escobar, "but rather [a] creative engagement with modernity and transnationalism" (Escobar, 1999: 15).

1.4 Food Security and Food Sovereignty

As Davis et al. (2001) explain, the notion of food security has taken on many meanings over the years. Much of the original thinking about food security arose in response to the 1970s food crisis in Africa. As articulated in the 1974 World Food Conference, the predominant belief at the time was that hunger and malnutrition were the result of an inadequate food supply (United Nations, 1975). Accordingly, the obvious solution was to increase food production; modern Green Revolution agricultural technologies were pushed by many international development agencies as the technological panacea.

Thinking about food security shifted in the 1980s with Amartya Sen's seminal *Poverty and Famines* (Sen, 1981). Sen rightfully argued that merely increasing food supplies is not a sufficient solution to hunger. In addition, people need the political and economic power to access the food that is produced. Hunger is not equitably distributed and those with the weakest "entitlements" (i.e. the command and control) over food endure the worst hunger. Peoples' entitlements, Sen observed, are shaped by their endowments of productive assets, the productive technologies available to them, and their exchange conditions, specifically their ability to purchase affordable commodities. Sen's critique could be interpreted as the need to invest in marginal populations and improve their access to land and other productive resources. In practice, however, food security is usually proffered through affordable commodities. Specifically, it is often argued that liberalizing trade in agricultural commodities will improve food security by increasing the supply cheap food items.

The concept of food security has come under attack in recent years. Led by international peasant movement *La Via Campesina*, a number of civil society and non-governmental organizations argue that the notion of food security has become watered-down and that it often represents little more than a front for agricultural dumping and expanding the domain of big agribusiness (Rosset, 2003). Moreover, the critique continues, the massive imports of cheap food that has occurred under trade liberalization have exacerbated food insecurity by undercutting local farmers and driving them off of their land.

In place of food security, *La Via Campesina* and its collaborators have argued for the more stringent practice of food sovereignty. Like food security, the notion of food sovereignty advocates that every human has access to a sufficient quantity food on a daily basis. But the concept differs from the paradigm of food security in three important respects. First, food sovereignty stresses the right of individuals, communities, and nations to determine the degree to which they would like to achieve food self-sufficiency and define terms of trade that are consistent with the sustainable use of natural resources and the health of local economies. Second, reinvigorating Sen's oft-neglected observation that resource endowments are important to ensuring access to food, the sovereignty approach advocates economic access to income- and food-producing resources, including land. Finally, food sovereignty advocates the right not only to sufficient calories, but also to the ability to fulfill nutritional needs with foods and practices that are culturally meaningful (Windfuhr and Jonsén, 2005).

Achieving food security is contingent upon the conservation of agricultural biodiversity. Without crop genetic resources, humankind's principal food crops would lack the ability to adapt to environmental change. Improvements in agricultural technology have played an important role in feeding "First World" populations; many of the improvements were contingent upon a diversity of crop genetic resources (Day Rubenstein, et al., 2005). At the same time, it could be argued that the food security of "First World" populations is contingent upon the food sovereignty of the "Third World" peasantry. By facilitating the influx of cheap agricultural imports, trade liberalization posses a threat to small-scale farmers and the on-farm conservation of crop genetic resources in centers of diversity (Boyce, 1996). If, however, peasants would like to maintain their traditional agricultural practices as a valued form of local economic provisioning, then ensuring their food sovereignty would, consequently, help to fortify global food security.

1.5 Research Questions, Methodology, and Findings

1.5.1 Research Questions

Despite the growing concerns that modernization and the expansion of the market economy threaten to spur the loss of crop genetic resources, there is a paucity of empirical research on the subject. The little research that has been completed has largely failed to distinguish among different forms of market participation, often inferring that engagement in one realm of the market is indicative of complete market integration. Moreover, it has included scant analysis of the interplay of economic and cultural forces in shaping the livelihood strategies of peasant farmers. With this dissertation I help to fill these lacunae.

My primary concern is the impact of market expansion upon the on-farm conservation of crop genetic resources. In particular, how do different forms of market participation affect the practices surrounding the cultivation of crop diversity? Does allocating household resources to various forms of market production (e.g. wage labor, commercial agriculture, petty commodity production) and expenditures in the market (e.g. on food purchases, hiring field hands) translate into less diversity on the farm? Do households substitute market forms of economic provisioning for subsistence-oriented agricultural practices? Or do the two realms of economic life play complementary roles in peasant livelihood strategies?

1.5.2 Methodology

I address the aforementioned research questions in the Guatemalan context. I focus my attention upon the conservation of crop genetic resources in the "megacenter" of biological diversity in the country's northwestern highlands. My analysis is mostly empirical, drawing primarily upon data collected during 20 months of field research. I also use a number of secondary sources, including results from national agricultural censuses, ethnographic studies, and inventories of crop diversity.

I conducted my field research during five separate trips to Guatemala, beginning in June 1999 and ending in August 2006.[12] During my initial trip to Guatemala in the summer of 1999, I conducted a number of preliminary interviews with peasant farmers and officials of governmental and non-governmental organizations. I also searched the highlands for possible communities for future field research.

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[12] I also spent 1.5 months studying the Mayan dialect of K'iche' in the summer of 2000, but I do not count that time during Guatemala towards my field research.

I returned to Guatemala for seven months of field research in November 2001. Some 3.5 months were allocated to collecting data from various branches of the Guatemalan Ministry of Agriculture and Livestock, Guatemala's land trust fund (FONTIERRAS), the country's rural development bank (BANRURAL), and various non-governmental organizations operating in the highlands. I spent much of the remaining time engaged in participant observation in the village of Nimasac, Department of Totonicapán.

I conducted the third stage of my field research in January – May 2003. My major project during this phase was to conduct a detailed household survey. (See Appendix I for the survey instrument.) With the assistance of four indigenous K'iche' speakers and local representatives who confirmed our appointments, I administered the survey to 120 households in two highland villages, the aforementioned community of Nimasac and the hamlet of Xeul in the Department of Quetzaltenango. Households were selected at random from maps of the villages. It took approximately two hours to administer each survey; I thanked each participant with a bag of daily use items, including soap, rice, and matches, that was worth approximately $2.25 (USD).

After conducting a preliminary review of the surveys, I returned to Guatemala in September 2003. I spent the following four months conducting follow-up interviews with survey participants and engaged in participant observation.

I concluded my field research in August 2006. During this last phase I conducted a number of focus group discussions and individual interviews with community members. The focus groups were designed to capture the perspectives of different gender and age groups.

I draw heavily upon my field data throughout this dissertation. I include descriptive statistics, econometric analysis of my survey results, quotations from interviews and conversations, and synopses of my impressions and observations. I pay particular attention to the way that peasants conceptualize local crop diversity, the ways in which they combine different economic activities in their livelihood strategies, and the values that they ascribe to different realms of their economic life.

1.5.3 Findings and Interventions

In contrast to the predictions of the economic models discussed in section 1.3.1, I find that peasants' participation in the market economy is not necessarily antithetical to the on-farm conservation of crop genetic diversity. Although certain forms of market participation are associated with lower levels of diversity maintained on the farm, many are complementary. The use of hired field hands is the only form of market participation that is consistently linked to lower levels of diversity on the farm. I also find that reallocating land to commercial crops translates into less land cultivated with native crops, but that commercial farmers do not necessarily cultivate fewer varieties of staple crops (i.e. cash croppers maintain levels of diversity that are similar to their neighbors on the plots of land that they dedicate to subsistence agriculture). Other market activities such as purchasing food commodities and allocating household resources to regional wage labor, transnational migration, and petty commodity production may actually complement subsistence-oriented agriculture.

Most rural Guatemalans conceptualize market activities and subsistence-oriented agriculture as equally important but distinct forms of economic provisioning. Their subsistence-oriented agricultural practices provide security, a connection to cultural heritage, and enjoyment. Market activities, for their part, augment insufficient agricultural returns and offer opportunities to improve material well-being.

Religion and size of arable landholdings were also found to play important roles in the on-farm conservation of crop genetic diversity. Subsistence-oriented agricultural practices are strongly connected to Mayan heritage; affiliation with evangelical Christian religions appears to undermine these cultural values and, thereby, lower the levels of diversity maintained on the farm. Expanding the size of peasants' arable landholdings, meanwhile, is associated with an increase in multiple measures of diversity. In addition to granting peasants the opportunity to plant more crop species and varieties, larger landholdings allow farmers to dedicate a larger share of their cultivated land to minority crops.

These findings make important interventions in three of the literatures of development and natural resource economics. First, they offer important insights for the literature on crop genetic resources by deconstructing the notion of an all-encompassing market economy and demonstrating the linkages of peasant livelihood strategies with the on-farm conservation of crop genetic resources. Second, by documenting the various cultural and economic motivations for engaging in different forms of economic provisioning, my research supplements the literature on market participation and the semi-proletarianization of the peasantry. Finally, my dissertation contributes to the literature on progressive strategies for building natural assets, as it explores locally and culturally appropriate strategies for rewarding poor peasant farmers for their stewardship of crop genetic diversity.

1.6 Dissertation Plan

The remainder of my dissertation consists of seven chapters. In Chapter 2 I discuss the importance of Guatemala as a "megacenter" of biological diversity and the contributions of traditional maize agriculture to global food security and the Guatemalan peasantry's food sovereignty. In Chapter 3 I use inventories of crop diversity in Guatemala to identify the genetic hotspots in the country and draw upon the country's four agrarian censuses and other secondary sources to speculate as to how that diversity has evolved over the past fifty years. I provide a description of the two communities where I conducted my field research in Chapter 4, giving careful attention to the history and relevance of different market activities in each village. In Chapter 5 I discuss the composition of peasant livelihood strategies that combine market activities with subsistence agriculture and describe the complementary roles played by the different forms of economic provisioning. I provide a description of the maize diversity present in the two communities in Chapter 6 and use Tobit regressions to estimate the effects of different forms of market participation upon the various measures of maize diversity at the household level. In Chapter 7 I describe the infra-crop diversity present in the two communities and use two-stage hurdled Poisson regressions to identify the processes that shape a peasant household's decision to intercrop. I conclude the dissertation in Chapter 8, providing an analysis of my results and discussing the policy implications of my research.

CHAPTER 2

MAIZE AGRICULTURE IN ITS GUATEMALAN HEARTLAND: CONTRIBUTIONS TO GLOBAL FOOD SECURITY AND THE PEASANTRY'S FOOD SOVEREIGNTY

2.1 Introduction

In K'iche' Mayan and several of the other indigenous dialects spoken in the country, Guatemala is referred to as *Iximulew*, or "The Land of Maize." In part, the name is in reference to the widespread cultivation of the grain. Maize is grown on one-third of the agricultural land (INE, 2004) and accounts for 91% of the total cereal area in the country (Pingali, 2001: 49). But the name *Iximulew* is also a reflection of the predominant role that maize plays in the history, culture, and economy of its Mesoamerican heartland.

Small-scale peasant farmers known as *campesinos* cultivate the majority of the maize that is grown in Guatemala. According to data from the country's 2003 agricultural census, 97% of the small-scale farmers who control less than 3.5 hectares of land plant maize (INE 2004). Combined, they control a mere 16% of the agricultural land in country, yet these smallholders harvest some 60% of the total maize production in Guatemala; one-third of the total maize is harvested by *campesinos* who control less than 1.5 hectares of arable land. Most of the maize that is produced by Guatemalan peasants – more than 90% (von Braun, et al., 1989: 24) – is consumed directly within the household.

The widespread cultivation of maize in Guatemala generates multiple types of benefits. In addition to providing food or a marketable commodity for its cultivators, small-scale maize agriculture is also the source of two important entailments. One entailment is that, via their traditional practices, Guatemalan peasants help to conserve one of the most diverse *in situ* collections of maize in the world. Along with neighboring southern and central Mexico, Guatemala is the cradle of domestication for maize and the crop's modern center of diversity. Some 7,000 years ago, Mayan farmers in this Mesoamerican region domesticated what is now, along with rice and wheat, one of the world's three most important staple cereal crops (Pingali and Smale, 2001). Over the millennia, the descendants of these Mayan farmers have developed a rich diversity of maize, yielding several thousand varieties[1] adapted to a wide range of environmental microhabitats. By maintaining this diversity in their maize plots, contemporary peasant farmers in Guatemala help to maintain the genetic resources for one of humankind's principal food crops, thereby helping to maintain a cornerstone of long-term global food security.

A second entailment relates to the important cultural connections that many rural Guatemalans have with maize and maize agriculture. Maize has long played an important role in Mesoamerican cosmology; its cultivation connects many present-day farmers with their Mayan heritage and continues to organize rural life throughout much of Guatemala. "Maize," writes anthropologist and economic botanist Stephen Brush, "is one of the few crops that is so dominant in the regional culture and society of its origin that it might be perceived as having domesticated humans as much as humans domesticated it" (Brush, 2004: 82).

[1] The multitude of maize varieties developed in Guatemala can be clustered into 28 races. These races make-up about 1/10 of the approximately 300 races that are maintained worldwide (Personal communication with maize biologist Garrison Wilkes, April 2007).

In this chapter I explore the multiple contributions of small-scale maize agriculture in Guatemala to human welfare. In the following section I discuss the importance of Guatemala as a "megacenter" of diversity and explore the contributions of peasant agriculture to the on-farm conservation of crop genetic resources and long-term global food security. In section 2.3 I document the contributions of traditional maize agriculture and food preparation to the nutritional well-being of peasant farmers. I discuss rural Guatemalans' cultural connections to maize in section 2.4, observing that cultivation of the grain serves as an expression of Mayan ethnic identity and offers a venue for fortifying social relationships within family and community. I conclude the chapter by discussing the contributions of Guatemala peasant agriculture to food security and food sovereignty. Traditional maize-based agriculture provides food security for both the peasants who practice it and the global population who benefit from the *campesinos*' conservation of crop genetic resources. Moreover, by provisioning food in a way that is ecologically appropriate and culturally empowering, the practice enhances the food sovereignty of the Guatemalan peasantry.

2.2 The Guatemalan Center of Crop Genetic Diversity

In his pioneering study of Mesoamerican plant life, the eminent Russian botanist, N.I. Vavilov (1931) identified nearly seventy species of cultivated crops that he believed to have originated in southern Mexico and Central America. He christened the region a center of origin for agriculture and a modern center of crop diversity. Several crops of global significance were domesticated in the region, including numerous species of beans, squash, and red peppers, maize, cotton, sisal, cherry tomato, chayote, cacao (or chocolate), avocado, guava, sapote, and vanilla (Vavilov, 1931; Wilkes, 2004). In reference to the rich diversity both among and within crop species, ecologists recognize Mesoamerica as a "megacenter" of biological diversity (Perales et. al, 2005: 949).

Maize – or "corn" as it is known in North American parlance – is arguably the most important crop to emerge from Middle America. Along with rice and wheat, maize is one of humankind's three main staple cereal crops. Though more acreage is allocated to rice and wheat, more maize is harvested than any other crop in the world, thanks to its comparatively larger grains and higher yields (FAPRI, 2006).[2] In total, some 700 million metric tonnes of maize were produced in 2006, the equivalent of 220 pounds for every living human.[3] Most of the maize that is currently cultivated in the world is the product of modern, high-yielding seed varieties. The seeds account for three-quarters of maize acreage worldwide, and a larger proportion of global production (Morris, 1998). Most of these varieties were derived from genetic material developed by farmers in the crop's Mesoamerican cradle of origin (FAO, 1992).

2.2.1 The Biological Origins of Maize

While there is a widespread consensus among crop scientists that the indigenous people of the Mesoamerican region domesticated maize some 6,000 – 9,000 years ago, the biological origins of the crop are hotly disputed (Wilkes, 2004; Brush, 2004). As Wilkes (2004) explains, the debate surrounding the domestication process for maize revolves around the role played by its closest relative, teosinte, a wild grass that is

[2] Maize yields are more than 60% greater than either wheat or rice (FAPRI, 2006).

[3] Of course, not all maize is destined for direct human consumption. Maize is also fed to livestock, fermented to produce a wide range of foods and beverages, and used as an industrial input in the production of starch, oil, sugar, protein, cellulose, and, most recently, ethanol.

endemic to the western escarpment of southern Mexico and northern Guatemala. The two plants are remarkably similar – "Corn is 90% teosinte and teosinte is 90% corn," writes Wilkes (2004: 18) – and hybridizations are common in areas where the two species exist. The question is whether teosinte is a progenitor to maize and, if so, whether it was crossed with another plant species to create maize. Perhaps the most prevalent theory, one initially offered by Paul Ascherson in the late nineteenth century and popularized by George Beadle in the 1930s and currently championed by John Doebley, is that maize is a direct descendant of teosinte and that no other plants were involved in its domestication. In the 1930s, the famed botanist Paul Mangelsdorf and his colleagues (Mangelsdorf and Reeves, 1939; Mangelsdorf and Cameron, 1942) offered an alternative theory known as the "Tripartite Hypothesis." According to Mangelsdorf, teosinte is not the progenitor of maize, but rather its hybrid progeny. Maize, he argues, is not a domesticated version of teosinte, but rather a hybrid of *Tripsacum* (another wild grass related to maize) and a now-extinct wild pod corn. Though Mangelsdorf's "Tripartite Hypothesis" has slowly unraveled over the years, Mary Eubanks (2001) has given it a new twist with her recent finding that maize represents a hybridized form of teosinte and *Tripsacum*. Eubanks' claim, however, remains contentious among maize biologists. Despite seven decades of research, the process by which Native Americans domesticated maize remains a partial mystery.

2.2.2 Guatemala – a Center of Maize Genetic Diversity and a Secondary Center of Origin

Though agricultural biodiversity rarely conforms to the rigidity of political boundaries, most studies rely upon nation states and their various subdivisions to describe the geographic distribution of crop diversity. The use of modern political entities to describe diversity is helpful to the extent that it provides commonly recognized geographic locations, and convenient to the extent that many of the socio-economic processes that affect agricultural practices are reported for nations, states, townships, etc. and not centers of diversity. An obvious drawback of using modern political boundaries to describe biodiversity, however, is that analysis that focuses upon crop diversity at the level of the nation-state and other political entities are fragmented and incomplete. Such is the case in Mesoamerica, where much of the literature on agricultural biodiversity has focused upon Mexico while granting significantly less attention to the crop diversity just south of the border in northern Guatemala.[4] Yet, as the handful of studies of crop diversity in Guatemala have demonstrated, it is a country that is rich in both infra- and intra-crop diversity. This diversity is particularly evident with respect to the within crop diversity of Guatemala's premier crop: maize.[5]

Guatemala has long been recognized for its rich maize diversity. In one of the earliest documented studies of Guatemalan maize diversity, Paul Mangelsdorf and James Cameron (1942: 219) noted that, "In an area half the size of the state of Iowa, are probably found more distinct types of corn than occur in the entire United States." They went on to write, "There is no doubt that western Guatemala is a concentrated center of diversity of maize" (Mangelsdorf and Cameron, 1942: 243). As part of the National

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[4] Indeed, the Mayan farmers who currently maintain much of the maize diversity bequeathed to them by their ancestors are widely prevalent on both sides of the border.

[5] This diversity is hardly limited to maize, however. As Vavilov himself noted, "There is a particularly striking diversity with respect to the seeds of the ordinary beans (*Ph. Vulgaris*) in Guatemala;" "A large number of species and types of squash are also concentrated in Guatemala;" and "The variation of peppers (*Capsicum annuum L.*) in Mexico and Guatemala is amazing, as is that of chayote (*Sechium edule* Schwartz) and cocoa (*Theobroma cacao L.*)" (Vavilov, 1992: 399).

Research Council's efforts to systematically catalog maize diversity throughout the Americas in the 1950s, E.J. Wellhausen and his colleagues (Wellhausen et al., 1952; Wellhausen et al., 1957) echoed Mangelsdorf and Cameron's observation, stating that, relative to its size, the small country has the highest concentration of maize races in the western hemisphere and, by implication, the world. Though subsequent and more comprehensive studies of Guatemala's maize diversity have yet to be undertaken, the country is widely recognized as a center of maize genetic diversity (van Etten, 2006).

The rich diversity of maize in Guatemala, along with the presence of its wild relatives teosinte and *Tripsacum*, have led several crop researchers to speculate that maize was domesticated in the country. Manelsdorf and Cameron (1942: 243) wrote that, "In so far as diversity is associated with centers of origin… this region [of western Guatemala] must also be regarded as *a* center if not *the* center of origin for cultivated maize varieties."[6] They ultimately went on to discard this notion, though, as it was inconsistent with their aforementioned "Tripartite Hypothesis." Using chromosome knob data, Kato (1984) and McClintock et al. (1981) theorized that the Guatemalan highlands were one of five independent sites for maize domestication, the remaining four occurring across the modern-day political border in southern and central Mexico. More recent studies have dismissed the theory that maize was domesticated in Guatemala, observing that the country is more likely a secondary center of origin. Based upon genetic and archaeological evidence, the modern consensus is that maize crossed the threshold of domestication in southern Mexico; it is believed to have been a singular event, occurring

[6] Authors' italics.

somewhere in the modern-day states of Guerrero, Chiapas, or Oaxaca (Wilkes, 2004; Brush, 2004; Piperno and Flannery, 2001; Matsuoka et al., 2002).[7]

Maize agriculture in Guatemala most likely began in the western highlands, somewhere in the present day departments of Huehuetenango, Totonicapán, Quetzaltenango, or San Marcos (Wellhausen et al, 1957; Mangelsdorf and Cameron, 1942). After entering Guatemala from Mexico, maize seed may have introgressed with native Guatemalan *Tripsacum* in the country's lowlands (Mangelsdorf and Cameron, 1942). From Guatemala, maize is believed to have followed two paths. One spread southward, through Central America, into the lowlands of South America, and, ultimately, into the Andes Mountains (Matsuoka et al., 2002). Along the other route, maize is said to have spread from Guatemala into the Caribbean, from where it was introduced to Europe and eventually to Africa (Taba, 1997 c.f. Turrent and Serratos, 2004). Thus, even though Guatemala is a secondary center of origin for maize, the races of maize that are native to Guatemala have been adapted throughout the world; it is widely recognized as a center for the crop's divergence (Anderson, 1947; Wellhausen et al., 1957; Matsuoka et al., 2002).

2.2.3 Comparatively Greater Variation Among Races of Highland Maize

Although they share a common progenitor, there is a marked difference between the maize cultivated in the highlands and the maize that is grown in the lowlands of Guatemala. Morphologically, highland maize varieties tend to be more flinty and floury whereas lowland varieties are more dented (Anderson, 1947; Wellhausen *et al*., 1957)

[7] Using genetic analysis, Matsuoka et al. (2002) have identified the Central Balsas river drainage in the Mexican state of Guerrero as a strong candidate for the location of maize domestication.

and share more similarities with their weedy relative *Tripasacum* (Mangelsdorf and Cameron, 1942). The differences between highland and lowland maize varieties are also reflected in their chromosome arrangements and enzyme structures. As the Nobel Prize-winning botanist Barbara McClintock and her Mexican colleague Angel Kato-Yamakake observed, the chromosome arrangements (i.e. karyotypes) across lowland races of maize are relatively similar, while there is much greater variation among races of maize from the highlands (McClintock, 1960; Kato, 1984). Focusing upon the biochemical reactions of amino acids (i.e. isoenzymes), Bretting et al. (1990) came to a similar conclusion, noting that there is significantly greater interracial diversity among highland races of maize. In short, maize varieties from the Guatemalan highlands tend to be more genetically unique than their lowland relatives.

The integrity of highland maize varieties is frequently attributed to the seed selection practices of its predominantly indigenous cultivators (Anderson, 1947; McClintock, 1960; Bretting et al., 1990). In his pioneering field study of Guatemalan maize, Edgar Anderson (1947) observed a surprising amount of uniformity among the maize plants from a given field. At the same time, however, he noted a marked difference among maize grown on different plots, even when those plots were located on the same mountainside. McClintock (1960) and Bretting et al. (1990) have supported Anderson's observation with their respective analyses of the chromosome arrangement and biochemical make-up of Guatemalan maize samples. In all three studies, the authors maintain that farmers' penchant to select seeds for varietal purity has prevented cross-pollination from dramatically altering highland races of maize, hinting at the invaluable role played by human hands in the shaping and conservation of maize diversity.

2.2.4 Factors Contributing to Maize Genetic Diversity in Guatemala

2.2.4.1 Environmental Heterogeneity

The aforementioned seed selection practices of its peasant farmers are one of several related processes that are responsible for the rich diversity of maize that is found in Guatemala. The environmental heterogeneity of its landscape is another. A small, mountainous country, with elevations ranging from sea level to 4,220 meters (nearly 14,000 feet) above sea level, the rugged topography of Guatemala is striking. Based upon altitude and rainfall, Higbee (1947) divided the country into nine agricultural zones, noting that the geographic variation of Guatemala plays a key role in shaping its agricultural diversity. The northwestern highlands, where much of the maize diversity is concentrated, are characterized by the convergence of two volcanic mountain ranges. The juncture of these two ranges is reflected in high peaks, small mountain lakes, and deep ravines. The rugged terrain isolates villages from one another and, even within villages, produces numerous environmental niches. Over time, the indigenous farmers of the region have identified and developed seeds that are uniquely suited to the soil quality, climate, and slope of each growing environment.

2.2.4.2 Cross Pollination and Seed Selection Practices

To an extent, the geographic isolation of villages has slowed cross-pollination of different maize varieties and helped to establish distinctions between maize populations grown in different villages. Combined with the rigid selection practices of the predominantly indigenous peasant population, geographic isolation has helped to maintain the genetic integrity of maize landraces across the Guatemalan landscape. The boundaries between the races, however, are not rigid (Goodman and Bird, 1977;

Goodman and Brown, 1988; Morris and Lopez-Pereira, 1999). Even as farmers conserve traditional maize varieties, they recognize that pollination across races occurs and they propagate hybridized seeds that exhibit desired traits (Van Etten, 2006; Bellon et al., 2006). Guided by the combined pressures of human and natural selection, new varieties of maize are continually evolving. Even established varieties themselves evolve over time; their genetic composition is not static.

2.2.4.3 Presence of Wild Relatives

In addition to the cross-pollination of domesticated maize varieties, the genetic diversity of maize in Guatemala is also attributable to the presence of its wild and weedy relatives. Guatemala is home to two of the eight known teosinte races, the remaining six lying across the border in Mexico (Wilkes, 1977; Wilkes, 2004).[8] Both of the Guatemalan populations of teosinte are fragmented and endangered (Wilkes, 2004; Wilkes, 2007).

Like most crops, maize has considerably less genetic diversity than its wild relatives. According to Vigouroux et al. (2005), maize has 12% less gene diversity and 24% less alleles than teosinte. The extinction of the teosinte populations would represent a tragic loss of biological resources (Wilkes, 2007). Teosinte often grows on the margins of cultivated maize fields; the introgression (or back-and-forth hybridization) of maize and its wild relatives has significantly enriched the crop's genetic profile over time. Wellhausen et al. (1957: 27) reported that "almost all" Guatemalan maize has crossed with teosinte and that the hybridizations have increased the crop's resistance to certain

[8] In the 1950s, Wellhausen et al. (1957: 24) noted that five of nine *Tripsacum* species were also present in Guatemala. Some twenty species of *Tripsacum* are now known; all are native to the Americas (Wilkes, 2004). Mangelsdorf and Cameron (1942) theorized that many of the varieties of maize emerging in the Guatemalan lowlands represented hybridizations of maize introduced from outside Guatemala and *Tripsacum*.

diseases and insect damage and improved its tolerance to excessive heat and moisture. Indeed, the introgression that occurs in these "evolutionary gardens" (Wilkes, 1992: 25) is an important element of the *in-situ* conservation of crop genetic resources in centers of agricultural biodiversity.

2.2.4.4 Prevalence of Indigenous Farmers and Ethnolinguistic Diversity

The prevalence of Guatemala's indigenous population represents another contributing factor for the rich diversity of maize that can be found in the country. Approximately 41% of the Guatemalan population identifies itself as indigenous; the proportion is significantly higher in the highland departments (INE, 2003a). In their *Races of Maize in Central America*, Wellhausen et al. (1957: 29) observed that there is a strong correlation between the presence of indigenous people and maize diversity; all but one of the maize landraces that they identified in Guatemala were located in departments where at least two-thirds of the population were indigenous.[9] Indeed, as will be discussed in section 2.4 and Chapter 4, there is a strong connection between Mayan culture and maize diversity. Equally important, however, may be the ethnolinguistic diversity that exists *within* Guatemala's indigenous Mayan population.

With 23 indigenous languages spoken among its nearly 5 million indigenous inhabitants, Guatemala is among the most ethnolinguistically diverse nations in the world. As a recent study by Perales et al. (2005) suggests, this cultural diversity may play an important role in explaining the diversity of maize in Guatemala. Based upon a comparative analysis of the maize maintained by two Mayan groups in Chiapas, Mexico,

[9] Of course, they also observe that these departments are also the most mountainous, and suggest that, "The mountainous terrain may have preserved both the Indians and the diversity of maize" (Wellhausen et al., 1957: 29).

the authors concluded that ethnolinguistic difference between neighboring groups contributes to genetic differences between maize populations. While the maize grown by outsiders may exhibit superior traits, the authors maintain that farmers may be reluctant to adopt it since ethnolinguistic difference makes it costly to acquire the necessary information. In Guatemala, Johannessen (1982: 86) has observed that indigenous farmers near Coban are reluctant to share seeds with outsiders, believing that their "maize fields at home would suffer if seed corn were given to strangers who did not revere it." Van Etten (2006) observes that while such boundaries exist to seed exchange, there are also notable movements of seed across community boundaries. He does not, however, clarify whether such exchanges occur between different ethnolinguistic groups. While they are certainly not rigid, the numerous cultural boundaries in Guatemala may contribute to the rich diversity of maize that is cultivated in the country.

2.2.4.5 Prevalence of Subsistence-Oriented Agriculture

Though it has received little recognition in the literature, the prevalence of subsistence agriculture is another important factor contributing to maize diversity in Guatemala. Most of the maize farmers in Guatemala allocate their product to direct household consumption, selling only surplus grain in the markets. As Bellon (1996) and Smale et al. (2001) have noted, self-sufficiency in maize requires that farmers cultivate multiple varieties that fulfill their various consumption needs, most notably culinary qualities for different maize-based food items. Anderson (1947) and Johannessen (1982) have observed that Guatemalan farmers will cultivate different varieties of maize for different needs. In addition to the commonly grown types of maize that are consumed on a daily basis and readily available in local markets, rural Guatemalans grow specialty corns that have particular uses such as brewing corn beer (*chicha*) and making popcorn balls (*alborotes*). They note that the boutique varieties are grown exclusively for home consumption and are generally unavailable in the market. Indeed, the small, mostly subsistence-oriented farmers produce a disproportionate share of non-commercial maize varieties in Guatemala. While two-thirds of the more marketable yellow and white maize are produced on farms with 3.5 or more hectares of land, farmers with less than 0.7 hectares of land cultivate 60% of the colored maize that is rarely sold in markets (INE, 2004).

2.2.5 *Milpa* Agriculture

Much of the maize that is produced in Guatemala is cultivated via a traditional agricultural practice known as "making *milpa*." While *milpa* plots are usually understood to be cornfields, they often – though not always – consist of much more than maize. In addition to having maize as its centerpiece, it is not uncommon for *milpa* plots to be interspersed with beans, squash, chilies, fruit trees, leafy greens, herbs, medicinal plants, and edible weeds. Given that multiple varieties of most of these plants are cultivated within a community, the landscape of the highlands is renowned for its rich inter- and intra-crop diversity. The component crops of *milpa* plots vary according to environmental conditions and the preferences of the farmers who maintain them. In general, however, the "classic" *milpa* includes three of the principal crops to emerge from Mesoamerica: maize, beans, and squash. The continued cultivation of the three crops in a single space represents one of the few remaining co-adapted agricultural systems from the Neolithic revolution (Wilkes, 1992: 25).

There is an undeniable genius to the *milpa*. When grown together, maize, beans, and squash are agronomic complements. The maize grows tall and upright; its stalks providing support for the beans to climb and eliminating the need for poles. The beans, in turn, fix nitrogen in the soil, providing important nutrients for the maize and squash. For its part, the squash, with its large leaves, provides a ground cover that discourages weeds and maintains moisture in the soil. In reference to the symbiotic relationship of the three crops, many refer to the classic *milpa* trilogy as the "three sisters."

Guatemala's *milpa* plots are the epitome of what biologist Edgar Anderson (1969) referred to as "Gardens of Chaos." In contrast to modern agricultural fields where a single crop is often planted in rows, gardens of chaos are like miniature, continuously evolving ecosystems (Wilkes, 1992: 26). In no apparent order, a variety of domesticated crops intermingle with "weeds" that are often used as greens for soups, medicinal herbs, and seasonings. Frequently, there is no clear boundary between the native and cultivated vegetation. With its linear logic, Western science has been unable to fully comprehend the web-like relationship that defines the interaction among the plants in the *milpa* ecosystem.

The inability of modern science to fully grasp the complexity of these gardens of chaos has led many agricultural "experts" to label traditional *milpa* farming as unproductive and "backward" (Scott, 1998). Economists, for their part, have identified it is as a "target for development" (Escobar, 1995), or something to be eradicated or modernized (*e.g.* Beal *et. al*., 1967; AVANCSO, 1993; Seavoy, 2000). These traditional farming methods, however, are not necessarily less productive or more "backward" than modern techniques (Perales *et.al*. 1998). Moreover, as will be discussed in the following two sections, they play a fundamental role in ensuring the food security and food sovereignty of Guatemala's predominantly rural population.

2.3 The Contribution of *Milpa* Agriculture to the Peasantry's Food Security

2.3.1 The Prevalence and Distribution of Hunger and Malnutrition in Guatemala

Relative to its Latin American neighbors, Guatemala suffers from an unusually high incidence of hunger and malnutrition. According to the most recent FAO statistics, nearly one-quarter (22%) of the Guatemalan population is food-deprived (FAO STAT, 2007). Since the early 1990s, the food supply per person in Guatemala has steadily decreased as the absolute number and proportion of the population that suffers from undernourishment has increased. The prevalence of hunger is significantly higher than the Latin American average of 10%, and as documented in Table 2.1, higher than the average Central American nation.

Most of the malnutrition in Guatemala affects children. Drawing upon data from the country's recent Living Standards and Measurement Survey, Marini and Gragnolati (2003) estimated that some 44% of the children under the age of five suffer from malnutrition.[10] Meanwhile, less than 3% of adults are undernourished.[11] As shown in Figure 2.1, the incidence of child malnutrition in Guatemala is significantly higher than any other Latin American country and among the highest in the world. While the incidence of stunted children in Guatemala has improved over time – dropping from 59%

[10] The authors based their estimates of malnutrition upon age-height measurements. Wilkes observes that the most malnutrition in rural Guatemala can be attributed to a deficiency of protein, vitamin A, and iron (personal communication, April 2007).

[11] But, as Marini and Gragnolati (2003: 32) caution, the 5-9% of the adult population with a body-mass-index less than 18.5% is a warning signal that malnutrition may become more problematic among older Guatemalans.

in 1987 – the authors note it is the slowest rate of change among countries in the Latin American and Caribbean region.

The prevalence of hunger in Guatemala is not equitably distributed. Among the 34 Latin American and Caribbean nations for which data are available, only six have a more inequitable distribution of food consumption (FAO STAT, 2007). Malnutrition tends to be concentrated among indigenous minorities, rural residents, and the poor. In terms of child malnutrition, Marini and Gragnolati (2003) found that 58% of Guatemala's indigenous children are stunted compared to one-third of non-indigenous children; the rates are notably higher in families with parents who are unable to speak Spanish. They also observed that half of the children residing in rural areas suffer stunted growth while slightly less than one-third of urban youth endure the same hardship. Among the poor, 53% of children are malnourished – 64% of the extremely poor – compared to 27% of children from families that are determined to be non-poor.

2.3.2 The Contribution of the *Milpa* Agriculture to the Rural Guatemalan Diet

Without the pervasive cultivation of *milpa* in rural Guatemala, hunger and malnutrition would likely be more widespread. *Milpa* crops are the principal food source for the country's vast rural population; maize plays a particularly important role in the Guatemalan diet. Whether it takes the form of tortillas or tamales, maize is the base of every meal in rural households. In the Mayan dialect of *K'iche'* two distinct verbs for "eat" are used to describe whether food is consumed with or without tamales or tortillas. One, *ti'jik*, refers to the act of eating food without tortillas or tamales, while *wa'ik* signifies the consumption of tortillas or tamales. The terms are used to distinguish mere snacking from the partaking of a veritable meal.

The significance of maize to the Guatemalan diet is reflected in its high level of consumption. Second only to their neighbors in Mexico, Guatemalans have the highest per capita consumption of maize in the world (Sevilla-Siero, 1991: 20). A nutritional survey administered to rural families in the western highlands determined that maize is the principal source of dietary energy for rural Guatemalans (Immink & Alarcón, 1992). According to the survey, maize provides 72% of total caloric intake.[12] Moreover, households with a sufficient caloric intake consume an average of 62% more maize than households with insufficient caloric intake. Beans, the most common companion crop to maize in the *milpa*, are the third highest source of dietary energy, accounting for 6% of total caloric intake.[13]

In and of itself, maize is not an especially nutritious foodstuff. Although a diet so heavily dependent on maize might suggest a deficiency of important vitamins and minerals, Guatemala's rural households typically employ two practices that significantly enhance its nutritional qualities. One technique is a traditional preparation process known as *nixtamalization*. The procedure, which entails soaking dry maize grains in a solution of water and alkaline limestone, adds calcium to the diet and releases niacin and amino acids that significantly enhance the digestable protein content of the grain. Indeed,

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[12] The importance of maize in rural Guatemalan diets has not changed much over the years. In the 1940s, E.C. Higbee observed that, "That average Indian workingman [in the Guatemalan highlands] eats two pounds of corn daily in the form of *tortillas*, *tamales*, and *atole* (gruel). By weight, corn constitutes 75-85 per cent of his diet; the remainder consists of beans, sugar, chili peppers, coffee, salt, a few garden vegetables, wild herbs, and occasionally a little meat" (Higbee, 1947: 181). During the 1950s, rural residents in Sacatepéquez obtained some three-quarters of their calories and 62% of their protein from maize; beans provided another 9% of caloric intake and 19% of protein intake (Annis, 1987: 33-34).

[13] Sugar was the second highest source of dietary energy.

maize accounts for nearly half of all protein intake in rural Guatemala (FAO, 1992: Table 25); this figure would likely be much lower with the widespread adoption of modern milling techniques that leave amino acids trapped inside the grain and impossible to digest. As Coe (1994: 14) writes, "So superior is nixtamalized maize to the unprocessed kind that it is tempting to see the rise of Mesoamerican civilization as a consequence of this innovation."

Unfortunately, the genius of *nixtamalization* did not accompany the global dissemination of maize. Maize's ability to thrive in any growing environment (Mangelsdorf and Reeves, 1939; Warman, 2003), combined with its high yields, has made it a favorite crop of poor farmers throughout the "Third World." Yet, without subjecting their grains to *nixtamalization*, the poor people who base their diets upon maize often suffer from vitamin deficiency and pellagra, a deadly disease caused by insufficient niacin. Though pellagra is often associated with old-world societies, it continues to plague the poor in several southern African nations where maize is not *nixtamalized* (Golden, 2002; Turrent and Serratos, 2004).

A second method for improving the nutrition of a maize-centered diet is simply a matter of supplementing it with food crops that accompany maize in the *milpa*. Despite its important contributions to human nutrition, *nixtamalized* maize does not provide a complete range of proteins. It provides a respectable amount of sulfur-containing amino acids, but is deficient in lysine and isolucine. Legumes, however, are an ideal complement as they are rich in lysine and isolucine but lacking in the sulfur-containing amino acids methionine and tryptophan. Consumed together – ideally in a ratio of 70 parts maize to 30 parts beans – the two foodstuffs create a complete protein balance

(Turrent and Serratos, 2004: 6; Wilkes, 2004: 19). When complemented with tomatoes and chilies (that provide vitamins A and C and fruity acids) and avocados (that provide fats), the *milpa* diet is a healthy, nutrient-complete package (Wilkes, 2004: 19). Thus, just as they are agro-ecological complements, the *milpa* crops are also dietary complements. This dual complementarity has led the biologist Garrison Wilkes to marvel that, "The *milpa* is one of the most successful human inventions ever created" (Mann, 2005: 198).

2.3.3 The *Milpa* Guarantee

Some might argue that rather than alleviating malnutrition and hunger, the prevalence of *milpa* agriculture exacerbates it. It is a common belief, for instance, that the practice of cultivating *milpa* is at the root of rural poverty in Guatemala. "Those *indios*," a Guatemalan official recently complained to James Boyce, "as long as they grow maize just like their grandparents, they'll be poor just like their grandparents" (Boyce, 2006). Higher levels of poverty, in turn, are directly related with the incidence of hunger and poor nutrition in Guatemala (von Braun, et al., 1989; Marini and Gragnolati, 2003, Alisei, n.d.) and elsewhere (Sen, 1982; Sen, 1999). If peasant farmers would reallocate their productive resources to market production, Seavoy (1986; 2000) and others have argued, they could increase their economic incomes and purchase more and possibly better quality foodstuffs in the marketplace.

While many forms of participation in the market economy offer rural Guatemalans the possibility to increase their incomes, they do not necessarily translate into improved nutritional outcomes. In his brilliant ethnography of a Guatemalan town in the central highlands, Sheldon Annis (1987) maintains that subsistence agriculture promises greater food security than market activities. “The hardiness of corn is remarkable,” he writes. “Despite misuse of the land, neglect, insufficient rotation, lack of fertilizer, drought, and eroded top soils, corn survives” (Annis, 1987: 33). Although cash cropping, wage labor, and other market activities are more lucrative than *milpa* agriculture, they are also substantially more risky. In an observation that rings true to Michael Lipton’s “safety-first decision rule” (Lipton, 1968), Annis notes that rural Guatemalans would prefer to cultivate a *milpa* that guarantees that a minimal level of nutrition will be met rather than try their luck in the marketplace and face the possibility of starvation. Even though market activities offer the *possibility* of better nutrition, they are not secure and marginalized *campesinos* are unwilling to take the gamble. Similar attitudes have been documented elsewhere in Mesoamerica (Shelley, 2003; Chapter 4 of this dissertation).

2.3.4 Cash-cropping versus Subsistence-Oriented *Milpa* Agriculture

It is often proposed that the cultivation of cash crops will improve the nutritional well-being of the farmers who grow them (Seavoy, 1986; Seavoy, 2000: Alisei, n.d.). Empirical evidence on the impact of cash cropping upon the diets of rural Guatemalans, however, is mixed. While commercial agriculture may improve nutritional outcomes in the short-run, the benefits are short-lived and may actually jeopardize food security over time.

In a 1989 study, von Braun et al. compared indicators of nutritional health for two groups of farmers from the highlands of western Guatemala: farmers who continued to cultivate mostly maize and beans and farmers who had diversified their agricultural production to include non-traditional export crops like broccoli, snow peas, and cauliflower. On average, they found that the households that diversified their agricultural production tended to consume more calories than traditional farmers and had lower levels of malnutrition.[14] Despite these favorable outcomes, the authors noted that the poorest of the poor farmers had not adopted the new export crops and, as a result, were excluded from the benefits. The exclusion of poor Guatemalan farmers from the purported benefits of cash cropping has also been documented elsewhere (Carletto, 2000; Conroy et al, 1996).

The dietary improvements associated with the cultivation of non-traditional export crops can be short-lived. A follow-up survey that included a larger sample size was analyzed by two of the collaborators in the aforementioned study, Maarten Immink and Jorge Alarcón, in 1992. In contrast to their earlier work, Immink and Alarcón found that the households of traditional maize and bean farmers consumed *more* calories per person than the households of diversified farmers and that they had a *lower* incidence of malnutrition. The authors do not offer an explanation for the turnaround. Elsewhere, however, it has been observed that increasing pesticide resistance and declining soil quality have contributed to falling yields for non-traditional export crops over time in Guatemala (Carletto, 2000). Combined with the rising cost of inputs, the falling yields have lowered the profitability of non-traditional cash crops (Carletto, 2000). Guatemalan farmers have abandoned non-traditional crops at an dramatic rate, shifting back to the

[14] Rates of malnutrition were determined by weight-for-height and height-for-age measures.

traditional *milpa* agriculture (Carletto et. al, 1999) that has historically provided a more consistent guarantee of their food security.

In sum, the traditional practice of *milpa* agriculture is fundamental to the food security of the Guatemalan peasantry. Not only does it provide much of the maize that is the staple of the rural Guatemalan cuisine, but it is also the source of a variety of food crops that significantly improve the *campesino* diet. Another important contribution of the *milpa* is its heartiness and reliability. While market activities such as cash cropping offer peasants the possibility of short-term economic gain, they also carry considerable risk for a poor rural population living on the verge of starvation.

2.4 The Contribution of *Milpa* Agriculture to the Peasantry's Cultural Well-being

In addition to securing a reliable and nutritionally balanced diet, *milpa* agriculture generates valuable cultural entailments for many of the peasants who cultivate it. As a focal point of Mayan cosmology, maize represents more than food to Guatemala's predominantly indigenous peasantry; its cultivation can be understood as an affirmation of Mayan cultural identity. Many of the practices that surround maize cultivation are also social practices that help to fortify relationships in the family and community.

Maize plays a preeminent role in Mesoamerican creation myths. The notion of maize-related deities is a common religious aspect throughout the crop's cradle of origin (Perez-Suarez, 1997, c.f. Turrent and Serratos, 2004). The Aztec, for example, conceptualized maize as a divine gift from Quetzalcoatl, their god of fertility and creativity. Throughout much of Guatemala, the creation myth is told in the sacred texts of the *Pop Wuj*. According to this so-called "Mayan Bible," Ixmucané, the grandmother of day, initially attempted to create humans from mud, but they crumbled and fell apart. On her second attempt, she used sticks, but the beings were stupid and did not respect her. (They became what are now known as monkeys.) Finally, on her third attempt, she used the four colors of maize. She used the white maize to create bones, the yellow maize to create flesh, the red maize to create blood, and the black maize to create hair, pupils, and bile. When composed of the four colors of maize, humans were good and whole; Ixmucané had succeeded in her task.

The spiritual importance of maize was reflected in the life of the pre-conquest Maya. Nearly every ceremony included maize, from birth when the umbilical cord was cut over a maize cob, to death when maize dough was placed in the corpse's mouth before burial (Coe, 1994). Recognizing its religious and social importance, the arriving Europeans identified the grain as the equivalent of their own "staff of life" and called it *pan*, or bread.[15] Centuries later, maize remains a central icon of popular religion in Guatemala, having been incorporated in Catholicism and other Christian denominations (Valladares, 1993).

Johannessen (1982) observes that there are an unusually large number of rituals surrounding the cultivation of maize in Guatemala. He describes many of the traditions, including various types of offerings to the gods, the blessing of maize seed in churches and on altars, and drinking at familial gatherings. Noting that the efficacy of such practices is not validated by modern scientific knowledge, Johannessen (1982: 92) writes, 'The Maya make no distinction between effective and noneffective planting ritual acts.' 'Maize,' he continues, has the highest INPRA (Index of Nonproductive Planting Ritual

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[15] The K'iche' Mayan, in turn, refer to bread as *Kaxlanwa*, or "foreign food."

Acts) of any plant I have studied.' While Johannessen attributes such "cultural baggage" to tradition and illiteracy, what he and many development practitioners fail to acknowledge is that maize cultivation is not only about crop yields. It is also an expression of cultural identity. Practices such as staying-up with one's family the night before the harvest, cooperatively planting fields, and burning candles and incense may not translate into more grain, but they accord meaning to the practice of food cultivation. They generate non-material benefits that are inherently valuable in and of themselves.

2.4.1 Maize as a Social Commons

Within the social science literature, much has been written to suggest that the practice of traditional agriculture forms the shared heritage, or 'commons,' upon which a community economy is founded. Among Mesoamerican farmers, for example, maize seeds with desirable traits are often given as gifts (Louette, 2000). Valued traits such as seed color or cob size make some traditional varieties especially prized 'cultural symbols that contribute to the maintenance of social relations both within and between communities' (Soleri and Smith, 1999: 137). Similarly, in the Andes traditional farmers walk as far as 50 miles to participate in seed-sharing festivals, which are valued as both a cultural and an agricultural activity (Zimmerer, 1996). As Brush (1998) explains, the evolution of crop genetic resources is itself the product of collective invention: through their interactions with one another, peasant farmers build upon and modify the technologies that they share, each benefiting from the improvements made by the others. Participation in this dynamic process of innovation entails membership in a *common* *heritage*, where inventions are the product of social collaboration and belong to the community.

It is important to note the distinction between this particular understanding of the commons and traditional economics' understanding of the commons. Most modern economists interpret the commons as a physical entity, something that is independent of the community in which it is embedded. This conceptualization—which is characteristic of a modernist epistemology that separates subject from object—has led to the belief that proper management of the commons requires explicitly stated and often externally imposed rights of access (Ostrom, 1990). This has led to the use of the term "common property," an expression that invokes the *de jure* or *de facto* ability to exclude non-community members. The commons as conceived here, however, is social. It is not the shared physical entity of maize germplasm *per se*, but rather to the social interaction which takes place in the process of collective invention. More succinctly, the commons is the social relationship of collective invention and reciprocal seed exchange. Any process that undermines the commons might be described as a social incident that destroys the basis of community. Such, as discussed in the previous chapter, is the perceived threat of modernization and the expansion of the market economy.

2.5 Conclusion

Though it is often perceived as "backward" and an "impediment to development," the subsistence-oriented agricultural practice of making *milpa* generates many positive benefits, both for the *campesinos* who cultivate it and the broader global population. Not only does *milpa* serve as a relatively secure and nutritious food source for the

Guatemalan peasantry, it also serves as a vehicle for *campesinos* to connect to their cultural heritage and fortify valued social relationships. Moreover, by conserving the crop genetic resources that Mayan agriculturalists have developed over the millennia in this "megacenter" of biological diversity, *milpa* farmers help to ensure the long-term evolutionary capabilities and resilience of the global food supply.

With its exceptionally high concentration of domesticated maize races and wild relatives, Guatemala is widely recognized as a center of maize genetic diversity. This diversity is richest in the northwestern highlands region of the country, where there are not only more races of maize but also greater variation among races. The diversity of maize in Guatemala is attributable to a number of factors, both environmental and social. In addition to the extreme environmental heterogeneity of the landscape and the presence of wild relatives that introgress with domesticated corn varieties, the agricultural practices of Guatemala's peasantry have played a key role in developing the rich diversity of maize. By carefully selecting seeds that can be grown in different environmental niches and can fulfill their various consumption needs, Guatemala's subsistence-oriented *campesinos* are the stewards of an invaluable collection of crop genetic resources. Unwittingly, they conserve the crop genetic diversity that is a cornerstone of long-term global food security.

In addition to ensuring global security, *milpa* agriculture also plays a key role in the nutritional well-being of the rural Guatemalans who cultivate it. Maize serves as the foundation of the rural Guatemalan diet, comprising nearly three-quarters of the peasantry's caloric intake. Other *milpa* crops such as beans and squash supplement the diet with essential vitamins, minerals, and amino acids. However, the *milpa* represents much more than calories and nutrients for *campesinos*, it also represents security. As the domesticated version of native weeds, *milpa* crops are remarkably hearty and guarantee that, even though they may suffer from hunger, marginalized peasants will not starve.

For many Guatemalan peasants, *milpa* agriculture is more than a component of food security. It also serves as a vehicle for achieving food sovereignty. As discussed in the previous chapter, food sovereignty is a much stronger condition than food security. Whereas food security represents the ability of people to obtain sufficient calories and nutrients, food sovereignty implies that people are able to acquire their food in a way that is ecologically appropriate and consistent with their social and cultural values, including sufficient access to arable land. Maize has long played an important role in Mayan cosmology; cultivating *milpa* is a means for Guatemala's predominantly indigenous population to connect to their cultural heritage and maintain social relationships with extended family and other community members.

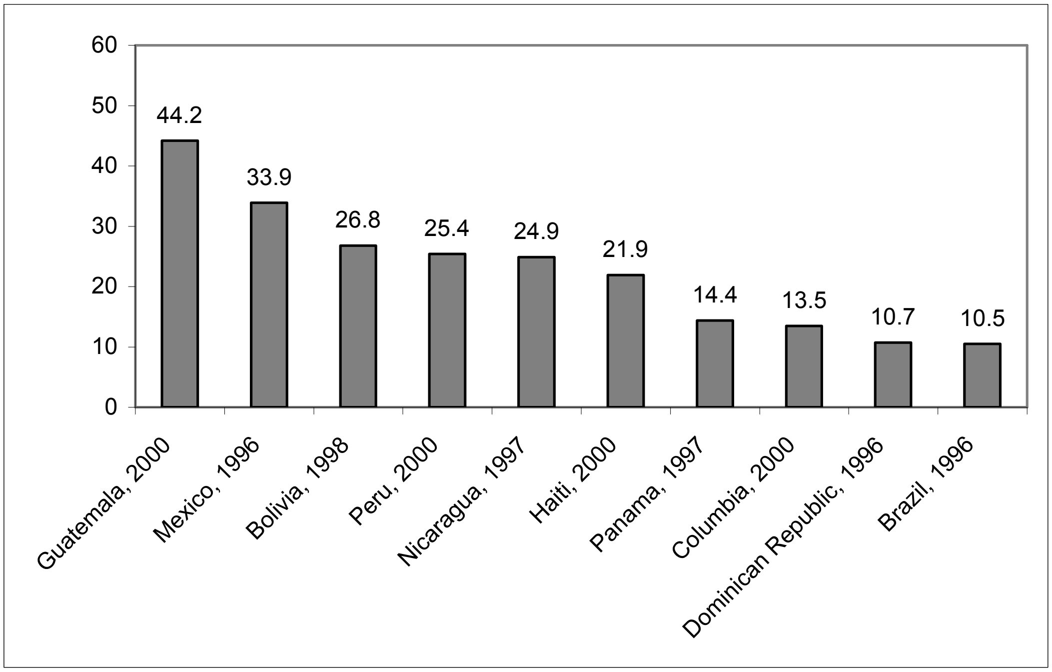
In conclusion, the Guatemalan peasantry's cultivation of *milpa* generates at least three types of values. First, by managing the genetic diversity of maize and other crops, *campesinos*' agricultural practices fortify a cornerstone of global food security. Second, by cultivating crops that are environmental and nutritional complements in their *milpa* plots, peasants guarantee themselves a secure and nutritionally complete food source. Finally, by engaging in practices that are deeply rooted in their Mayan heritage and fortify valued social relationships, many *campesinos* are also exercising their food sovereignty.

Table 2.1: Food Supply, Undernourishment, and Distribution in Central America

	Proportion of Population Suffering from Undernourishment (2002 - 2004)	**Food Supply Kcal/person/day** (2002-2004)	**Gini Coefficient for Dietary Energy Consumption** (Percent)
Belize	4%	2,850	14
Costa Rica	5%	2,810	12
El Salvador	11%	2,560	14
Guatemala	22%	2,230	15
Honduras	23%	2,340	17
Nicaragua	27%	2,290	17
Panama	23%	2,300	15
Regional Avg.	**19%**	**2,417**	**n/a**

Source: FAO STAT, 2007

Figure 2.1: The Prevalence of Childhood Malnutrition in Guatemala and Latin America



Note: Proportion of children under five
Source: Marini and Gragnolati, 2003

CHAPTER 3

THE IMPACT OF ECONOMIC RESTRUCTURING UPON GUATEMALAN FOOD SOVEREIGNTY AND THE *IN SITU* CONSERVATION OF MAIZE GENETIC DIVERSITY

3.1 Introduction

The economic stabilization and structural adjustment programs that have dramatically transformed much of the Global South – and indeed the global economy – since the 1980s, have significantly undermined Guatemalan food sovereignty and, quite possibly, hastened the loss of crop genetic resources in the country. Since the beginning of economic restructuring in 1983, annual net imports of maize in Guatemala have exploded from 1,100 tonnes to 659,000 tonnes in 2005, or from 0.11% of total consumption to 38.06%. Meanwhile the proportion of agricultural land dedicated to the grain has fallen by 14%. In addition to ending Guatemala's long history of self-sufficiency in its principal food crop, the transformation of the country's maize economy has likely contributed to genetic erosion in the crop's center of diversity, thereby compromising global food security.

While other factors were likely at play, two related processes can be linked to the weakening of the Guatemalan maize economy. First, the conditions attached to structural adjustment loans required the opening of Guatemala's maize market to competition from low-priced – and heavily subsidized – foreign imports. Second, the US Agency for International Development and other actors engaged in a coordinated effort to push Guatemala's embattled small-scale maize farmers to shift to the cultivation of non-traditional agricultural exports like winter vegetables, flowers, and fresh fruits that can be sold in the United States and other foreign markets. These related efforts both undermined Guatemala's maize autonomy and displaced maize agriculture in the crop's center of diversity.

This chapter examines the impact of restructuring on Guatemala's maize economy. It is organized as follows. In section 3.2 I document the detrimental impact of economic liberalization and the campaign for non-traditional agricultural export crops upon Guatemala's self-sufficiency in maize production. In section 3.3 I identify eleven "hotspots" for maize genetic diversity in Guatemala and discuss the possible ramifications of the recent restructuring of the national economy upon the *in situ* conservation of crop genetic resources. I conclude in section 3.4.

3.2 Maize Self-Sufficiency and Guatemalan Food Sovereignty

Throughout most of its modern history, Guatemala maintained a high degree of self-sufficiency in its principal food crop. As illustrated in Figure 3.1, Guatemala was nearly self-sufficient throughout the 1950s and 1960s, producing more than 98% of its total maize consumption during the period. Guatemala continued its self-sufficiency in maize through the 1970s and 1980s, when it produced 97% of its total consumption in the grain (see Figure 3.2). In a 1995 econometric study, Reyes Hernández identified a number of factors that shaped Guatemala's relative maize autonomy over the 1975-1990 period, including rainfall patterns and the expected profitability of maize agriculture as determined by prevailing interest rates and prices for improved of seed varieties. One variable that he failed to consider, however, was the importance that Guatemalan policymakers place upon the grain's cultivation.

The importance of government policy for maize autonomy is evidenced in Figure 3.2. Up through the late 1980s Guatemalan policymakers endeavored to achieve self-sufficiency in basic grains. Although promoting traditional export crops like coffee, cotton, and sugar were its primary focus, the government also instituted a number of strategies to protect and promote domestic maize producers. In an effort to shield domestic grain producers from the effects of its strong currency policy during the 1960s, for example, the Guatemalan government began restricting maize imports through a licensing program that remained in effect through the early 1990s (Da Costa, et al., 1998). To further bolster domestic maize producers, the Laugerud García (1974 – 1978) regime instituted a grain purchasing board in 1974 that bought grain at artificially high prices and sold it to distributors at artificially low prices (Berger,1992: 181-2) . Under the conditions set forth in structural adjustment agreements with the World Bank and International Monetary Fund, both protections were systematically dismantled in the late 1980s and early 1990s (Da Costa, et al., 1998; Toro Briones, 1991). The result, as illustrated in Figures 3.2 and 3.3, was the unleashing of a process whereby Guatemala has become increasingly dependent upon imported maize.

3.2.1 Structural Adjustment and the Undermining of Guatemala's Maize Autonomy

The loss of Guatemala's self-sufficiency was articulated by the international actors as a "freeing" of the country's "distorted" market economy. Like nations throughout the Global South, Guatemala had incurred substantial debt during the 1980s. Some \$1.2 billion (USD) of external debt in 1980 had more than doubled into a burden of \$2.8 billion (USD) by 1990; including interest, Guatemala's debt burden was equivalent to 43% of total export earnings in 1989 (Conroy et al., 1996: 12 - 13). Much of this debt was incurred in the context of rising petroleum prices and important substitution industrialization policies, accompanied by a characteristically overvalued currency (the quetzal). While the strong quetzal created the illusion of relatively cheap capital goods that were imported for the industrialization strategy, it also stymied exports like coffee, which was facing increasing competition in international markets. Over the course of the 1980s, declining export earnings contributed to an 18% drop in the country's GDP per capita (Conroy et al., 1996: 8). As Guatemala's macroeconomic conditions became increasingly intolerable, the country had no choice but to turn to international and bilateral financial institutions.[1]

The undoing of Guatemala's maize autonomy began with the government's adoption of structural adjustment and stabilization policies in 1983. The restructuring of the economy over the ensuing two decades would transform an initial trickle of maize imports into a proverbial flood. The first phase of Guatemala's economic restructuring entailed a devaluation of the quetzal (Sain and López-Pereira, 1999: 4). The weakening currency provided a mild stimulus for traditional agricultural exports. It did not, however, have an immediate effect on maize imports, as much of the domestic grain market was still protected by trade restrictions. The opening of Guatemala to foreign-produced maize in the 1980s took the form of a series of "food aid" loans and donations that the U.S. Agency for International Development included in its structural adjustment

[1] Four institutions participated in the restructuring of the Guatemalan debt. According to the number of conditions that they placed on Guatemala, the World Bank was the most demanding, followed by the US Agency for International Development, the International Monetary Fund, and the International Development Bank (Toro Briones, 1991: 24 - 25).

package. Under PL-480 the first loan was promulgated in 1985 and took the form of $18.6 million (USD) of maize and beans that were to be sold to help balance Guatemala's federal budget (Toro Briones, 1991: Annex 2).[2] A follow-up donation under Section-416(b) brought another $3.3 million (USD) of maize, rice, and wheat into the country in 1987 (Toro Briones, 1991: Annex 2).[3]

While the U.S. food aid did not have an immediate, noticeable impact on the country's maize self-sufficiency, it primed the domestic market for the influx of low-priced foreign grain that has steadily commanded a growing share of maize consumption in Guatemala. In 1987, the World Bank stipulated that Guatemala begin easing restrictions on the importation of basic grains (AVANCSO, 1998). At the time, import tariffs for agricultural products averaged 21.3%, a rate that was steadily decreased to 11.4% in 1996 (Da Costa et al., 1998: 46). Restrictions on maize were eased even further. In 1996, Guatemala increased its maize import quotas by 10% from 306,200 to 336,820 metric tonnes, while lowering its tariffs from 15% to 5% within quota, and from 55% to 35% outside of quota (Da Costa et al., 1998: 55). Correspondingly, maize imports increased 18%. Relative to other basic grains at the time, maize had the lowest

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[2] Also known as "Food for Peace," Title I of Public Law 480 authorizes AID to sell surplus commodities to developing nations at low rates. The commodities, in turn, are monetized in the recipient's market. The income generated is to support objectives articulated in a predetermined agreement between the US and recipient governments. Many of conditions set in the PL-480 donations to Guatemala required that the returns be spent on small-scale irrigation projects, technical assistance, agricultural credit, and roads that were all targeted at shifting peasant farmers away from subsistence-oriented maize agriculture and into the production of non-traditional agricultural exports (Garst, 1992).

[3] Amid accusations of dumping, donated maize from the United States continues to enter the Guatemalan market, including some 18,000 tonnes of yellow maize – an amount equivalent to nearly 2% of the country's total maize production – that the US Department of Agriculture announced it was sending to Guatemala in September 2006. Guatemala's National Committee of Grain Producers estimates that it would take Guatemalan farmers 25-30 million working person days to produce an equivalent quantity of maize (Central America Report, 2006b: 6).

tariff rates. Nonetheless, researchers from the International Monetary Fund voiced the opinion that, "*More remains to be done*" (Da Costa, et al., 35).[4]

The opening of Guatemala's maize economy to foreign importers coincided with a significant decline in its maize self-sufficiency. Whereas it had produced an average of 98% of its total maize consumption during the 1980s, the proportion has sharply declined to an average of 77% since 1990. As shown in Figure 3.2, by 2005 Guatemala was producing less than two-thirds of its total maize consumption.

The dramatic increase in maize imports since the 1980s has been accompanied by a noticeable drop in maize production in absolute terms, as well as the relative share of consumption. Domestic maize production in 2005 was 27% less than its high of 1.4 million metric tonnes in 1992. As a comparison of Figures 3.3 and 3.4 illustrates, the fall in maize production coincided with a noticeable drop in the amount of land allocated to maize production. Total maize acreage has fallen 17% since 1992. As shown by a comparison of Figures 3.4 and 3.5, maize's share of total agricultural land in Guatemala has declined since 1950. Overall, the proportion of cultivated land allocated to maize production has decreased by 38% over the past five decades. But until 1990, the changing composition of Guatemala's agricultural landscape was largely attributable to an overall increase in cultivated land; the actual decrease in national maize land is a recent phenomenon.[5]

The recent decrease in maize acreage can be attributed to a number of structural adjustment-related factors. In addition to exposing domestic producers to competition

[4] The authors are members of the IMF staff; the emphasis is theirs.

[5] Overall maize acreage increased by 41.5% between 1950 and 2003; despite the recent decrease in maize acreage, total maize acreage increased by 1.1% between 1979 and 2003 (DIGESA, 1954; DIGESA; 1982; INE, 2004).

from subsidized maize harvested abroad, the restructuring of the Guatemalan economy has diminished the ability of the state to shape agricultural practices in the country. In response to stipulations that it reduce its federal budget, the Guatemalan government cut back on agricultural expenditures, particularly its spending on technical assistance and agricultural credit. Between 1983 and 1987, state-financed credit for maize, beans, and rice fell by 40% (Conroy et al, 1996: 33). As Guatemala's agricultural support institutions were dismantled, the US Agency for International Development began replacing them with what Conroy et al. (1996) have referred to as a "parallel state" that promoted the cultivation of non-traditional export crops like broccoli, snow peas, strawberries, and melons that could be exported to foreign markets. Devastated by the loss of their maize market, many basic grain producers took the bait and adopted the new crops.

3.2.2 Non-traditional Agricultural Exports and the loss of Maize Self-Sufficiency

Although many other forces were at play, Guatemala's declining maize autonomy can be associated with the adoption of non-traditional agricultural exports (NTAE). As Figure 3.5 demonstrates, there was a notable increase in the cultivation of Guatemala's principal non-traditional crops during the early 1990s. Though there was some lag, a comparison of Figures 3.4 and 3.5 suggests that the reduction in maize acreage during the early 1990s was soon followed by the expanded cultivation of broccoli, cauliflower, strawberries, snow peas, melons, and sesame seeds that were primarily destined for foreign markets.[6] Accounting for a one-year lag between abandoning maize agriculture and the adoption of non-traditional crops, there is a strong correlation between the proportional change in maize area and the proportional change in the area allocated to NTAE. For the 1990–2005 period, the Pearson correlation coefficient of –0.77 indicates that the reduction in maize area is highly correlated with the expanded cultivation of non-traditional crops the following year.[7]

Guatemalan farmers did not shift to the cultivation of non-traditional export crops entirely of their own volition. Rather their adoption was the result of a coordinated push by structural adjustment lenders and international development agencies to "diversify" agricultural production in Guatemala. Under pressure from the International Monetary Fund and the World Bank, for example, the Guatemalan government removed import tariffs on the fertilizers, herbicides, and pesticides that were necessary to create a suitable growing environment for the non-native plants (Da Costa et al., 1998: 31). The processors of non-traditional crops also benefited from structural adjustment policies, as they were granted the right to import the necessary equipment and machinery duty-free and were exempted from paying income tax on their profits related to processing activities for a period of ten years (Da Costa et al., 1998). Finally, the devaluation of the Guatemalan quetzal improved the terms of trade for exporters, increasing foreign demand for the relatively low-priced fruits and vegetables.

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[6] Flowers and ornamental plants are also a relatively new export crop. Unfortunately, compatible data on their cultivation are not available. Cultivation of ornamental plants exploded from 85 hectares in 1979 to 2,390 in 2003 (DIGESA, 1982; INE, 2004).

[7] With a t-statistic of –4.25, the correlation coefficient is significant at the 0.05% level.

Whereas the IMF and World Bank pushed for the trading conditions necessary to make non-traditional export agriculture profitable, the US Agency for International Development played the principal role in reaching out to farmers and encouraging them to alter their production practices. In essence, the Agency sought to replace state agricultural programs that had been dismantled during structural adjustment with an array of private – yet highly subsidized by AID – bodies that pushed the expanded cultivation of non-traditional export crops (Conroy et al, 1996). It provided funding for training, infrastructure development, export promotion, research and extension, and agricultural finance (Escoto and Marroquín, 1992). Along with the World Bank, the Agency also provided loans – many of them financed by PL-480 sales (Garst, 1992) – that allowed the Guatemalan Ministry of Agriculture to engage in a concerted effort to develop the small-scale irrigation projects necessary to practice NTAE. With its newly acquired funds and a mandate, the Ministry dramatically expanded irrigation in the country. Over a six-year span beginning in 1983, it oversaw the completion of 256 small-scale irrigation projects, helping to expand the cultivation of the non-traditional cash crops by some 1,800 hectares (MAGA, 1991). In total, irrigated acreage increased by 48% in the 1980 – 1995 period (FLACSO, 2002: 160). Much of the expansion was the result of small irrigation projects that facilitated the cultivation of new export crops for foreign markets,[8] contributing to the unraveling of Guatemala's maize autonomy and food sovereignty.

[8] Prior to the 1980s, most of the irrigation in Guatemala serviced large-scale farms that cultivated traditional export crops. During the 1980s, however, 86% of new irrigation was so-called "mini irrigation" projects that facilitated small-scale farmers cultivation of non-traditional export crops (MAGA, 1991).

3.3 Economic Restructuring and the Conservation of Maize Genetic Diversity

Whereas the impact of structural adjustment policies and their corresponding opening of Guatemala to the forces of the global market had an obvious and detrimental impact on the country's maize self-sufficiency, evaluating the impact of economic restructuring upon the *in situ* conservation of maize genetic diversity in the country is more problematic. As Stephen Brush (2004: 160) has observed, large-scale longitudinal studies on crop diversity are difficult since comprehensive inventories of crop genetic resources are rare and seldom consistent over time. Such is the case in Guatemala. E.J. Wellhausen and his colleagues conducted the country's only systematic cataloging of maize diversity in the 1950s (Wellhausen et al., 1957), some thirty years prior to the implementation of most structural adjustment policies. Without conducting another inventory, it is impossible to determine precisely the present state of crop genetic diversity in the country. Nonetheless, using Wellhausen's study as a baseline and evaluating trends that may have shaped maize diversity over the subsequent fifty years, it is possible to speculate about the current health of maize genetic resources in Guatemala.

Like many studies at the time, Wellhausen et al. used the concept of landraces to describe the diversity of maize in Guatemala. Landraces, it will be recalled from Chapter 1, are locally grown crop populations that are the product of farmer selection and management over several generations; they are the "treasure house" of genetic diversity (Wilkes, 1992: 19). Based upon ear morphology and geographic distribution, Wellhausen and colleagues identified 13 distinct races and 10 subraces of maize in Guatemala. Using an alternative taxonomic scheme, Goodman and Brown (1988) observed that several of the Guatemalan subraces could in fact be classified as distinct races. Following Goodman and Brown, I treat each subrace identified by Wellhausen et al. as a unique race, bringing the total number of Guatemalan landraces identified in the 1950s to 23.

Table 3.1 presents the distribution of the 23 landraces across Guatemala's 22 departments. Drawing upon a genetic diversity index developed by James Boyce (1996), I have listed the departments according to their concentration of maize landraces. The index, which could be described as a measure of genetic richness (Magurran, 1988), is derived as

$$D = L/A^z,$$

where L = the number landraces collected by Wellhausen et al. (1957), A = maize acreage for the department in 1964, and z is a parameter accounting for the distribution of diversity across space. Like the area-species curve employed by ecologists and population biologists, z accounts for the notion that as maize area increases more landraces are likely to be identified but their discovery is likely to occur at a decreasing rate. Following Boyce – and what is reportedly biological convention – I set z to a value of 0.3 (Boyce, 1996: 281). Though it is not included in the diversity measure, Table 3.1 also indicates the departments where Wilkes (1977) and others identified teosinte populations during the 1960s and '70s.

As the ranking of departments in Table 3.1 indicates, maize genetic diversity in 1950s Guatemala was concentrated in the country's northwestern and central highlands. Indeed, all four of the northwestern departments (Quetzaltenango, Totonicapán, San Marcos, and Huehuetenango) and all five of the central highlands departments (Sololá, Chimaltenango, Quiché, Sacatepéquez, and Guatemala) were among the ten most genetically rich departments in Guatemala. With their populations of teosinte and their concentration of several lowland varieties, the southeastern departments of Jalapa and Jutiapa are also important sites of maize genetic diversity.

Guatemalan society has undergone tremendous transformation since the 1950s when the data for these diversity rankings were collected. In addition to structural adjustment during the 1980s and '90s, the country has endured nearly four decades of civil war, undertaken a substantial road building campaign, seen a significant proportion of its population convert to evangelical Christian denominations, witnessed the introduction and spread of improved seed varieties, and – simply put – survived the era of modernization. Whether its maize diversity has also endured these transformations is possible, but doubtful.

Table 3.2 provides six descriptors for the health of contemporary maize populations in the eleven departments that were identified in Table 3.1 as important sites of maize genetic diversity. The six indicators are (1) the change in maize acreage between the 1950 and 2003 agricultural censuses, (2) the change in maize's share of agricultural land over the same period, (3) the proportion of agricultural land currently dedicated to maize agriculture, (4) the proportion of maize land with intercropping, (5) a Simpson index of maize diversity (defined below), and (6) the proportion of farmers using improved seed varieties. The measure of intercropping is indicative of the proportion of maize land cultivated with a poly-crop *milpa*. Assuming that the farmers who intercrop are more likely to cultivate a diversity of maize landraces – including less common varieties – the departments with a greater proportion of intercropped maize are more likely to have maintained diversity since the 1950s.

The Simpson index is discussed in Peet (1974) and Magurran (1988). Ecologists often use the measure to describe the proportional distribution of species in a given habitat. Drawing upon the 2003 agricultural census, I have extended the framework to account for the distribution of different colors of maize across the different departments of Guatemala. The index is derived as

$$D = 1 - \Sigma\alpha_i^2,$$

where α_i = area share occupied by *i*th color of maize (white, yellow, or other) grown in the department. The closer the index is to one, the more equitably distributed the different colors of maize. The Simpson index is not comparable with the diversity index used in Table 3.1, since the earlier index measures the concentration of maize landraces within a given department while the Simpson index measures the spatial distribution of different maize colors.

As discussed in Chapter 1, the adoption of improved seed varieties is not necessarily synonymous with genetic erosion. In fact, the introduction of improved seed varieties has the potential to contribute new alleles to a crop's pedigree and to enrich the overall genetic landscape. The wholesale replacement of landraces with improved varieties, however, results gene displacement and, ultimately, the loss of genetic resources (Qualset et al., 1997; Brush, 2004). Thus, the impact of modern seed varieties upon the *in situ* conservation of maize genetic diversity in Guatemala is uncertain.

The change in maize acreage over time is the simplest, and arguably the most accurate, gauge of how Guatemalan maize diversity has evolved over the past five decades. If less land is dedicated to maize agriculture, it is quite likely that maize genetic resources have been lost as well. Accordingly, Table 3.2 ranks departments according to their change in maize acreage since 1950. Overall, maize acreage in the Republic of Guatemala has increased by 42% (see Figure 3.6). Much of this expansion (59%), however, has occurred in the frontier lowlands of the Petén. A much different story has unfolded in the regions with the greatest maize diversity. Among the eleven departments identified for their genetic richness in Table 3.1, six have incurred a loss in overall maize acreage since 1950; the decreases were quite dramatic in the genetic "hotspots" of Sololá and Chimaltenango. In part, the decrease in maize area can be attributable to a reduction in overall agricultural land, as the size of cultivated landholdings shrunk in all but two of these eleven departments. Yet as the second column of Table 3.2 indicates, the overall proportion of cultivated land dedicated to maize has also significantly decreased in nine of the eleven departments. The replacement of maize with other crops is indicative of genomic erosion; it is likely that some maize genetic resources have been lost.

Figures 3.7, 3.8, and 3.9 show how maize acreage has evolved over the past five decades in each of the eleven departments. The evolution of the share of agricultural land dedicated to maize production is shown in Figures 3.10, 3.11, and 3.12. All of the trends are based upon data in Guatemala's four agrarian censuses: 1950, 1964, 1979, and 2003. While the progressions vary across departments, it is possible to identify some general trends. In general, maize area across the departments tended to decrease between the 1950 and 1964, increased between the 1964 and 1979 censuses, and then fell again between the 1979 and 2003. Meanwhile, the share of land cultivated with maize tended to decrease across all three time periods; the sharpest reductions occurred between the 1964 and 1979 censuses.

The decrease in maize cultivation between 1950 and 1964 is at least partly attributable to the promotion of export agriculture. Susan Berger (1992) has observed that after the overthrow of the Arbenz government in 1954, peasant farmers who had traditionally cultivated *milpa* for household consumption slowly lost their land to an expanding plantation economy. The government of Ydígoras-Fuentes (1958-1963) was especially keen to expand, modernize, and diversify agro-export production (Berger, 1992: 108 – 114). Indeed, the growth of plantation crops like coffee and cotton during the 1950-1964 coincides with a reduction in maize acreage in San Marcos, Huehuetenango, Jutiapa, and Jalapa.

Meanwhile, in departments with environmental characteristics less amenable to plantation agriculture – specifically, Totonicapán, Sololá, and Chimaltenango – the loss of maize land corresponds with growth of wheat farming. Even as it promoted traditional export crops, the government focused upon decreasing national dependence on imported goods. Beginning in the 1960s, the Ministry of Agriculture encouraged famers in the highland departments to cultivate wheat for domestic consumption, providing them with hybrid seeds, fertilizers, herbicides, extension services, and, in some cases, agricultural machinery (Wittman and Saldivar Tanaka, 2006). Harvested wheat was sold to regional flourmills and became became an important cash crop for highland farmers. Though it is impossible to determine the direct impact of the changing agricultural patterns, it is plausible that the decrease maize cultivation contributed to some loss of some maize genetic diversity in the 1950s and '60s.

Like the decline in maize acreage in between 1950 and 1964, the decrease between 1979-2003 can also be linked to the promotion of export crops. The more recent drop is not associated with an expanding plantation economy, however, but with the adoption of non-traditional agricultural export crops like broccoli, snow peas, and strawberries. The campaign to shift to the new crops was not targeted at the large plantations where coffee, sugar, and cotton were grown, but rather at the small-scale farmers who cultivated maize and other *milpa* crops for household consumption. Many of the principal non-traditional export crops were targeted at farmers in the central and northwestern highlands, i.e. the region where maize diversity was historically concentrated.

The push for farmers to adopt non-traditional export crops began in the central highland departments of Sacatepéquez and Chimaltenango in the 1980s and gradually spread westward into Sololá, Quetzaltenango, and Totonicapán (Conroy et al., 1996). As a result, the center of maize diversity is now the hub for NTAE production in Guatemala. Consider, for instance, the two principal non-traditionals: broccoli and snow peas. Neither crop was prevalent enough to even be counted in the 1979 agricultural census, yet by 2003 they were grown by some 8,500 farmers on 3,000 hectares of land, most of it in the genetic "hotspots" of Chimaltenango and Sacatepéquez. Farmers in the two departments cultivated 83% of total snow pea production in 2003, while farmers in the highland departments of Quiché, Sololá, Quetzaltenango, Totonicapán, and Huehuetenango produced another 10%. As for broccoli, farmers from Chimaltenango and Huehuetenango produced 60% of the total harvest in 2003; farmers from the remaining nine genetically rich departments accounted for another 31%.

The adoption of non-traditional export crops is correlated with the loss of maize acreage and, potentially, crop genetic resources. As discussed in section 3.2.2, the US

Agency for International Development facilitated the adoption of the new cash crops by funding (a) the construction of small-scale irrigation projects that allowed farmers to cultivate NTAE and (b) agricultural extension agents who promoted their adoption, provided training in cultivation techniques and marketing, and offered credit assistance. Table 3.3 shows the relationship between the proportion of agricultural land with irrigation in 2003 and the change in maize acreage that has occurred during the NTAE campaign for the eleven departments that have been noted for their maize diversity. The departments are listed according to the share of cultivated land with irrigation. As the data indicate, there is a strong negative association between the share of land with irrigation and the recent reduction in maize acreage ($r = -0.71$). Assuming that most of the irrigation was constructed since 1979 and that it has been used to cultivate cash crops, one can conclude that the campaign for non-traditional agricultural exports has contributed to the loss of maize agriculture in the areas where most of the crop's genetic diversity has been historically concentrated.

The negative impact of new agricultural strategies upon maize agriculture in the crop's Guatemalan center of diversity is further illustrated in Table 3.4. The table relates the proportion of farms receiving technical assistance in 2003 with the change in maize acreage during the 1979-2003 period; the departments are listed according to the relative prevalence of technical assistance. Assuming that the technical assistance offered was dedicated to the promotion of cash crops – as US AID and most providers of technical assistance intend it to be – then there is once again a strong correlation between the campaign for commercial agriculture and the decline of maize agriculture in its center of genetic diversity.

In addition to their impact on maize acreage, it is also worthwhile to consider the combined impact of irrigation and technical assistance upon the other indicators of maize health. As the data in Table 3.3 and Table 3.4 indicate, the departments of Totonicapán and Quiché have been relatively untouched by the recent efforts to transform agricultural production. Interestingly, as the data in Table 3.2 suggest, these two departments also happen to be the areas where the maize diversity observed in the 1950s is likely to be the most intact. Among the eleven departments considered, Totonicapán (the most neglected department in terms of agricultural modernization) has expanded its maize production the most (in absolute and relative terms), has the largest share of land currently allocated to maize agriculture, has the lowest rate of adoption for improved seeds, and has the most equitable distribution of maize colors.[9] Meanwhile, Quiché (the second-most neglected department) is second only to Totonicapán in terms of the positive change in maize cultivation since the 1950s and the equitable distribution of maize colors, and it has the third-highest incidence of intercropping. As these two cases suggest, exclusion from the current campaign to diversify agricultural exports may have protected the *in situ* conservation of maize genetic resources in some parts of Guatemala.

3.4 Conclusion

Guatemala's food sovereignty and the on-farm conservation of maize genetic diversity have both been undercut by the economic stabilization and structural adjustment

[9] Ironically, PL-480, the US AID food aid program that has been implicated with the adoption of non-traditional crops in other areas of Guatemala, may have spurred expanded maize production in Totonicapán. Prior to the 1980s, the department was a major wheat producer. The massive shipments of wheat that began entering Guatemala under PL-480 in the 1980s, however, destroyed the country's wheat market. As a result, wheat cultivation in Totonicapán fell by 98% between 1979 and 2003. As will be discussed in Chapters 4 and 5, maize agriculture replaced much of the land that fell out of wheat production.

policies imposed upon the country since 1983. Guatemala has a long history of self-sufficiency in maize. The economic liberalization that occurred under structural adjustment, however, allowed low-priced – and heavily subsidized – maize imports to flood the market and undercut domestic farmers. Meanwhile, US AID and other foreign development agencies promoted and subsidized the adoption of non-traditional agricultural exports like broccoli, snow peas, and flowers. Combined, the two processes can be linked to the drop in maize production in Guatemala and the country's growing dependence upon foreign-cultivated maize.

In addition to undermining maize autonomy, the restructuring of the Guatemalan economy may have also contributed to the loss of maize genetic resources in the country. The campaign for non-traditional agricultural exports has focused heavily upon the departments where maize diversity has been historically concentrated. Indeed, the growth of small-scale irrigation projects and the receipt of technical assistance – two key ingredients for NTAE promotion – are strongly correlated with the loss of maize land in genetic "hotspots." Meanwhile, indicators suggest that the departments that have been relatively untouched by efforts to commercialize agriculture are also the areas where the *in situ* conservation of maize genetic diversity has likely persisted. Although botanical surveys are necessary to confirm these conclusions, it appears that the recent efforts to transform Guatemala's rural economy have hastened the loss of maize genetic resources in the country's central and northwestern highlands.

Table 3.1: Races of Maize and Maize Diversity in Guatemala, 1957

Department	Landraces Present	No. Races	Teosinte	Diversity Index*
Sololá	Nal-Tel Ocho, Serrano, San Marceño, Quicheño, Negro de Chimaltenango, Salpor Tardio, Olotón, Comiteco	8		1.35
Quetzaltenango	Nal-Tel Amarillo Tierra Alta, Imbrigado, Serrano, San Marceño, Quicheño Rojo Introgression, Quicheño Ramoso, Negro de Chimaltenango de Tierra Fría, Salpor, Salpor Tardio, Dzit-Bacal, Tepecintle	11		1.29
Totonicapán	Nal-Tel Amarillo Tierra Alta, Nal-Tel Blanco Tierra Alta, Imbrigado, Serrano, Quicheño, Negro de Chimaltenango de Tierra Fría, Salpor	7		1.18
Chimaltenango	Nal-Tel Ocho, Imbrigado, Serrano, San Marceño, Quicheño, Negro de Chimaltenango, Olotón, Comiteco, Dzit-Bacal	9		1.08
San Marcos	Nal-Tel Ocho, Serrano, San Marceño, Negro de Chimaltenango de Tierra Fría, Salpor Tardio, Olotón, Comiteco, Dzit-Bacal, Tepecintle	9		0.92
Quiché	Nal-Tel Amarillo Tierra Alta, Nal-Tel Blanco Tierra Alta, Serrano, Quicheño, Quicheño Rojo, Quicheño Grueso, Negro de Chimaltenango, Olotón, Comiteco	9		0.87
Huehuetenango	Imbrigado, Serrano, San Marceño, Quicheño, Quicheño Rojo, Quicheño Grueso, Quicheño Ramoso, Olotón, Comiteco	9	Y	0.86
Jalapa	Nal-Tel Blanco Tierra Baja, Quicheño, Negro de Chimaltenango de Tierra Caliente, Olotón, Comiteco, Dzit-Bacal	6	Y	0.76
Sacatepéquez	Serrano, Quicheño, Olotón, Comiteco	4		0.73
Guatemala	Quicheño, Negro de Chimaltenango, Negro de Chimaltenango de Tierra Caliente, Olotón, Comiteco, Tepecintle	6		0.7
Jutiapa	Nal-Tel Amarillo Tierra Baja, Nal-Tel Blanco Tierra Baja, Quicheño, Negro de Chimaltenango de Tierra Caliente, Comiteco, Dzit-Bacal	6	Y	0.63
Baja Verapaz	Nal-Tel Amarillo Tierra Baja, Nal-Tel Blanco Tierra Baja, Quicheño, Negro de Chimaltenango de Tierra Caliente, Olotón	5		0.58
Suchitepéquez	Quicheño, Negro de Chimaltenango de	4		0.42

	Tierra Caliente, Comiteco, Tepecintle			
Santa Rosa	Quicheño, Olotón, Comiteco, Tepecintle;	4		0.39
Chiquimula	Nal-Tel Amarillo Tierra Baja, Nal-Tel Blanco Tierra Baja, Negro de Chimaltenango de Tierra Caliente	3	Y	0.38
Retalhuleu	Negro de Chimaltenango de Tierra Caliente, Comiteco, Tepecintle	3		0.34
Escuintla	Negro de Chimaltenango de Tierra Caliente, Comiteco, Dzit-Bacal, Tepecintle	4		0.32
Alta Verapaz	Quicheño, Olotón, Comiteco, Tepecintle	4		0.32
Izabal	Negro de Chimaltenango de Tierra Caliente, Tepecintle	2		0.24
Zacapa	Negro de Chimaltenango de Tierra Caliente, Dzit-Bacal	2		0.24
Petén	Tuxpeño	1		0.22
El Progreso	Dzit-Bacal	1		0.14

Sources: The inventory of maize landraces is provided in Wellhausen et al. (1957). The location of teosinte populations is described in Wilkes (1977) and Iltis et al. (1986). Maize acreage from Guatemala's 1964 agrarian census (DIGESA, 1968).

* Genetic diversity index = $L/A^{0.3}$, where L = number of landraces and A = maize acreage in 1964.

Table 3.2: The Health of Guatemalan Maize Populations

	Maize Area, 1950-2003 (percent change)	Maize Share of Cultivated Land, 1950-2003 (percent change)	Maize Share of Cultivated Land, 2003 (percent)	Maize Area Intercropped, 2003 (percent)	Simpson Index of Maize Diversity, 2003*	Farms Using Improved Seed, 2003 (percent)
Total Republic	**41.54**	**-38.30**	**32.21**	**25.69**	**0.25**	**24.84**
Totonicapán	31.48	36.03	95.76	31.71	0.52	10.58
Quiché	25.93	-45.54	47.53	41.64	0.47	22.71
Jutiapa	19.35	16.4	64.27	65.63	0.02	30.11
Huehuetenango	3.48	-47.51	41.37	34.77	0.46	18.71
Quetzaltenango	0.18	-16.93	27.99	28.88	0.45	32.38
San Marcos	-3.57	-44.63	29.04	22.8	0.40	21.26
Jalapa	-9.72	-33.34	59.41	38.11	0.23	18.84
Sololá	-28.47	-39.31	45.12	33.49	0.44	17.16
Chimaltenango	-38.21	-43.44	46.10	36.47	0.38	20.17
Guatemala	-46.39	-55.04	35.64	66.61	0.15	25.03
Sacatepéquez	-58.46	-48.55	32.66	21.70	0.25	28.31

Sources: DIGESA, 1954; INE, 2004

* The Simpson index is derived as $D = 1 - \Sigma\alpha_i^2$, where α_i = area share occupied by *i*th color of maize grown in the department.

Table 3.3: The Relationship of Irrigation with the Change in Maize Area

	Percent of Arable Land with Irrigation, 2003	**Percent Change in Maize Area, 1979 - 2003**
Total Republic	**8.39**	**1.09**
Sacatepéquez	42.87	-42.61
Quetzaltenango	10.24	-4.88
San Marcos	9.00	-18.21
Guatemala	7.15	-16.12
Jalapa	4.78	-13.75
Chimaltenango	4.72	-15.42
Sololá	3.84	2.70
Jutiapa	3.54	-1.26
Huehuetenango	2.23	-17.43
Quiché	1.07	-3.23
Totonicapán	0.30	30.26
Pearson r = -0.71***		

Sources: INE, 2004, DIGESA, 1982
*** Significant at 1% level

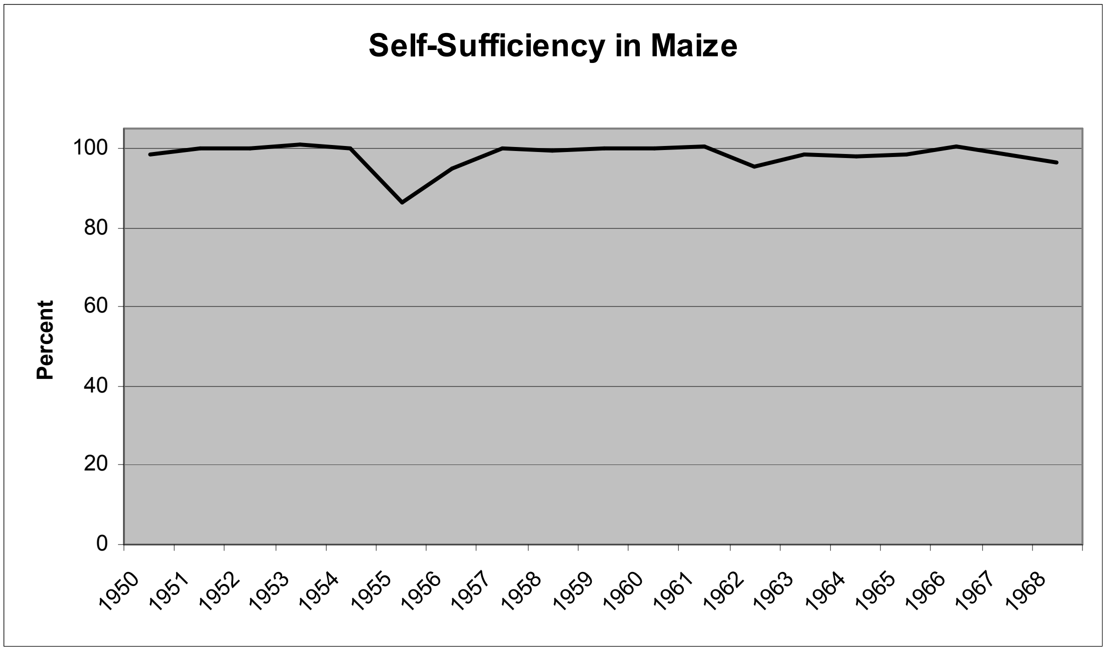
Table 3.4: The Relationship of Technical Assistance with the Change in Maize Area

	Percent of Farms Receiving Technical Assistance, 2003	**Percent Change in Maize Area, 1979 - 2003**
Total Republic	**6.90**	**1.09**
Huehuetenango	10.36	-17.43
Chimaltenango	8.94	-15.42
Jalapa	7.61	-13.75
Sololá	6.56	2.70
Sacatepéquez	6.54	-42.61
Guatemala	5.76	-16.12
Jutiapa	4.76	-1.26
San Marcos	4.66	-18.21
Quiché	3.97	-3.23
Quetzaltenango	3.49	-4.88
Totonicapán	0.75	30.26
	Pearson r = -0.63**	

Sources: INE, 2004, DIGESA, 1982

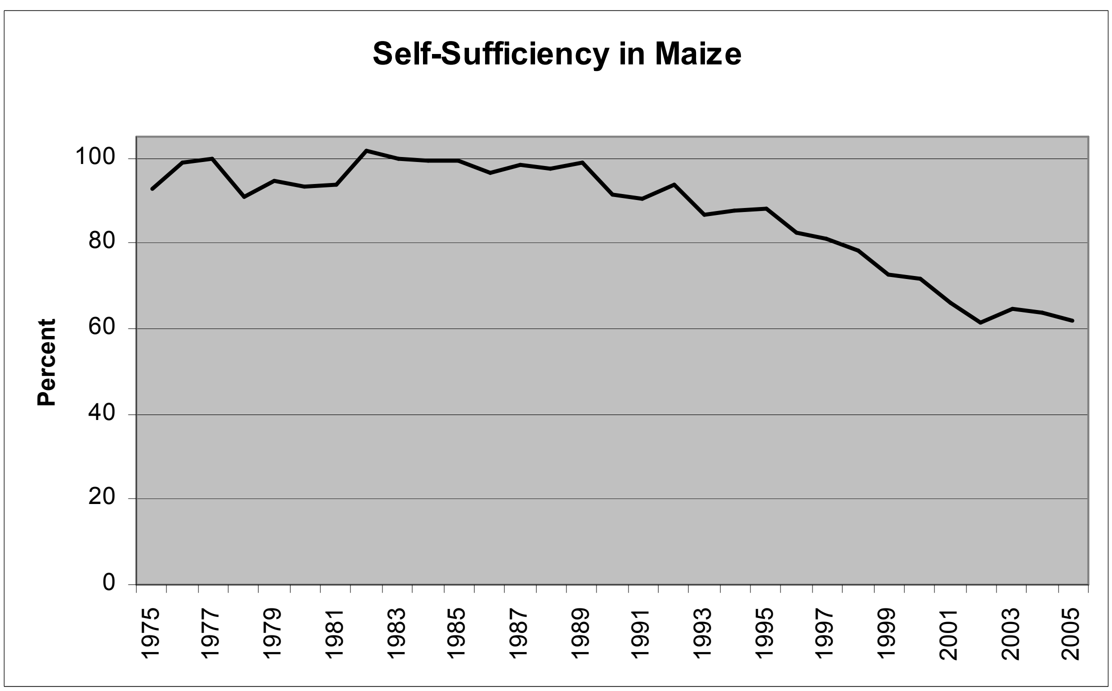
** Significant at 5% level

Figure 3.1: Self-Sufficiency in Maize (production as share of consumption), 1950 – 1969



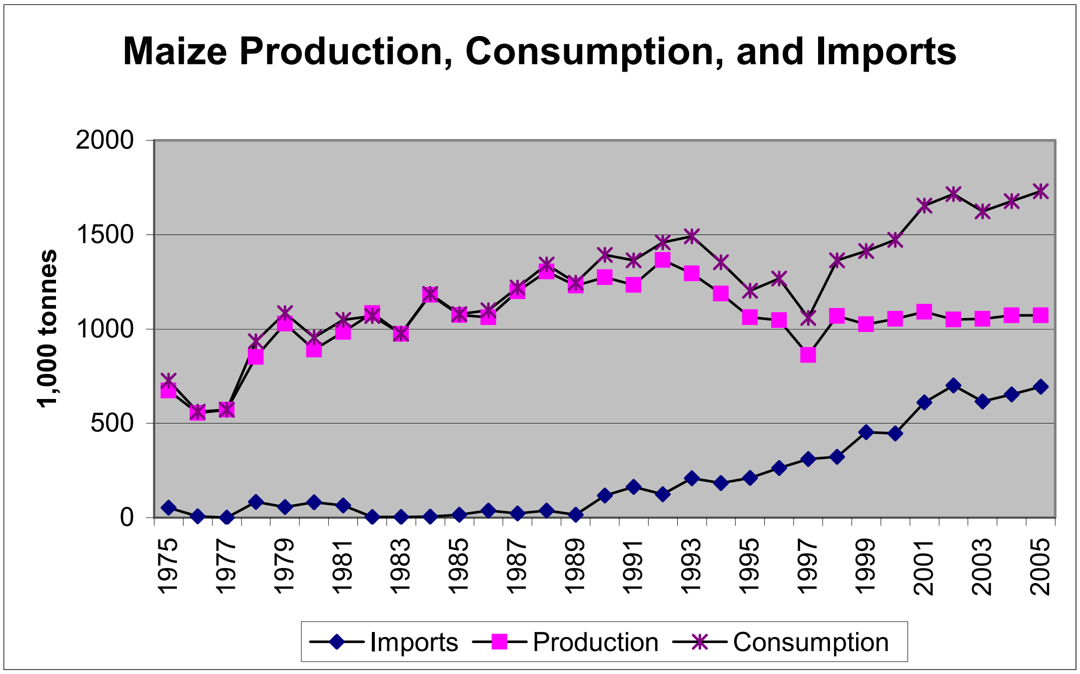
Source: DIGESA, 1968
Note: The deficiency in 1955 has been attributed to poor weather that year and, more importantly, the military coup that overthrew the Arbenz government the preceding year (DIGESA, 1971: 126).

Figure 3.2: Self-Sufficiency in Maize (production as share of consumption), 1975 - 2005



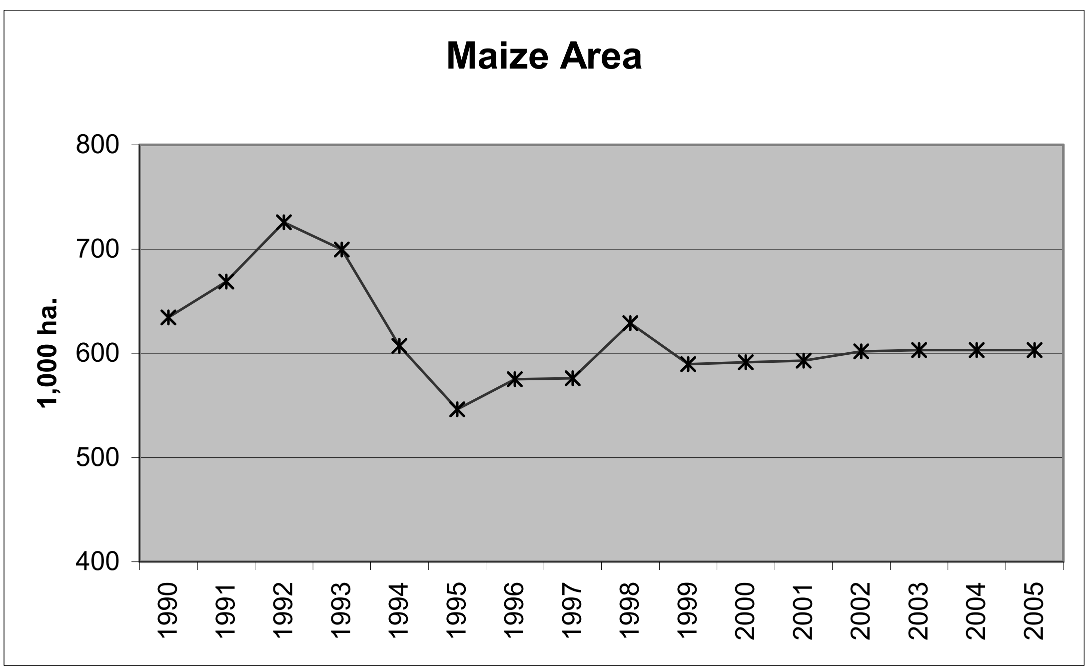
Sources: Reyes Hernández, 1995; FAO STAT, 2007

Figure 3.3: Maize Production, Consumption, and Imports, 1975 - 2005



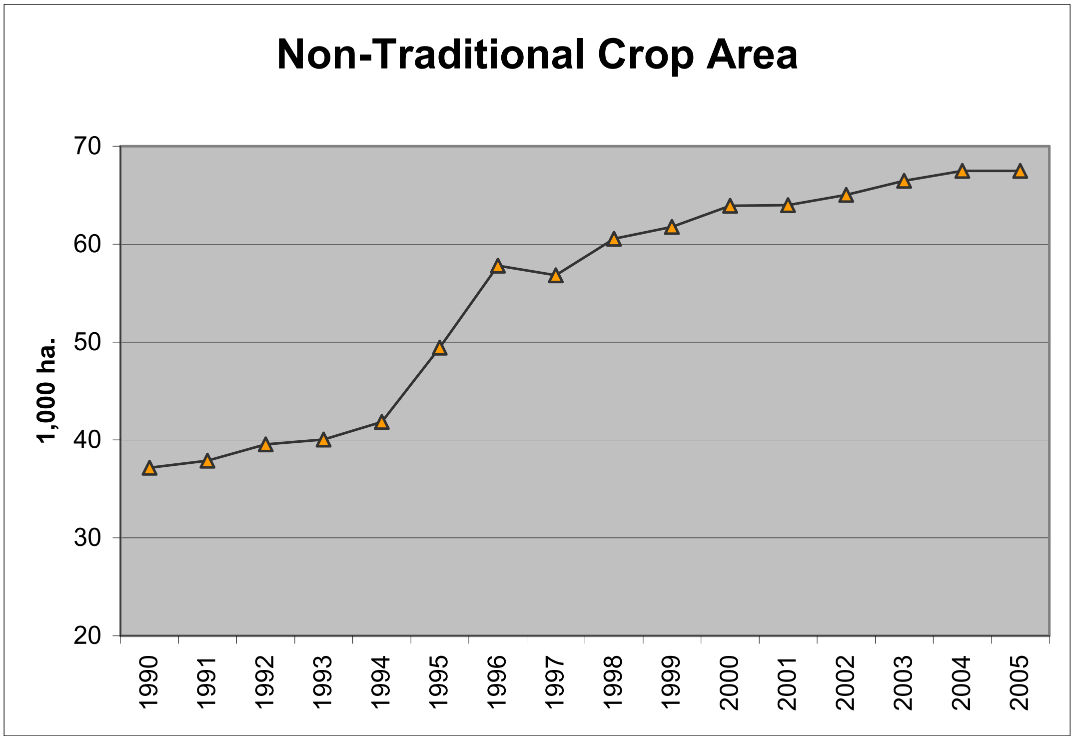
Sources: Reyes Hernández, 1995; FAO STAT, 2007

Figure 3.4: Maize Area, 1990 – 2005



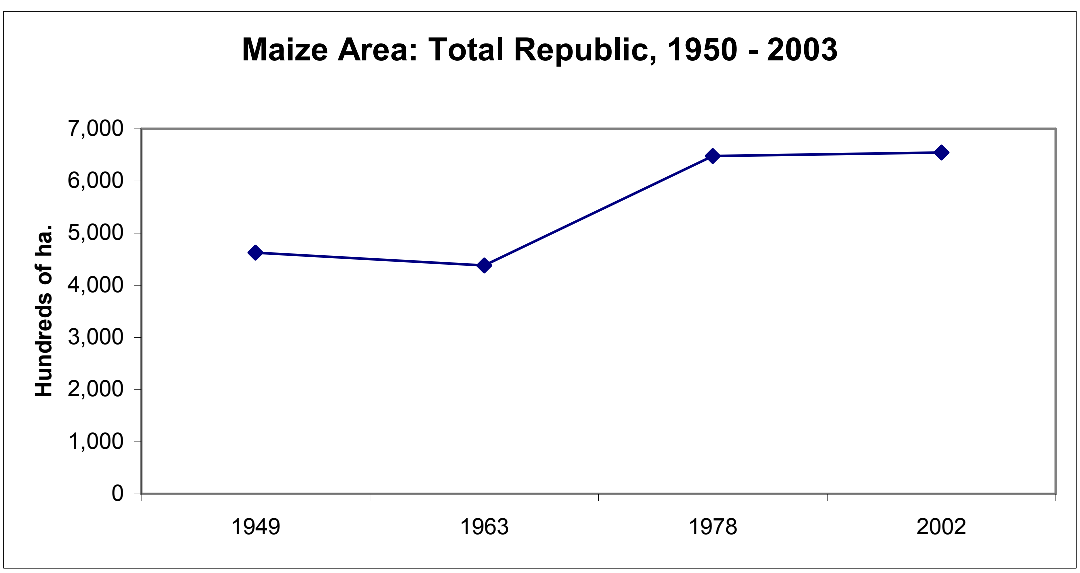
Source: FAO STAT, 2007

Figure 3.5: Area Allocated to Non-traditional Crops, 1990 - 2005



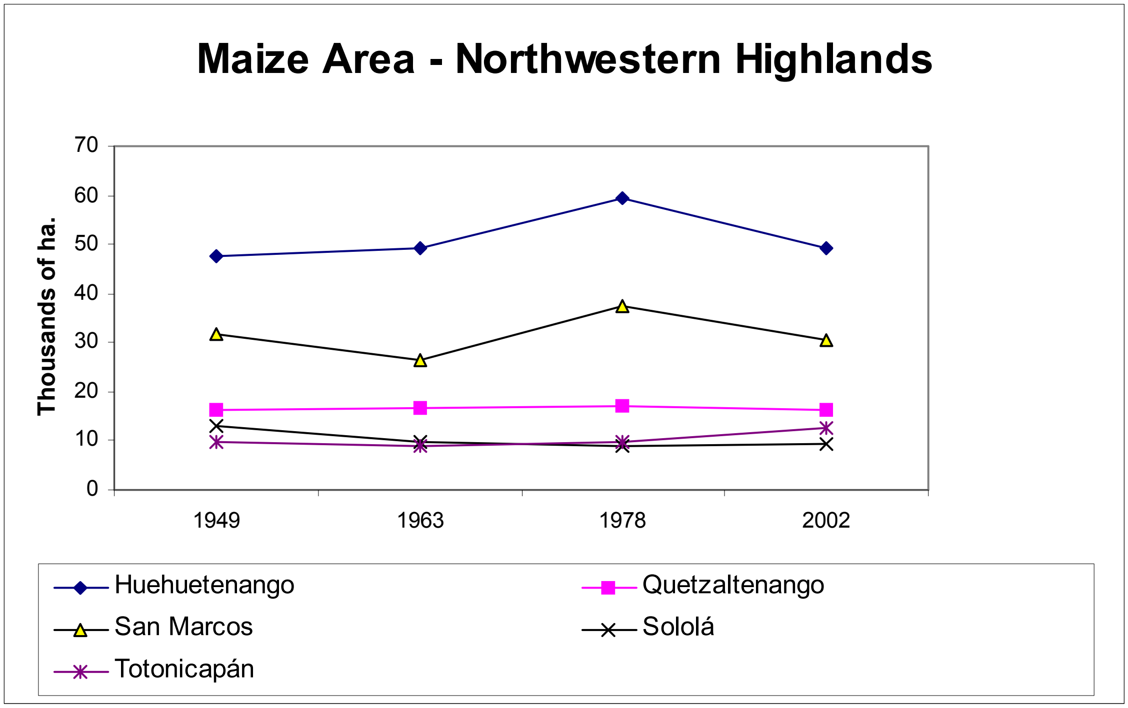
Source: FAO STAT, 2007
Note: The non-traditional crops accounted for are broccoli, cauliflower, strawberries, peas, sesame seeds, and melons.

Figure 3.6: Changes in Maize Area, Republic of Guatemala



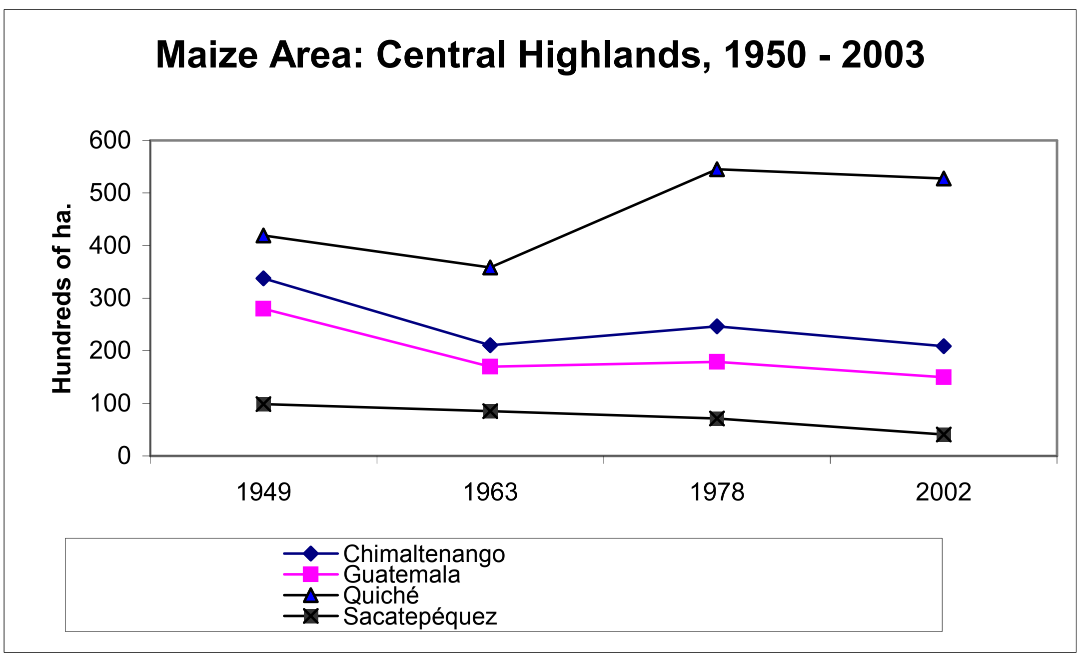
Sources: DIGESA, 1954; DIGESA, 1968; DIGESA, 1982; INE, 2004

Figure 3.7: Changes in Maize Area, Northwestern Highland Departments



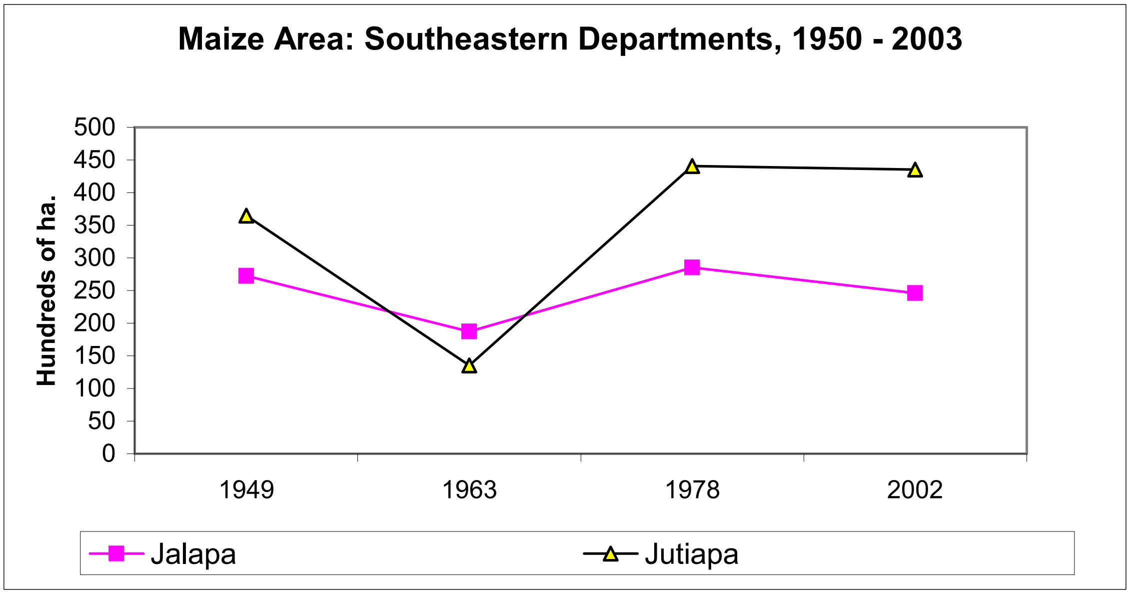
Sources: DIGESA, 1954; DIGESA, 1968; DIGESA, 1982; INE, 2004

Figure 3.8: Changes in Maize Area, Central Highland Departments



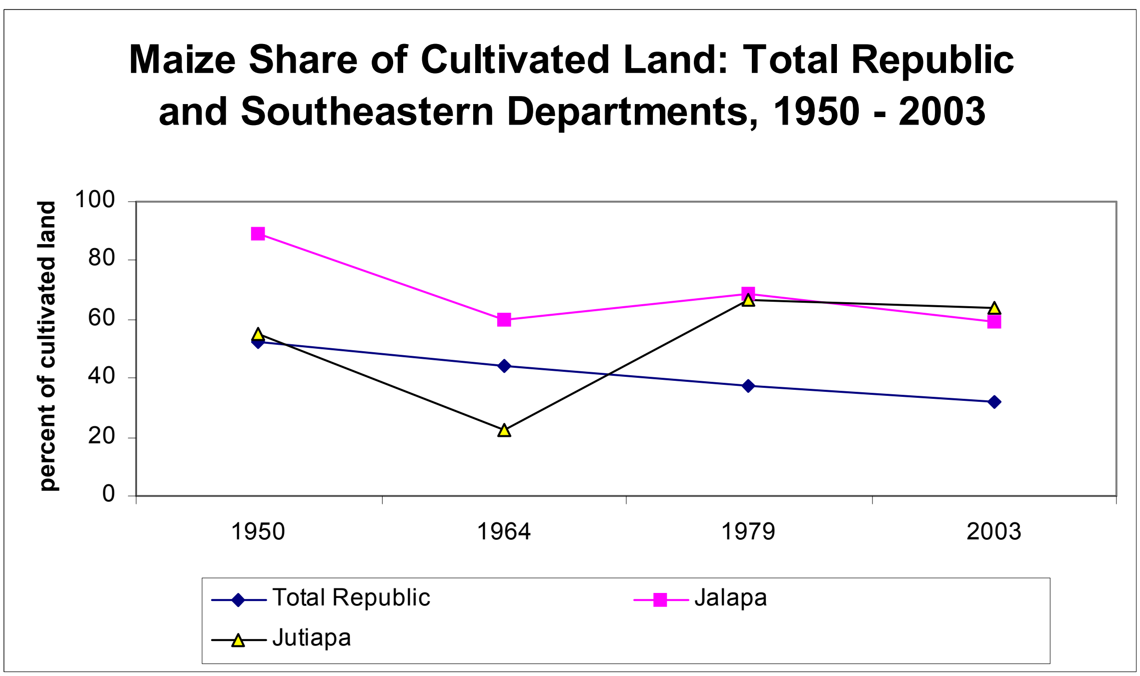
Sources: DIGESA, 1954; DIGESA, 1968; DIGESA, 1982; INE, 2004

Figure 3.9: Changes in Maize Area, Southeastern Departments



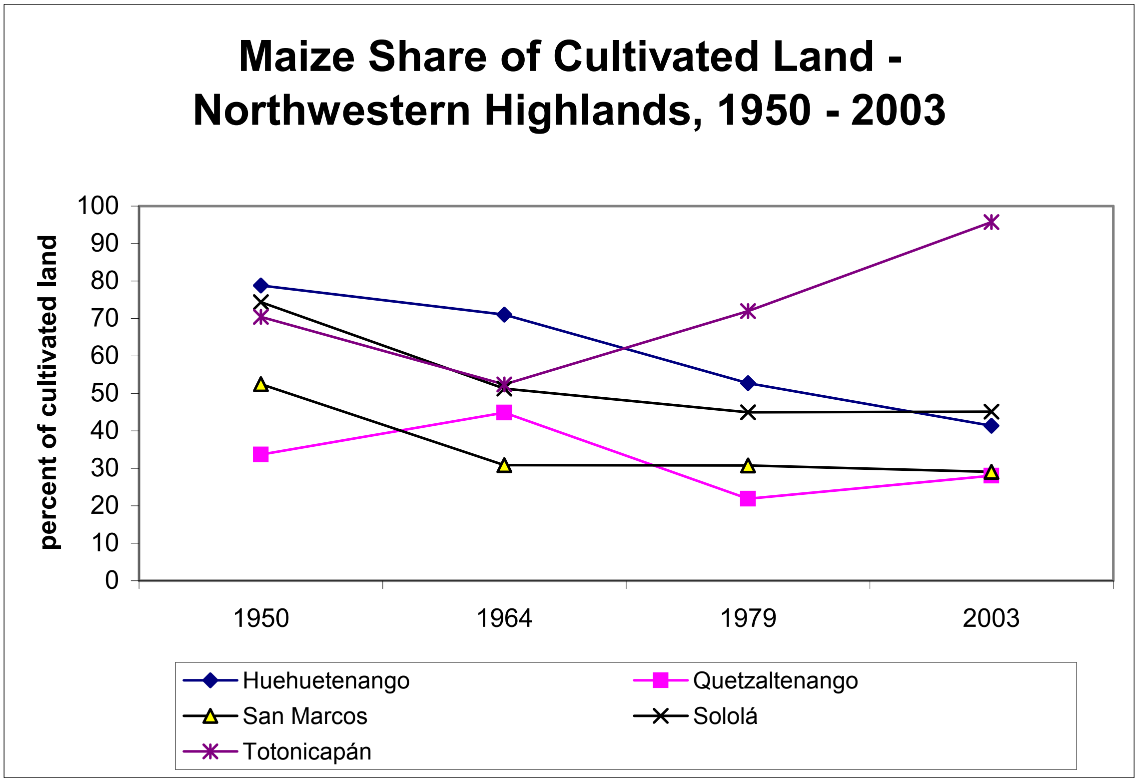
Sources: DIGESA, 1954; DIGESA, 1968; DIGESA, 1982; INE, 2004

Figure 3.10: Share of Maize Area, Total Republic and Southeastern Departments



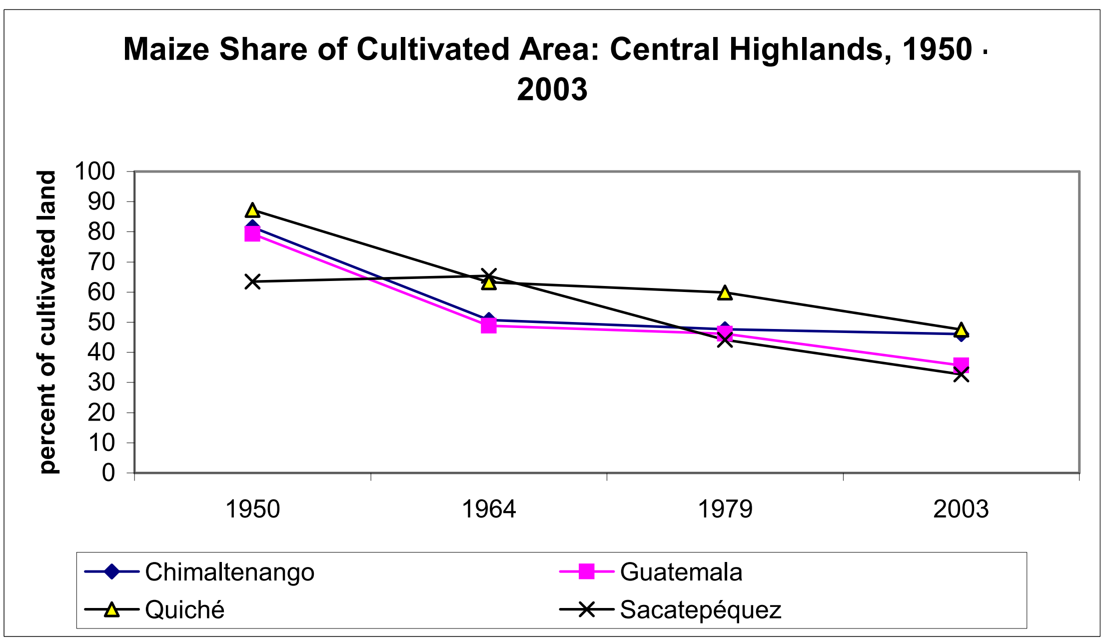
Sources: DIGESA, 1954; DIGESA, 1968; DIGESA, 1982; INE, 2004

Figure 3.11: Share of Maize Area, Northwestern Highland Departments



Sources: DIGESA, 1954; DIGESA, 1968; DIGESA, 1982; INE 2004

Figure 3.12: Share of Maize Area, Central Highland Departments



Sources: DIGESA, 1954; DIGESA, 1968; DIGESA, 1982; INE, 2004

CHAPTER 4

THE FIELD SITE: A BRIEF DESCRIPTION OF NIMASAC AND XEUL

4.1 Introduction

A primary objective of this dissertation is to explore the impacts of market expansion upon the *in situ* conservation of crop genetic diversity in the Guatemalan highlands. As previously mentioned, however, the management of crop genetic resources in this "megacenter" of biological diversity is seriously understudied. Since there has been no systematic cataloging of crop diversity in Guatemala since the liberalization of its economy and the expansion of global markets into its countryside, I chose to conduct a micro-level analysis on the management of crop genetic resources and the economic activities of farmers in two highland communities.

The household-level data for this study were collected from Nimasac and Xeul – two villages located in the heart of Guatemala's western highlands and its center of maize genetic diversity. Nimasac is a hamlet in the Municipality of Totonicapán in the Department of Totonicapán; Xeul is a hamlet in the Municipality of Cantel, Department of Quetzaltenango. Table 4.1 provides descriptive statistics for the two communities. They share many similarities. Both are predominantly K'iche' Mayan and, though they have a sizable minority of evangelical Christians, the majority of people are Catholic. Both communities are also situated in what economic geographer Carol Smith (1989) identified as the "core" of northwestern Guatemala's regional market system. Indeed, located within 20 miles of Guatemala's second largest city, Quetzaltenango, and a short distance from several of the country's major market centers, both communities are in the hub of economic activity in the highlands. They have also developed new linkages with the global market economy in recent years. The types of connections that they have made with international markets, however, are one of their key differences. Whereas Nimasac has a relatively high proportion of community members who work as migrant laborers in the United States or cultivate "non-traditional" export crops, a significant portion of the population in Xeul participate in Guatemala's expanding textiles trade.

The organization for the remainder of this chapter is fairly straightforward. In sections 4.2 and 4.3 I describe Nimasac and Xeul, respectively, focusing upon the role of indigenous governance, the evolution of market activities, and the development objectives in each community. In section 4.4 I document the prevalence of subsistence-oriented *milpa* agriculture in the two communities and discuss the factors that influence the engagement of different households in maize markets. I discuss the contributions of hired field hands in section 4.5, and offer a brief conclusion in section 4.6.

4.2 Nimasac

Nimasac is located in a wide mountain valley just outside the town of Totonicapán, the capital of department of same name. In K'iche' Mayan, Nimasac means "Big Field," a name that is reflective of the broad, open valley where the village is located. Locals distinguish three regions of the community: (1) the wide valley floor where villagers reside and cultivate *milpa*; (2) the steep mountainside, which is a mosaic of privately owned, communally managed, and clan-controlled forest; and (3) the plateau-like mountaintop known as "Alaska" where community members cultivate additional *milpa* plots. Located some 2,000 feet higher in elevation, Alaska is – appropriately enough – much colder and windier than the community center and is said to have poorer soils.

4.2.1 Indigenous Governance

Like most communities in Totonicapán, Nimasac is renowned for its indigenous culture. As evidenced in their language, dress, and other facets of their daily life, the people of Nimasac are proud of their Mayan heritage. The strength of Nimasac's Mayan culture is reflected in the relative clout of its indigenous governing body, which runs parallel to formal state and municipal governance. Continuing a tradition that preecedes the Spanish conquest, many aspects of community life are administered by a group of respected community members who donate one year of their time to various posts in the village government.[1] According to indigenous values, the body engages in public works, administers justice, mediates conflicts, sanctions community members who violate norms, and oversees Totonicapán's acclaimed communal forests.[2] Residents are proud to note that their village organization is not a "political" institution with parties and divisive factions, but a traditional body that governs according to "custom" and the "indigenous

[1] Members refer to their participation in community governance as their *k'axk'ol*, variously translated as their "duty" or "suffering."

[2] Totonicapán lays claim to the healthiest highland forest in Guatemala, if not Central America. See Wittman and Geisler (2005) and Utting (1993). As the administrator of a local environmental organization noted, "In Guatemala, where there are trees there are indigenous people and where there are indigenous people there are trees."

laws" of complementarity, fairness, and community.[3] Along with indigenous leaders from the other forty-seven hamlets in the Municipality of Totonicapán, Nimasac is a member of "Los 48," a body that provides a powerful voice for Guatemala's Mayan population.

4.2.2 Market Activities

In addition to its indigenous culture and governance, the people of Nimasac are renowned for their production of popular artisanal goods that are sold in the markets throughout northwestern Guatemala. In-home petty commodity production[4] has long been an important form of economic provisioning in the municipality (Utting, 1993; FUNCEDE, 1997b; Smith, 1989); its K'iche' craftspeople are famous for a number of goods, particularly their leather shoes and sandals, traditional weavings, wooden furniture, and clay pottery. As shown in Table 4.2, a prodigious 92% of Nimasac households earn income from such petty commodity production; in total, it accounts for more than one-third of total household income.

Despite the important contributions of petty commodity production to livelihoods in Nimasac, its importance has apparently decreased in recent years. Carol Smith (Smith, 1988; Smith, 1989) has argued that prior to the 1980s, nearly all income in Totonicapán

[3] Rather than incarcerating or fining those who are caught stealing, for example, the body typically requires thieves "pay back" the victims and community with public service. Public works such as construction and maintenance of village water systems, roads, and recreation areas are a major function of the community organization. Known as *faenas*, these projects are typically financed by donations and fees administered to all households according to their ability to contribute. Stener (n.d.) estimates that value of *faenas* is much greater than the value of government-funded projects in the region.

[4] I use the term "petty commodity production" to refer to the various income-generating activities that take place within Guatemalan homes. While weaving, sewing, making shoes, and other artisanal activities make up the bulk of petty commodity production, it also includes the running of *tiendas* (or small stores) out of the family home and the renting of electric mills to grind maize.

was earned in its “artisanal economy.” The armed conflict in Guatemala reached its peak in the 1980s, however, causing massive movements of people in the “periphery” of the regional markets where the artisans sold their goods and undermining demand for their products. The result, she claims, was a proletarianization of the weavers, tailors, and other artisans who sought wage labor both in and outside their communities.[5] Peter Utting (1993) maintains that the crisis in petty commodity production contributed to underemployment in Totonicapán, forcing many farmers to intensify their agricultural production.

Wage labor is now quite common in Nimasac. As shown in Table 4.2, nearly two-thirds of all households in Nimasac have family members who sell their labor power in the regional labor market. At 44%, wage labor is the largest generator of income in the community. Half of the jobs in Nimsac are in the manufacturing sector, many of which are in construction.[6] The agricultural sector and the service sector each lay claim to another 20% of the jobs in Nimasac, while the remaining 10% are in marketing and commerce.

In addition to selling their labor power in the regional labor markets, the residents of Nimasac are increasingly drawn to work as transnational migrant laborers in foreign markets, particularly the United States. Transnational migration is one of the most rapidly expanding livelihood strategies in Guatemala. According to a recent study by the

[5] Whereas the indigenous population in other areas of the highlands had a long history of seasonal migration to work on coffee plantations on the coast, Smith (1988) argues that petty commodity production provided an alternative for the people of Totonicapán. The older residents of Nimasac claim that seasonal migration was common but that it was not as prevalent as it was in other highland communities.

[6] As will be discussed later, remittances from abroad are fueling a construction boom in Totonicapán. Construction accounts for 38.5% of jobs in the manufacturing sector and one-fifth of all jobs held by wage workers from Nimasac.

International Organization for Migration, the practice has mushroomed in the 1990s; more than one-third of Guatemalan households now have at least one family member living abroad (OIM, 2002).[7]

Nimasac is one of the many rural Guatemalan communities whose members are contributing to the upsurge in transnational migration. As data from my household survey indicate, 45% of households had a family member residing outside of Guatemala in 2002. Nearly all of these migrants (94%) had left their communities in hopes of improving their economic situation; most (90%) had done so by seeking employment in the United States. The majority of immigrants are young adult males in their 20s or 30s; they typically spend 2-7 years laboring as undocumented workers in the United States, eventually returning to their families in Nimasac. More than half (58%) of the households with a family member living abroad received remittances; the average family received $680 (USD) per year. Some households received as much as $3,600 per year in remittances; others received as little as $50.[8]

In addition to selling their labor power abroad, a number of households in Nimasac have experimented with selling their agricultural products in foreign markets. As discussed in the previous chapter, for more than twenty years the Guatemalan government and international development agencies have encouraged small-scale farmers

[7] The U.S. Immigration and Naturalization Service estimates that 144,000 undocumented Guatemalans were residing in the United States in 2000. This represents a 22% increase since 1990, and means that, grouped by nationality, Guatemalans are the third largest group of undocumented immigrants residing in the United States.

[8] According to a 2005 report from the Bank of Guatemala, remittances from the United States achieved a record $2.55 (USD) million in 2004 (Prensa Libre, January 12, 2005); they were expected to increase by another 13% in 2005 (Hernández, 2005). As of 2002, remittances accounted for 5% of Guatemala's GDP and generated 30% of all export earnings (more than the combined value of Guatemala's traditional exports: coffee, banana, sugar, and cardamom) (OIM, 2002).

to adopt the cultivation of fruits and vegetables for export. Their efforts have entailed a series of coordinated campaigns throughout the countryside. Nimasac was the target of one such initiative.

In the early 1980s, the German International Development Agency teamed-up with Guatemala's Ministry of Agriculture to construct a small reservoir in the mountains above Nimasac. Upon its completion in 1984, the dam provided irrigation to cultivate cauliflower, sugar snap peas, broccoli, and other non-traditional export crops on seven hectares of land in the community. The 22 "beneficiary" families who received the irrigation were required to pay some $90 (US) for pipes and tubing and to commit to the cultivation of export vegetables.[9] Depending upon the agency that it is working with at the time, the group, which was once known as *Nuevo Sembrador*, has undergone various incarnations over the years. All have focused upon the cultivation of cash crops, differing only in the particular crops that they grow and the means for marketing them.

Over the years, *Nuevo Sembrador* has received technical assistance from a variety of development agencies, including the US Agency for International Development and the US Peace Corps, the development agencies of the Netherlands and Germany, and several branches of Guatemala's Ministry of Agriculture. The different organizations have encouraged the farmers to adopt different forms of agriculture. Some stressed the cultivation of cauliflower and snow peas that were exported to Europe; another stressed the cultivation of tomatoes and bell peppers that could be sold to a chain of Guatemalan

[9] The participants were supposed to be "poor-to-middle income" community members, though the $90 up front cost discouraged some farmers from joining the group. While the participants are certainly not the wealthiest members of Nimasac, they are not the poorest either. Many observers have speculated that nepotism played a role in determining which community members were included in the project.

supermarkets; others encouraged farmers to grow beets, cabbage, and cauliflower for local markets; and one focused upon the cultivation of seedlings that could be sold to other commercial farmers in the highlands.

While there have been some individual gains, none of the experiments in cash cropping have been overwhelmingly successful. Exporters refused to buy diseased snow peas and spotted cauliflower; the supermarket chain transferred too many costs and responsibilities to the growers, making the practice unprofitable; and tomatoes were unable to withstand the cold and hail of the highlands. During the 1990s, to help protect the crops from the harsh climate of the highlands, farmers were encouraged to construct greenhouses on their irrigated plots. Members were required to pay up to $2,100 (US) in subsidized loans to construct greenhouses that consisted of a cinderblock base and plastic tarps strung over PVC tubing. In total, some seven greenhouses were constructed, providing a protected environment for farmers to grow tomatoes, flowers, bell peppers, and other commercial crops. Like the plants within them, however, the greenhouses were not able to weather the harsh highland climate. Winds tore the transparent plastic shells and the plants were once again exposed. Rather than spending some $450 (US) to replace the plastic every 3 – 4 years, the members of *Nuevo Sembrador* have slowly abandoned their greenhouses over time. As the foreign aid has withdrawn, the ventures are no longer profitable. Upon my last trip to the village in August 2006, only one greenhouse was still functioning (thanks to financial assistance from a brother working the United States). A handful of participants now make an hour-long bus ride to Salcaja where they sell their export crops to a buyer. Most of the farmers have abandoned export agriculture, however, choosing instead to sell cash crops in the local markets or revert the land to *milpa*.

4.2.3 Development Goals

While it is certainly not the most marginalized village in the highlands, the residents of Nimasac still consider their community to be poor and would like to see their living situation improve. During a series of focus group interviews, I was able to identify five broad sets of development objectives that the residents of Nimasac have for their community. Perhaps the most desired goal is to improve the infrastructure of the community. In particular, residents would like a more reliable water system, improved roads, and a community park with a soccer field and playground equipment for children. Participants in my female groups expressed a desire for women's empowerment. Specifically, they would like better family planning and more control over their reproductive lives and a reduction in domestic violence. Like their male counterparts, the women also expressed an interest in better paying jobs with more flexible schedules. Women complained that the rigid work schedule conflicted with their traditional household duties and therefore prevented their participation in the labor market, while men noted that the long workdays did not allow them sufficient time with their families or to give sufficient attention to their *milpa* plots. The residents would like better access to higher education, specifically high school and technical schools. Finally, the focus group participants expressed two agriculture-related goals. One goal is to improve agricultural yields and the other was to preserve *milpa* agriculture as an enduring feature of the local landscape.

4.3 Xeul

The second community where I gathered field data is the hamlet of Xeul, in the Municipality of Cantel, Department of Quetzaltenango. Like Nimasac, Xeul is located in the "core" of northwestern Guatemala's regional market system (Smith, 1989). Though is an undeniably rural community, it enjoys relatively easy access to Guatemala's second largest city, Quetzaltenango, located some ten miles away on paved roads. (Nonetheless, many residents must walk a good distance to those paved roads and bus service is infrequent.)

In the K'iche' dialect spoken by its residents, Xeul means "beneath the mountain." The name is fitting, as the hamlet sprawls out along the foothills of a steep mountain slope. Altitudes in the community range from 7,500 to 9,000 feet above sea level. Farmers reside and grow their *milpas* in the foothills; the steeper hillside is dominated by privately-owned and municipally-held forest plots.

4.3.1 Governance

Like Nimasac, Xeul is governed by a traditional village council that runs parallel to the official municipal and department governments. The body is relatively weak, however. With community members reluctant to participate in its governance, the body temporarily dissolved around 2000, leaving most authority to a village water board. It has reemerged in recent years and even engaged in a campaign to pave several roads in the community. Nonetheless, in relation to the municipal government of Cantel and in comparison with the indigenous organization in Nimasac, the village council is not particularly influential.

4.3.2 Market Activities

As a hamlet of Cantel, Xeul is renowned for its textiles production. The town is most famous for the presence of a large textiles manufacturing plant known colloquially as *La Fábrica*, or "The Factory." There is also a great deal of textiles manufactured in the homes of Xeul's residents. Clothing production has a long history in Xeul. As part of the *repartamiento* system during the 18th century, the colonial governor of the highlands required the indigenous people to spin and weave cloth (Pollack, n.d.). This was a unique arrangement at the time, as most of the colonial leaders extracted surplus from their subjects by requiring them perform agricultural labor on their haciendas. This history of textiles production, combined with Cantel's convenient location on the Río Samalá and proximity to major market centers, was a major factor in the decision to locate *La Fábrica* in the town.

The history of *La Fábrica* in Cantel is chronicled in Manning Nash's *Machine Age Maya* (Nash, 1958). With the blessing of Guatemala's liberal dictator Justo Rufino Barrios, the factory was introduced by a Spanish enterprise in 1876. The local indigenous population, however, was strongly opposed to its construction and was particularly upset about the loss of 25 hectares of communal land where *La Fábrica* was erected. The community organized in an attempt to oust the factory, but their uprising was met with a bloody repression from the Guatemalan army. The factory began operating in 1884, but its managers had to import workers from neighboring communities. The local Canteleños were so resentful that they would not start working there for another six years. Even though the factory was continually reliant upon military and police repression to quell labor disputes, in time *La Fábrica* emerged as a major employer of Canteleños. According to one former employee, the factory employed as many as 1,800 locals during the 1970s. While mechanization has significantly reduced its payrolls in recent years, the textiles mill continues to employ some 500 – 600 Canteleños, many of them from Xeul.

For much of its history, *La Fábrica* produced for the national market. With the liberalization of the Guatemalan economy in the 1980s, however, it began exporting its products. Most of its production is now shipped abroad; employees believe that the vast majority is exported to the United States.

The presence of *La Fábrica*, combined with Xeul's proximity to the urban center of Quetzaltenango, render wage employment a principal form of economic provisioning in the community. As shown in Table 4.2, 82% of the households surveyed in Xeul sell their labor power for a wage; wage labor generates nearly three-quarters of total household income. Although 40% of the jobs held in Xeul are in textiles manufacturing, it is difficult to determine exactly how many of them are with *La Fábrica*. One knowledgeable local estimates that about one-quarter Xeul's wage laborers work at the textiles mill. According to my household survey, another 25% of jobs are held in Quetzaltenango, making urban employment another important livelihood strategy.

In addition to wage labor, artisanal production is another important form of economic provisioning in Xeul. More than three-quarters of households earn income from petty commodity production; it accounts for more than one-quarter of total income (see Table 4.2). Like wage labor, most of the petty commodity production in Xeul is dedicated to the production of textiles. More than one-quarter of households earn income weaving the traditional Mayan skirts that are worn by indigenous women throughout the Guatemalan highlands. An equal proportion of households earn income from activity known as "making *amarradores*," where the thread that is used for the weavings is tied in patterns that are subsequently dyed.[10] Embroidery is another important form of artisanal production. In a type of cottage industry, the residents of Xeul embroider designs on shirts, hats, and other clothing items that are exported or sold in Guatemala's tourist markets. The emergence of embroidering in Xeul is said to have offset the layoffs that occurred when *La Fábrica* mechanized its production; the practice currently generates income for nearly one-third of Xeul households.

Via its textiles production, Xeul has a long history of engagement with the market economy. With the opening of the Guatemalan economy in the 1980s, the community has developed new linkages with the global marketplace. Wage laborers at La Fábrica produce export textiles while artisans embroider logos and other designs destined for foreign buyers. The globalization of the Xeul economy, however, can be distinguished from the globalization of Nimasac. Whereas Nimasac has established international connections via transnational migration and the cultivation of export crops, such practices are virtually non-existent in Xeul.

[10] Wrapping thread in different configurations before it is dyed is what gives the traditional Mayan dresses (known as *corte*) their intricate patterns. The dress is "traditional" only to the extent that it emerged in the era of conquest. Many observers claim that the patterns of "traditional" dress were forced upon the indigenous people by their colonial rulers. The patterns, which vary from one municipality to another, were a way for the rulers to identify the natives under their control. Many Mayans now wear the *corte* as a showing of ethnic pride, as a way of distinguishing themselves from the more westernized *Ladinos* (Warren, 1998; Stenar, n.d.).

4.3.3 Development Goals

Xeul is arguably a poorer community than Nimasac. The average household earns 7% less income and controls 32% less land. Like Nimasac, however, it is a poor community but not among the most marginalized in the highlands. The development goals of Xeul's residents focus upon improved community services and infrastructure. In terms of services, the residents would like a local health clinic and free public schools for secondary education.[11] Like their counterparts in Nimasac, the residents of Xeul would also like a more reliable water system, improved roads in their community, and a community soccer field.

4.4 *Milpa* Agriculture in Nimasac and Xeul

As discussed in the previous sections of this chapter, the residents of Nimasac and Xeul are active in many realms of the market economy. Despite the importance of market activities like wage labor and transnational migration, subsistence-oriented milpa agriculture serves as the foundation of livelihood strategies in both communities. With the exception of four landless households in Xeul, all of the households surveyed cultivated *milpa*. In total, some 97% of households in the two communities engaged in the subsistence-oriented agricultural practice.

4.4.1 Maize Cultivation

Maize is the most commonly cultivated crop in the highland communities. With the exception of the forested mountainsides, *milpa* cultivation is ubiquitous in the villages

[11] They were particularly concerned that privatization of the educational system would make it inaccessible to most residents, thereby exacerbating Guatemala's dualistic society.

of Nimasac and Xeul. It accounts for more than half (56%) of total land use in the two communities and 95% of the cultivated land. It is grown in the fertile river valley of Nimasac, on the drier foothills in both villages, and even on the top of mountain in "Alaska."

The cultivation of maize on the mountaintop is a relatively recent phenomenon. As several informants explained, it is a practice that was established during the early 1990s. Prior to the 1990s, most farmers cultivated *wheat* – not maize – in Alaska. In part, this was due to their inability to grow maize on the mountain since local seed varieties were not suited to the cold and the wind. Wheat, on the other hand, performed much better in the high elevation. The wheat was not generally consumed in the community. Instead, it was sold to regional flour mills and the returns from its sale were typically allocated to the purchase of maize – since it is was the grain of choice – yet only a small percentage of the population was self-sufficient in its production. During the early '90s, however, there was a dramatic drop in the price of wheat and the buyers became more critical of the quality of the wheat that was cultivated on the mountaintop.[12] The lower prices combined with more finicky buyers undermined the profitability of growing wheat; as a result, many farmers ceased its production.

Fortunately, most families were not severely affected by the changes in the wheat market. At roughly the same time that Nimasac was losing its wheat market, farmers discovered that they could, in fact, grow maize in Alaska. Using seeds that they acquired

[12] None of my informants were able to identify a reason for the changes in the market for wheat. One might suspect, however, that they are at least partly attributable to the dramatic influx of low-priced wheat from the United States that began entering Guatemala in the late 1980s under PL-480. Ironically, the wheat was imported into Guatemala under the mantra of "food for peace." See Garst (1992) for a discussion.

from the nearby municipality of Nahualá and fertilizing the plants with chicken manure that "warmed the soil," farmers were able to make a relatively seamless transition from the cultivation of wheat to the cultivation of *milpa* on the mountaintop. At the time of my fieldwork, one farmer was still ecstatic about the discovery, noting that since they are less affected by price fluctuations in the markets for maize and wheat, many families in Nimasac now enjoy a greater sense of food security.

As shown in Table 4.3, the majority of land in Nimasac and Xeul is allocated to agriculture.[13] Most of the agricultural land, in turn, is allocated to maize agriculture. All of the arable land in Xeul is cultivated with maize, while the crop is grown on three-quarters of the agricultural land in Nimasac (Table 4.4). The lower rate of maize cultivation in Nimasac is mainly attributable to the cultivation of cash crops on 8% of the arable land and the fallowing of another 10%. More than half of the land left fallow by Nimasac residents belonged to one farmer who had recently purchased a significant tract of land on the southern Guatemalan piedmont. The remaining fallow land was located on the mountaintop in Alaska, where half of the farmers already cultivated enough land to be self-sufficient in maize. The remaining farmers were either too old to work their mountaintop land or had determined that its distance from the community, combined with its relatively poorer yields, did not justify the effort.

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[13] The well-preserved forests on the hillside of Nimasac, translate into a relatively smaller proportion of total land cultivated than Xeul. But, due to larger landholdings overall, the average farmer in Nimasac controls two more *cuerdas* (0.236 hectares) of arable land than the average farmer in Xeul.

4.4.2 Maize Consumption

The widespread cultivation of maize in Nimasac and Xeul is reflected in their high levels of consumption. Adjusting for the varying caloric needs of different age groups and sexes, the average consumption per adult equivalent unit (AEU) is 278 lbs. of maize per year, or 345 grams per day. This is 9% more than the daily maize consumption of 318 grams throughout rural Guatemala (FAO, 1992: Table 25).

4.4.3 Landholdings and Participation in Maize Markets

Most of the maize that is cultivated in the highland communities is destined for direct household consumption. As shown in Table 4.5, the farmers of Nimasac and Xeul consumed 82% of their total maize harvest. Nearly three-quarters of total maize consumption is grown on household land. The remaining 28% of maize is purchased in local markets, most of it from neighbors who have produced a surplus. Despite the relatively small percentage of overall maize that is purchased in the market, some 53% the households sampled are dependent upon the maize market to fulfill at least a portion of their consumption needs; combined, these households purchase one-half of their total maize consumption.

Table 4.5 describes the maize production and consumption characteristics for the different types of participants in the maize market. As it suggests, the degree to which a household is self-sufficient is associated with the amount of arable land that it controls. The average adult (equivalent) in the two communities consumes 278 lbs. of maize per year, slightly more than the average yield of 257 lbs. of maize per *cuerda* (or 988 kg/ha) of land. Thus, a general rule of thumb is that roughly one *cuerda* – or, specifically 1.08

cuerdas – of land is required to cultivate enough maize for each adult's annual consumption. This rule of thumb is reflected in the sizes of arable landholdings among the sellers, buyers, and non-participants in the maize market. On average, maize buyers control only three-quarters of a *cuerda* of arable land per adult equivalent unit, whereas the average maize seller controls nearly three times the amount of arable land necessary to achieve self-sufficiency in maize. With an average of 1.06 *cuerdas* per AEU, the non-participants in the maize market control just enough land to achieve self-sufficiency. The association between landholdings and participation in maize markets is clearly illustrated in Table 4.6, where nearly two-thirds of the households that control more than 1.5 *cuerdas* per AEU are maize sellers while 83% of the household with less than 0.5 cuerdas per AEU are buyers. Among the households with 1.0 – 1.5 *cuerdas* per AEU, 60% are neither buyers nor sellers of maize.

It is also worth noting that maize yields, in addition to the size of arable landholdings, may be associated with the role that a household plays in the grain market. In addition to commanding more land, maize sellers typically have higher yields than maize buyers and those who do not participate in maize markets. The non-participants also have higher yields than the buyers. The difference in yields may be attributable to a combination of factors, including the varying quality of landholdings (in addition to controlling more land, maize sellers may control better quality land), different technologies, or the relative quantity of human labor invested in the crop.

4.5 Reliance Upon Hired Field Hands

Based upon the country's 2003 agrarian census, Table 4.7 shows the distribution of agricultural labor for Totonicapán and Cantel, the respective municipalities to which Nimasac and Xeul appertain. Hired laborers – known as *mozos* – perform the majority of agricultural labor in Guatemala. The proportion is noticeably less in the municipalities of Cantel and Totonicapán. Nonetheless, with a respective 48% and 41% of *mozos* hired in the two communities, it is apparent that even though households consume the vast majority of the maize cultivated on their land, they rely heavily upon hired laborers to grow it for them. Among the hired workers in the two municipalities, nearly all (96%) are employed on a temporary basis to fulfill specific agricultural tasks.

Table 4.8 describes the different tasks performed by hired field hands in the milpas of Nimasac and Xeul. It is important to note that landowners will often work alongside *mozos* in their fields. The statistics should not be interpreted as the overall proportion of work performed by field hands, but rather the different tasks that they are hired to perform (assisted by the landowner or not). In general, it appears that households in Nimasac are much more reliant upon hired labor. It is not obvious why nearly two-thirds of households in Nimasac hire field hands, compared to 42% of households in Xeul. Two factors might help to account for the difference: (1) households in Nimasac control more arable land than their counterparts in Xeul; and (2) many of the adult males who would normally maintain the *milpas* of Nimasac are currently working abroad as migrant laborers. The later observation might also help to explain why women in Totonicapán have unusually high rates of participation in agricultural household labor, as shown in Table 4.7. Indeed, as Carmen Diana Deere (2005) has observed, the diversification of livelihood strategies, including the growing prevalence of male migration, has contributed to the feminization of peasant agriculture throughout Latin America.

The use of *mozos* is relatively consistent across the major agricultural duties. In total, about one-third of households hired field hands to help with each of the four principal milpa tasks: preparing the land for planting, planting the seed, hilling dirt around the plants to prevent them from lodging (i.e. blowing over in the wind), and harvesting. While I did not observe an explicit gendered division of labor in the milpa, two of these four tasks – preparing the land and mounding dirt around the plants – are often considered "male" duties. (Harvesting and planting, in contrast, tend to be joint efforts in which the whole family participates.) Interestingly, these "male" tasks also happen to be the duties where the use of hired labor is unusually high in Nimasac, especially when compared to their use in Xeul. The relatively greater reliance upon agricultural laborers to perform male tasks in Nimasac – even when a significantly larger proportion of the men from Xeul are wage laborers with inflexible schedules – once again suggests the possibility that transnational migration may increase a household's dependence upon hired field hands.

4.6 Conclusion

The communities of Nimasac and Xeul share many similarities. They are both predominantly K'iche' Mayan and are situated in the core of northwestern Guatemala's regional market system. They have a long history of participation in the regional market economy and, over the past twenty years, have developed new linkages with the global market economy. Many households in Nimasac are participants in the rising trend of transnational migration from Guatemala and several have experimented with the cultivation of non-traditional export crops. Xeul, meanwhile, has connected to global markets through the production of export textiles. Many residents of Xeul sell their labor power to a local textiles mill while others engage a cottage industry of embroidering clothing items for foreign markets.

Despite their various linkages with regional and global markets, *milpa* agriculture remains a prevalent component of livelihood strategies in the highland communities. All households with the means to do so grow maize and other crops for household consumption, and most maize is consumed within the household. The degree to which a household is self-sufficient in maize is associated with the amount of land it controls per adult equivalent. In general, roughly one *cuerda* of land is necessary to cultivate enough maize to feed an adult for a given year. Households with more than one *cuerda* of land per adult household member tend to sell surplus maize in the market while those with less than sufficient land purchase maize in local markets. Some 52% of households must purchase maize in the market while 16% sell a surplus. The remaining 32% harvest just enough maize to be self-sufficient.

A significant proportion of households are reliant upon hired field hands known as *mozos* to assist with their *milpa* cultivation. Households from Nimasac are more reliant upon *mozos*, which may result from the higher incidence of male migration in the community. Migration may also be fueling the feminization of *milpa* agriculture in Nimasac.

Table 4.1: Community Characteristics of Nimasac and Xeul, 2002

	Nimasac	**Xeul**
Number of Households (Approximate)	605	545
Number of Households Surveyed	59	60
Annual Net Product per Household ($USD)	3,025	2,824
Average Members per Household	6.61	6.97
Indigenous Population (Percent)	99.4	97.0
Catholic (Percent)	67.0	53.0
Evangelical Christian (Percent)	33.0	46.0
Households Cultivating *Milpa* (Percent)	100.0	93.3
Adults Participating in Labor Market (Percent)	30.2	39.8
Elevation (feet above sea level)	8,000 – 10,100	7,500 – 9,000
Annual Precipitation (inches)	40 – 160	40 – 160
Med. Annual Temperature (Min – Max) (F ^{o})	53^{o} – 64 ^{o}	53^{o} – 64 ^{o}
Distribution of Landholdings (Gini Coefficient)	0.46	0.50

Sources: Data collected by author, 2001– 2006; FUNCEDE, 1994a; FUNCEDE, 1994b

Table 4.2: Sources of Household Income, 2002

	Total Sample			**Nimasac**			**Xeul**		
	Percent of HHs Engaged	Avg. Value per HH ($USD)	Percent of HH Income	Percent of HHs Engaged	Avg. Value per HH ($USD)	Percent of HH Income	Percent of HHs Engaged	Avg. Value per HH ($USD)	Percent of HH Income
Wage Labor	72.3	1,557.01	58.0	62.7	1,155.79	43.8	81.7	1,951.54	71.7
Petty CD Production	84.9	850.13	31.7	91.5	990.86	37.5	78.3	711.74	26.1
Remittances	16	180.32	6.7	27.1	336.59	12.7	0.1	26.66	1.0
Crop Sales	37.8	94.94	3.5	42.4	158.68	6.0	33.3	32.26	1.2
Total		**2,682.39**	**100.0**		**2,641.92**	**100.0**		**2,722.19**	**100.0**

Source: Survey data collected by author, 2003

Table 4.3: Land Use, 2002

	Total Sample		Nimasac		Xeul	
	Avg. Size (cuerdas)	Percent of Total	Avg. Size (cuerdas)	Percent of Total	Avg. Size (cuerdas)	Percent of Total
Buildings	0.85	9.2	0.89	8.0	0.81	10.9
Forest	1.93	20.9	2.62	24.2	1.20	16.0
Agriculture	5.90	64.1	6.37	57.9	5.47	73.1
Fallow	0.54	5.8	1.08	9.8	0.00	0.0
Total	**9.24**	**100.0**	**11.00**	**100.0**	**7.48**	**100.0**

Source: Survey data collected by author, 2003

Table 4.4: Arable Land Use, 2002

	Total Sample	Nimasac	Xeul
Median Size (cuerdas)	4.5	4.5	4.5
Percent Allocated to Maize	86.8	77.2	100.0
Percent Allocated to Other Crops	4.9	8.4	0.0
Percent Fallow	8.3	14.4	0.0

Source: Survey data collected by author, 2003

Table 4.5: Maize Production, Consumption, and Marketing, 2002

	All Households	Role in Maize Markets		
		Sellers	Non-Participants	Buyers
Percent of Households	100.0	16.7	30.8	52.5
Maize Consumption per AEU* (lbs/year)	277.9	361	257	285
Arable Landholdings per AEU (*cuerdas*)	1.16	2.88	1.06	0.73
Avg. Size of Arable Landholdings	6.46	15.17	5.62	4.25
Maize Yields (lbs./*cuerda*)	256.7	299.5	266.4	247
Maize Purchased - % of Tot. Consumption	27.6	0.0	0.0	50.7
Maize Sold - % of Total Harvest	17.8	39.0	0.0	0.0
Maize Cultivation - % of Arable Land	86.8	86.0	95.7	80.9
% of Cultivated Maize Consumed w/in HH	82.2	61.0	100.0	100.0

Source: Survey data collected by author, 2003
*AEU = Adult Equivalent Unit

Table 4.6: Arable Landholdings and Household Participation in Maize Markets

Arable Landholdings per AEU	Role in Maize Markets		
	Sellers	**Non-Participants**	**Buyers**
Less than 0.5 cuerdas			
Frequency	0	6	29
Row Percent	0.0%	17.1%	82.9%
Column Percent	0.0%	15.8%	47.5%
0.5 – 0.99 cuerdas			
Frequency	3	13	22
Row Percent	7.9%	34.2%	57.9%
Column Percent	15.8%	34.2%	36.1%
1.0 – 1.49 cuerdas			
Frequency	4	9	2
Row Percent	26.7%	60.0%	13.3%
Column Percent	21.0%	23.7%	3.3%
1.5 cuerdas *or more*			
Frequency	12	10	8
Row Percent	40.0%	33.3%	26.7%
Column Percent	63.2%	26.3%	13.1%

Source: Survey data collected by author, 2003

Table 4.7: Description of Agricultural Workers in Guatemala, 2002

Agricultural Laborers (percent of total)	**Guatemala**	**Totonicapán**	**Cantel**
Household Members	44.5	58.7	51.8
Female Household Members	8.4	17.5	9.9
Hired Workers	55.5	41.3	48.2
Temporary Hired Workers	49.3	39.3	47.1

Source: INE, 2005

Table 4.8: Tasks Performed by Hired Field Hands, 2002

	Total Sample	**Nimasac**	**Xeul**
Percent of Households Hiring Field Hands	53.3	64.4	42.4
Tasks Performed by Hired Field Hands (percent of households)			
Burn Brush	4.2	1.7	6.8
Prepare Land	36.4	50.8	22.0
Sow Maize Seeds	33.9	39.0	28.8
Hilling Dirt around Maize Plants*	31.4	44.1	1.7
Weed	15.3	20.3	10.2
Apply Fertilizer	8.5	8.5	8.5
Harvest Maize	30.5	35.6	25.4
Shell Maize	1.7	1.7	1.7
Select Maize Seed	0.8	1.7	0.0

Source: Survey data collected by author, 2003

* Hilling dirt around the maize plants often entails weeding and applying fertilizer, but the tasks are occasionally performed separately.

CHAPTER 5

PEASANT LIVELIHOOD STRATEGIES: THE COMPLEMENTARITY OF MARKET ACTIVITIES AND *MILPA* AGRICULTURE

5.1 Introduction

In her study of northwestern Guatemala's regional economy, Carol Smith (1989) observed that the archetypical self-sufficient peasant is far more often the exception than the norm in the country's highlands. Due to insufficient landholdings, most are reliant upon some form of market income. Like rural households throughout Latin America (Reardon and German Escobar, 2001; de Janvry and Sadoulet, 2001; Deere, 2005), Guatemalan *campesinos* obtain income from a variety of non-farm endeavors (Botello, 2004; Chiriboga *et al*., 1996). Indeed, as Anthony Bebbington (1999) convincingly argues, *rural* livelihoods should not be conflated with *agrarian* livelihoods. People frequently reside in rural areas and incorporate non-agricultural activities into their livelihood strategies. A recent report from the United Nations, for instance, determined that 41% of adults residing in rural Guatemala are employed in non-agricultural activities (*c.f.* Botello, 2004).[1] The highland communities of Nimasac and Xeul epitomize this trend.

As discussed in the previous chapter, the cultivation of *milpa* is nearly universal among households in Nimasac and Xeul. All of the households with arable land cultivate maize for household consumption. Despite its widespread cultivation, however, the practice of maize agriculture is not usually in and of itself a sufficient livelihood strategy.

[1] More than two-thirds of rural Guatemalan women participate in non-market activities, more than double the rate for their male counterparts (Botello, 2004).

Most households do not control enough land to be truly self-sufficient. Only one of the 119 households included in my survey based its livelihood entirely upon its agricultural production. The majority of households (53%) did not even control enough land to fulfill their own maize consumption needs, let alone sell a surplus to purchase additional consumption goods. To supplement their insufficient agricultural returns, nearly all households (99.2%) engage in non-agricultural income-generating activities.

The peasants of Nimasac and Xeul compose their livelihoods in a variety of ways. In this chapter, I explore the ways in which rural households combine subsistence-oriented *milpa* agriculture with four types of market activities: (1) wage labor in the regional labor market; (2) petty commodity production; (3) the cultivation of commercial crops; and (4) wage employment outside of Guatemala as transnational migrant workers. In particular, I am concerned with the ways in which peasants conceptualize the different forms of economic provisioning. Do they, for instance, value their subsistence production in the way that many economists do, viz. according to the implicit market value of the crops? Or do they conceptualize *milpa* and market activities as distinct types of economic provisioning, each realm generating similar but different forms of benefits? In other words, do they view the market and *milpa* as substitutable or complementary activities? These are not merely questions of curiosity, as the relative values placed upon market activities and *milpa* agriculture in peasants' livelihood strategies carry important implications for development strategy and the on-farm conservation of crop genetic resources in the Guatemalan center of "megadiversity."

To address the substitutability/complementarity of market activities and *milpa* agriculture, I draw upon qualitative and quantitative observations from my fieldwork in Nimasac and Xeul. I find that market activities are just as prevalent as *milpa* agriculture in the communities and that they are a fundamental component of rural households' livelihood strategies. Peasants do not necessarily value one form of economic provisioning over the other. Rather they conceptualize the market and the *milpa* as playing important but distinct roles in their rural livelihoods. In other words, they are complements. Although the *milpa* generates food, security, and important cultural entailments, its returns are insufficient to sustain most families. Meanwhile, market activities represent lucrative opportunities for improving economic well-being, but they are also insecure and devoid of the socio-cultural meaning imbued in *milpa*. Peasants combine market activities and *milpa* agriculture so as to compose the most economically fulfilling and culturally meaningful livelihoods possible.

5.2 Diversified Livelihood Strategies

Table 5.1 describes the prevalence of six major forms of economic provisioning and the monetary value of their contributions to economic well-being in Nimasac and Xeul. The six activities considered are *milpa* agriculture, wage labor, petty commodity production, crop sales, returns from livestock and poultry, and remittances from transnational migrant laborers.[2] Following a common practice in economic analysis, I have calculated the monetary value of agricultural output consumed within the household

[2] This is certainly not an exclusive listing of all forms of economic activity in the Guatemalan highlands. Nor is it intended to be an inventory of the most important forms of economic provisioning. This taxonomy does not account for childcare, food preparation, and other duties that are typically performed within the household. I did not address the relationship between market activities and non-agricultural forms of domestic provisioning during my research.

– here categorized as "*milpa*" – according the price of the crops in local markets. Although it fails to include other important forms of economic provisioning (e.g. food preparation, child care, chopping firewood, etc.), total household production is here understood as the sum of income earned for the four market activities and the implicit market value of crops consumed within the household. The annual returns from livestock and poultry are calculated as 10% of the animals' market value.

Three forms of economic provisioning are particularly common. As previously observed, nearly all households engage in subsistence-oriented *milpa* agriculture. Moreover, 85% of the households surveyed engage in petty commodity production, and nearly three-quarters earn income by selling their labor power in the regional labor market. Though less common, significant proportions of households also earn income from remittances and agricultural sales.

As indicated in Table 5.2, diversified livelihood strategies are widespread. Nearly all of the sample households are engaged in multiple economic activities; less than 2% of the families in the survey earn income from just a single source. In fact, the typical household is engaged in at least three different types of economic activity; one-third of the households obtain income from four or more of the identified activities.

The extent to which peasant households are dependent upon market income appears to be related to the quantity of arable land that they control. Table 5.3 shows the contributions of market activities to the total household production of five quintile groups, arranged according to the size of their arable landholdings. Not surprisingly, the 20% of households that control the least amount of land are the most dependent upon off-farm sources of income. Combined, these households earn only 1.4% of their income on the farm. This is in marked contrast to the 20% of households with the largest landholdings, who cultivate 18% of their total household income on the farm. Though not shown on the table, the 10% of households with the largest arable landholdings produce more than a quarter of their total household production on the farm. In general, the size of a household's arable landholdings is inversely related to the share of income that it generates from off-farm activities (Pearson r = -0.49).[3] Based on these statistics, one cannot necessarily rule-out the Leninist thesis of peasant socio-economic differentiation, which posits that capitalist development in rural areas will allow a small number of peasant households to expand their landholdings at the expense of an expanding land-poor rural proletariat. But, as will be discussed below, Lenin's prediction is dubious.

5.3 Subsidizing *Milpa* Agriculture with Market Income

Given the prevalence of diversified livelihood strategies in Nimasac and Xeul, one should not expect the market value of *milpa* agriculture to be an especially dominant contributor to household production. Indeed, it is not. Among the five broad categories of economic activity, agricultural production that is consumed within the household only accounts for some 8.5% of the value of net household production in the two communities (see Table 5.1).[4] The contribution of agricultural activities to household income is

[3] With a t-statistic of –6.161, the correlation coefficient is statistically significant at the 0.0001 level.

[4] Even when combined with agricultural sales, agricultural production accounts for less than 10% of net household production in the two highland communities. This is significant drop from 1974, when agricultural production accounted for more than three-quarters of family income in rural Guatemala (Deere and Wasserstrom, 1981).

significantly constrained by the scarcity of arable land in the highlands. Excluding one notable outlier, the average family in the highland communities controls less than six *cuerdas* (or 0.67 ha) of arable land. Given that it is possible to successfully cultivate a *cuerda* of maize with seven full days of labor, the average family would only need to allocate some 42 days of labor to maize agriculture in order to produce an acceptable harvest in a given year. Additional time in the fields allows peasants to attend to other *milpa* crops and to improve maize yields. Nonetheless, most families have a "surplus of labor" in the sense that they do not own sufficient landholdings to provide all of their adult family members with full-time employment in the cultivation of *milpa*. Moreover, since few families own enough land to be entirely self-sufficient in agriculture, most households require some form of non-farm income in order to purchase their necessary consumption goods.

Of particular interest are the ways in which families combine these multiple activities. Do they prioritize one type of activity over another? If so, which activities are prioritized and why? What are the different types of values generated by various economic activities? Why is it that *milpa* agriculture is the most pervasive economic strategy even though it is the least lucrative?

I contend that peasant families in the Guatemalan highlands distinguish the rewards of *milpa* agriculture from the income earned in market-oriented activities. Whereas the income that is earned in the market helps to compensate for insufficient returns in the *milpa*, the practice of making *milpa* should not be reduced to the market value of the output. *Milpa* agriculture generates many entailments that cannot be reduced to a market price. This section is oriented towards showing how families are eager to engage in market activities, but how they also place boundaries on the market so that it does not preclude the cultivation of *milpa*.

5.3.1 Wage Labor

Although wage labor provides the bulk of their monetary incomes, peasants in the Guatemalan highlands do not necessarily prioritize wage employment over *milpa* agriculture. In general, peasants do not allow their participation in the labor market to supplant their self-provisioning of food crops. The income that rural families earn in the labor market is rarely viewed as a substitute for the agricultural output that is produced with household resources; it is more adequately described as a complement. Thus, even though households engage in the labor market, they utilize a variety of strategies that allow them to continue cultivating *milpa* for household consumption.

The contribution of non-farm employment to rural livelihoods is extremely important. Not only does wage income account for the majority of net household production, it is also one of the more remunerative opportunities available to the peasant population. As illustrated in Table 5.1, income from wage labor accounts for 69% of net household production in Xeul, and more than a third of net household production in

Nimasac.[5] In general, total returns from non-farm employment are more than six times the market value of agricultural output that is consumed within the household. Moreover, at $4.99 (USD) per day, the average returns from a day of wage labor are 39% greater than the $3.59 (USD) of value that is produced during the average day of maize farming (see Table 5.4).

Given the higher returns from wage labor, the theory of economic "rationality" would suggest that peasants should prioritize non-farm employment over *milpa* agriculture. This, however, is not what they do. Despite the relatively higher returns of wage labor, over 60% of the households whose family members held jobs maintained that the two activities were equally beneficial to their family's welfare. Moreover, all but three of the 86 families who reported income from non-farm employment also grew maize; none of the three households that do not grow maize control any arable land.[6] Expressing a sentiment that is shared by much of the rural population, a peasant from Xeul maintains that, "Without maize, one cannot eat. But one cannot eat without work either." The income from wage labor is an extremely important component of *campesino* livelihoods. At the same time, however, peasants typically are reluctant to participate in the labor market if their participation would not permit sufficient time to attend to their

[5] Among the 119 households surveyed in the highland communities of Nimasac and Xeul, nearly three quarters reported income from non-farm employment. The pervasiveness of wage labor in these communities is significantly higher than the national average. According to the 2003 national agrarian census, less than one-quarter of the respondents reported having non-farm employment (INE, 2004: 15). The discrepancy is due, in part, to different objects of measurement – the national survey reported wage employment for individual respondent while the statistics for Nimasac and Xeul account for employment at the household level. Nonetheless, it is obvious that a greater proportion of farmers from the highlands engage in wage labor than in rural Guatemala as a whole. At 57% and 52%, the respective rates for off-farm employment reported in the national census are much higher in the Totonicapán and Cantel than the national rate of 21% (INE, 2004).

[6] Two of the three were elderly households who had given their land to the children. The third was a recently married couple of 19 year-olds.

milpa plots. If non-farm employment does impede their ability to work in the *milpa*, peasants utilize various techniques such as hiring agricultural day laborers and squeezing-in some of their agricultural duties before work and during their limited time off. In general, peasants in Nimasac and Xeul do not substitute wage labor for the practice of making *milpa*. Instead, they persist in their self-provisioning of staple food crops while using their income from non-farm employment to purchase additional maize and consumption goods that supplement their insufficient level of agricultural output.

The pursuit of flexible employment is one of the more common strategies that peasants exercise in order to complement agricultural production with a monetary income. Many working peasants express a preference for jobs that permit them a leave of absence in order to perform essential tasks in the *milpa*, especially tasks like planting and harvesting that should be performed at specific times of the agricultural cycle. Some wage laborers must request the time off. Others – specifically those working for small-scale employers in the region – are automatically granted vacation time when key tasks should be performed in the *milpa*. Even those who hire-out their labor as field hands reserve days to perform essential duties in their own *milpas* (which, as a result of a common agricultural calendar, also happen to be when their services are in greatest demand).

Although many employers allow their workers to take time off to work in their *milpa* plots, some of the more prominent employers in the region are not as accommodating. Enterprises that produce goods and services that are consumed *outside* of the local rural economy (*e.g.* western style clothing, house-cleaning and janitorial services in urban areas, security, work with the national government) do not generally permit their workers to take time off so that they can attend to their agricultural duties. In contrast, small-scale employers who produce traditional weavings, shoes, construction and other goods that are exchanged in the local economy are usually more willing to grant of leave of absence for their employees who farm. Employment with the former category of employers tends to be more consistent and reliable, but peasants express a preference for more flexible jobs. For example, three randomly selected informants from Xeul complained about the working conditions at "*La Fábrica*," maintaining that their jobs were inflexible and interfered with their agricultural responsibilities. Given that the managers of the textile mill are more concerned about fulfilling their contracts with foreign importers than local maize production, this is not surprising. Nonetheless, the peasants did not share their managers' values; all of them had left their jobs at "*La Fábrica*" in recent years and found alternative income-generating activities with more flexible schedules. These and other anecdotal stories suggest that peasants who engage in wage employment prefer jobs that do not interfere with their ability to cultivate *milpa*.

Of course, not all Guatemala's rural households are able to find off-farm employment that permits them to fulfill their agricultural duties in the *milpa*. Moreover, at 8% there is small but significant portion of wage workers (a group that is disproportionately female) who do not work on their families' farms. Among those who do work in the *milpa*, 36% report that their participation in the labor market impeded their ability to fulfill their agricultural responsibilities. Nonetheless, all of the households with members who reported that their jobs impeded their ability to perform their agricultural duties managed to grow *milpa*; less then 10% of them left a portion of their land fallow.

Peasants whose participation in the labor market impedes their ability to cultivate *milpa* have found several ways to overcome the constraints placed on them by their jobs. Many of them simply find a way to squeeze in more time on the farm. They perform agricultural tasks early in the morning before their work day begins, in the evening once they've returned home, or during their limited days off (most work 5 ½ days per week). As Amartya Sen (1975) has noted, this is a common practice of peasants throughout the world and thus, he maintains, wage employment is not necessarily in opposition to subsistence-oriented agriculture. Nonetheless, several peasants reported that their jobs did not provide them with enough "spare hours" to properly maintain their *milpa*. For some households, participation in the labor market means forgoing certain agricultural tasks. The families plant *milpa*, but do not perform less essential duties such as weeding, applying fertilizer, and possibly even mounding dirt around the plants so that they are less likely to lodge in the wind. Their failure to perform these tasks obviously results in lower yields; the *campesinos* are well aware of this. But they also understand that maize is a remarkably resilient plant that is able to withstand such neglect (Annis, 1987; Warman, 2003); they do the best that they can with the time constraints that are placed upon them by their wage employment.

Despite the *milpa*'s ability to withstand neglect, its propagation still requires farmers to perform essential tasks such as preparing the land and planting at the proper times during the agricultural calendar. Rather than forgo cultivating maize entirely, working peasants with inflexible schedules often hire *mozos* to cultivate their *milpa* for them. Among the households with members whose labor market participation had impeded their ability to work in the *milpa*, 60% had hired agricultural laborers known as *mozos* to perform certain *milpa* tasks. The hiring of *mozos* was especially prevalent for essential duties: nearly two-thirds of the households reported hiring *mozos* to sow the seeds (a task that is normally performed in mid March); and more than half had hired *mozos* to prepare the land (in late January), to mound dirt around the plants (in June and July), and to harvest the maize (in mid November). It is not as common to hire *mozos* to perform less time-specific tasks like weeding and applying fertilizer, since it is possible to spread such duties out over a longer period of time and it is easier to squeeze them in during "spare time" away from work.

As will be discussed below, it is not economically "rational" to hire *mozos* to cultivate *milpa*. Measured in monetary units, the average value produced by a day of working in the *milpa* is 24% less than the standard daily wage for the agricultural workers. Moreover, most of the wage workers who hire *mozos* earn a daily wage that is less than or equal to the $4.48 that is typically paid for a day of agricultural help.[7] The common practice of hiring *mozos* to cultivate *milpa*, even when it would be more economical to purchase food in the market, is yet another indication subsistence-oriented agriculture generates benefits beyond the market value of the crops.

[7] 46% earn more than *mozos*; 46% earn less than *mozos*; the remaining 8% earn the same wage as *mozos*. These figures do not account for the fact that most *mozos* are provided lunch when they work, while other wage employees do not usually receive this benefit.

5.3.2 Petty Commodity Production

The in-home production of commodities that can be exchanged in the marketplace is widespread in the Guatemalan highlands. Some 85% of the households surveyed in Nimasac and Xeul produced non-agricultural commodities in their homes in 2002, making this the most prevalent method of generating monetary income (see Table 5.1). However, given the low returns from certain forms of in-home commodity production and their frequent status as part-time endeavors, its overall contribution total to household income was disproportionately smaller. In relation to the five broad categories of economic activity examined in this chapter, petty commodity production accounted for 29% of net household production, second only to non-farm income as a source of monetary income. More than half of the households surveyed earn 20% or more of their total household income from the sale of artisanal goods; one-third of the households earn 50% or more of their income from the activity.

Table 5.5 lists the prevalent forms of petty commodity in Nimasac and Xeul and their contributions to total household production. With 40% of households earning income from the activity, the most common form of petty commodity production is "making *amarradores*," which is the practice of wrapping the thread that is dyed and then woven into traditional Mayan skirts. Weaving traditional skirts, sewing western-style clothing, making shoes, embroidery, and small-scale retailing are other common forms of artisanal production.

Petty commodity production is decidedly gendered. Consider, for instance, the two most common forms of artisanal production: *ammaradores* and woven skirts. As shown in Table 5.4, making *amarradores* is an exclusively female task.[8] Meanwhile, weaving the thread from the *amarradores* into the cuts of fabric that are used as skirts is an exclusively male occupation. The difference in the returns from these activities is striking. A day of making *amarradores* earns the equivalent of $1.56 (US) while the male task of weaving earns $5.52 (US) per day, a return that is 250% greater.[9] Though less dramatic, the in-home commodities that are typically produced by men (*e.g.* textiles and shoes) consistently earn higher returns than the commodities that are produced by women (*e.g.* embroidery by hand and by machine).

One of the most desirable qualities of petty commodity production is the flexibility that it provides its producers. Although several types of in-home commodity production might best be described as "cottage industries" where buyers provide the raw materials and expect the peasants to produce a given level of output, most producers of artisanal goods still have a large degree of control over their working hours. For women, the part-time making of *ammaradores* and embroidery provides them with an opportunity to earn income even as they attend to their traditional domestic duties like childcare and food preparation.[10] For men, the flexibility of in-home commodity production is often lauded for the opportunity that it provides them to attend to their *milpa*. Several male informants who had previously participated in the labor market told me about how the

[8] It is only practiced by women, but it is practiced by women of all ages, from girls as young as eleven years-old to elderly women in their seventies.

[9] The varying returns might be attributable to different capital requirements. Weaving requires a loom that costs some $330 (US), while amarradores requires little capital investment. Nonetheless, it is highly likely that the varying returns are also attributable to a devaluing of female labor.

[10] "For me, they're both important," one woman explained about *milpa* and *amarradores*. "For instance I can go to the mountain and work in the *milpa* in the morning. Then I can come home and make *amarradores*. I can eat the maize, but if I do not do *amarradores*, I cannot buy coffee. The *amarradores* allow me to earn money."

inflexibility of their jobs had led them to purchase weaving looms so that they could more easily attend to their agricultural duties.

Although artisans frequently mention flexibility to work in their *milpas* as one of the principal benefits of their work, many of the households who generate income from petty commodity production utilize hired field hands to perform agricultural tasks. Among the households earning at least half of their income from non-agricultural commodity production, 45% rely upon hired labor to perform at least some of their agricultural tasks.[11] While artisans are less likely to employ field hands than the typical household (see Table 4.8 from the previous chapter), *mozos* still perform a significant portion of their agricultural labor. Like the households dependent upon income from wage labor, petty commodity producers typically hire field hands to perform essential duties in the *milpa* like preparing the land, planting, and harvesting. They are less dependent upon hired labor to perform non-essential tasks like weeding, applying fertilizer, and mounding dirt around the maize stalks.

Given that one of the supposed benefits of petty commodity production is the flexibility that it provides peasants to attend to their *milpas*, an obvious question that emerges is why so many artisans employ hired labor to perform agricultural tasks. One obvious explanation that emerged during my field research is that the returns from certain forms of in-home commodity production (*e.g*. shoe-making, weaving, textiles production) have returns that are significantly greater than the costs of hiring *mozos*. As a man who produced textiles from his home explained, "If I were to work in my *milpa* I

[11] 51% of the households earning 20% or more of their income from in-home commodity production had employed field hands in 2002. Among the households earning any income from petty commodity production, 54% had hired agricultural laborers.

would lose 45 *quetzales* ($5.77), but if I hire a *mozo* I only have to pay 35 *quetzales* ($4.49). So, for me, it's better to work here in my home and to hire *mozos* to work in the *milpa*." A shoemaker from Nimasac provided a similar explanation for hiring the labor power of agricultural workers, noting that, "Everyone has their job. My job is to make shoes where I can earn more money."

The prevalent use of *mozos* among the artisanal households is, in some respects, a testament to the enduring importance of growing *milpa*. Other than two households who do not control arable land, all of the households earning 50% or more of their total income from petty commodity production cultivate *milpa*; combined, they grew maize on 96% of their arable land. Moreover, it is important to note that the majority of these households take time away from lucrative commodity production in order to attend to their *milpa*. For example, one successful shoemaker in Nimasac forewent $287 (US) in returns so that he could cultivate $164 (US) worth of maize. As he explained it, "This is one of the benefits of my job, that I can take-off time to work in the *milpa*." Only a small fraction of the petty commodity producers (16%) had hired *mozos* to perform all of their tasks in the *milpa*.

The fact that rural residents hire others to attend to their food crops does not mean that they place more or less priority on petty commodity production than the cultivation of *milpa*. But it does suggest that both activities are valued components in the overall livelihood strategies of rural Guatemalans. For most, the returns from artisanal production are used to *complement* – or subsidize – *milpa* production, not displace it. For example, several artisans mentioned that the returns from their sales had allowed them to purchase more land and, thereby, *expand* their agricultural production.[12] Some peasants prefer petty commodity production for the flexibility that it gives them to work in their *milpas*, while others commend it for the relatively high returns that allow them to hire *mozos* to cultivate their food crops for them.[13] Whatever the case, nearly all peasant households have devised strategies that allow them to continue cultivating *milpa* even as they allocate significant household resources to the production of non-agricultural commodities.

5.3.3 Transnational Migration and Remittances

As discussed in the previous chapter, transnational migration is one of the most rapidly expanding livelihood strategies in rural Guatemala. The practice has grown especially quickly in Nimasac, where 45% of households have a family member living abroad, and more than one-quarter receive remittances. There is considerably less transnational migration in Xeul, where the practice is still a novelty: only 10% of households had a family member living abroad and only one of the 60 households surveyed had received remittances.[14] Nonetheless, the male residents of Xeul are

[12] Several of these informants noted that they had been able to purchase more landholdings by hiring *mozos* at a wage rate that was lower than their returns from commodity production. This, of course, is reminiscent of the Leninist theory of the social differentiation of the peasantry: the wealthier peasants employ the poorer peasants at low wages and thereby accumulate more land at the expense of poorer peasants. The slight variation is that the field hands do not produce any surplus value since the $3.59 worth of maize that is produced by the typical day of working in the *milpa* is less than the $4.49 (plus lunch) that is typically earned by *mozos*. Nonetheless, the higher wages of the wealthier peasants are largely attributable to their ownership of capital such as shoe-making equipment, weaving looms, and sewing machines.

[13] It would, however, be cheaper to purchase maize in the market. It costs about $12.82 to have a *mozo* cultivate a *quintal* of maize, while a *quintal* of maize in the market only costs $10.25.

[14] The differences in participation rates is largely due to social networking: if peasants living in Guatemala have a friend or family member already living in the United States, it is much easier for them to obtain (false) papers and find a job and a place to live. Many informants from Xeul mentioned that they would like to work abroad, but they did not know where they would go or how they would find work.

intrigued by the possibility of earning "*mucho dólar*" in the United States and it is quite possible transnational migration will become more prevalent in the village.

Most transnational migrants are young males in their 20s or 30s. Given that these are often the same family members who are responsible for attending to the family *milpa*, one might expect that many households receiving remittances would abandon the cultivation of maize and simply purchase the grain in the market. This, however, is not the case. All of the households with a family member living abroad have continued to cultivate *milpa*. Moreover, the income earned abroad has allowed many returning migrants to purchase more land and thereby expand their agricultural production. Thus, rather than replacing the self-provisioning of food crops, the remittances from transnational migration have helped to fortify the practice.

To be sure, most rural migrants do not seek foreign employment for the sole reason of expanding *milpa* agriculture. In fact, many households – about 12% – sell plots of land in order to finance their journey, thereby diminishing their ability to engage in subsistence cultivation. Nonetheless, the standard practice for migrants is to work abroad for 2 – 5 years and earn an income that will allow them to return to their communities and re-establish more or less "traditional" livelihoods that always entail *milpa* agriculture. For most migrant workers, the principal objective is to expand consumption opportunities and to build larger and better homes. In other words, they look to transnational migration as a means of improving their material living conditions. But, the windfall returns that most peasants earn while working abroad is also what allows them to maintain their more traditional livelihood strategies. As a Mayan priest who was familiar with several communities in Totonicapán explained:

> In villages like Buenabaj there isn't much migration. As a result, the people there have to find different ways to earn money. They grow tomatoes… Or they find other alternatives. But, the people in the area of San Bartolo mostly practice traditional agriculture. They grow *milpa*. *Remittances from the States allow them to do this*. [Emphasis added.]

Rather than replacing *milpa* agriculture, remittances and other income earned while working abroad are thus employed in ways that help to maintain its conditions of existence. While they are away, migrants send remittances that enable their families to continue cultivating maize and other crops for household consumption. All of the families receiving remittances had continued to grow *milpa* in the absence of a family member; combined they grew maize on 92% of their arable land. For some households, the income from remittances means that certain household members are able to allocate their time to cultivating *milpa* instead of pursuing other income-generating activities. But for most households, particularly those where the husband or male sons are absent, remittances enable the household to hire *mozos* to farm the family's agricultural plots. Among the families receiving remittances, three-quarters hired agricultural day laborers to attend to at least some agricultural tasks; one-third had hired *mozos* to complete all of their agricultural responsibilities. This stands in marked contrast to the overall sample: only half of the households hired *mozos* and 16% utilized the laborers to complete all of their farming duties. In general, households receiving remittances tend to substitute hired labor for family labor. They do not, however, substitute maize grown on family land with maize purchased in the market.

In addition to generating remittances that allow households with absent family members to continue cultivating maize, the income earned from employment abroad continues to subsidize *milpa* agriculture once migrants return to their home communities. Many returning peasants purchase capital goods like weaving looms and sewing machines that allow them to earn a relatively high income and provide them with the flexibility to either work in the *milpa* themselves or to hire *mozos* to work the land for them. Returnees also use their newly acquired wealth to purchase land. Some households are simply purchasing land to recoup plots that they sold to finance their members' migration. Other families view migration as an accumulation strategy, as a means for augmenting their landholdings. As one recent returnee explained, "It's not possible to build a house or to buy more land unless one migrates." Another migrant was using his income to pay for some 3.5 hectares of land that he had purchased on Guatemala's southern coast through the national government's land reform program. Whether they purchased their land inside the immediate community or beyond it, all migrants use their new landholdings to expand their cultivation of maize.

5.3.4 Commercial Agriculture

As discussed in the previous chapter, commercial agriculture has been encouraged in Nimasac for two decades. Given the scarcity of land in the village, the adoption of cash crops necessarily translates into less land allocated to *milpa* agriculture. This section ponders the ways in which farmers combine cash cropping with *milpa* agriculture in their livelihood strategies and explores the possibility that farmers might substitute the income earned from agricultural sales for maize and other crops that are grown for direct household consumption.

Table 5.6 lists the prevalence and marketing characteristics for the crops (excluding fruit trees) cultivated in Nimasac and Xeul. The crops are listed in decreasing order of occurrence. Not surprisingly, the ten most widely grown crops are typical *milpa* crops, including maize, different species of legumes and squash, and a leafy green known as *nabo culix* that is a favorite in hearty soups. As *milpa*, most of these crops are consumed within the household; usually only the surplus that exceeds household consumption needs is sold in the market.

While the ten most widely grown crops are primarily destined for household consumption, the remaining crops can be described as "cash crops." For this chapter, cash crops are defined as crops where half of the households that grow the crop sell a portion of it in the marketplace *and* at least at least half of the total output for the crop is sold. In other words, the crops are grown foremost as agricultural commodities. None of the thus defined cash crops are grown by more than 5% of the sampled households. Given the relatively small proportion of households cultivating cash crops, it is obvious that commercial agriculture has not made a significant dent into *milpa* farming in the communities.

Cash cropping is constrained, in part, by the limited acreage of irrigated land in the highlands. As shown in Table 5.7, only a small fraction of farms and agricultural land is irrigated in Totonicapán and Cantel. Table 5.8 demonstrates the importance of irrigation to commercial agriculture. Among the 20 commercial crops identified, 14 are grown entirely on irrigated land, while only three of the crops were entirely rainfed. Thus, while irrigation is not the only requisite, it plays an undeniably important role in determining the extent of commercial agriculture. The question, then, is whether the farmers who have access to irrigation prefer cash cropping over making *milpa*.

Among the 22 households who had received irrigation through the cash cropping initiatives in Nimasac, four were included in the random household survey. Another two were observed during participant observation. With the exception of one of the farmers, "José," all of the commercial farmers included in my study place *milpa* agriculture in high esteem. Among those surveyed, all but José indicated that *milpa* agriculture was "very important to their family's food security."[15] They consumed slightly more maize than the average household and grew a sufficient quantity to fulfill all of their households' consumption needs. In short, cultivating cash crops had not reduced their reliance upon *milpa* agriculture.

Most of the farmers who cultivate cash crops tend to view market and *milpa* agriculture as distinct forms of economic provisioning. When I asked one commercial farmer why he did not grow cash crops on all of his land, he responded, "I grow vegetables to earn money. The *milpa* is for eating." With the exception of José, the

[15]Having received training from a variety of institutions, José was the original commercial farmer in Nimasac. He was the first to have a greenhouse in the village and the only farmer to have it built for free (compliments of the federal government). He was president of *Nuevo Sembrador* (the group of commercial farmers mentioned in the previous chapter) and has worked for several years as an extension agent, promoting cash cropping and greenhouses throughout Totonicapán. When the aid agencies – along with their money – left Nimasac and most of the greenhouses were torn to shreds by the highland winds, many farmers in the village abandoned their greenhouses. Some even converted the land back to *milpa*. But José appealed to his brother who was working abroad in the United States. With his brother's help, José was the only farmer to rebuild his greenhouse. Having left a significant plot of land in Alaska (the mountaintop) fallow, while purchasing the majority of his family's maize, José has definitely prioritized the market over the *milpa*. As mentioned, however, he is an exception.

farmers do not substitute cash-cropping for *milpa*, rather they employ it as a strategy to earn an income that complements their subsistence production.

Even though farmers may currently conceptualize different roles for milpa farming and commercial agriculture, a note of caution is in order. The cash cropping of most farmers is constrained by the amount of land that they have irrigated. There is no guarantee that if given an opportunity to irrigate a greater share of their land, farmers would not shift land out of milpa and into commercial agriculture. Given most peasants' experience, however, expanded irrigation would have to be accompanied with higher prices for products and/or lower input costs as well as some form of crop insurance to insulate farmers from the environmental and market uncertainties of commercial agriculture. With no counterfactual, it is indeed plausible that expanded irrigation combined with institutional changes in the markets for agricultural commodities could result in the displacement of *milpa* agriculture in Nimasac and Xeul.

5.4 Testing the Complementarity of Market and *Milpa*

Rather than supplanting *milpa*, I have argued that most market forms of income generation tend to complement the subsistence-oriented agricultural practice. The peasants of Nimasac and Xeul view the market and the *milpa* as two distinct forms of economic provisioning. The *milpa* secures the foundation of the rural Guatemalan diet while market activities provide the income to supplement any shortfalls in maize and beans and to purchase other consumption necessities.

Correlation coefficients provide a relatively straightforward approach for testing the hypothesis that *milpa* and market activities are complementary. Table 5.9 shows the

Pearson correlation coefficients for the four forms of market provisioning considered in this chapter and three different measures for the importance of subsistence-oriented agriculture to livelihood strategies. As hypothesized, participation in different market activities does not appear to displace *milpa* agriculture. The only strong negative correlation is between the proportion of land allocated to maize and the value of agricultural output sold per unit of land.

As would be expected, the share of land dedicated to maize is negatively correlated with the value of agricultural sales per unit of land. Most maize is consumed within the household and it, along with all of the crops that typically accompany it in the *milpa*, command relatively low prices in the market. Commercial agriculture necessarily requires that land be reallocated from milpa crops to cash crops that fetch a notably higher price in the marketplace. Cash cropping reduces the amount of land dedicated to *milpa* agriculture. Nonetheless, the income from commercial agriculture is not correlated with the consumption of maize and other *milpa* crops. Thus, even though cash cropping decreases the proportion of land allocated to *milpa*, it does not undermine the importance of subsistence-oriented agriculture in peasants' livelihood strategies.

5.5 Why Cultivate *Milpa*?

As the discussion thus far suggests, rural livelihood strategies in the Guatemalan highlands are a complex mosaic of economic activities. Households earn income from several different forms of market engagement—from wage labor to petty commodity production and from the cultivation of cash crops to transnational migration. Regardless of how they combine these various forms of market engagement, rural households are reluctant to become fully integrated into the market economy. Even as they embrace the market, nearly every peasant family retains some resources for the cultivation of *milpa*. An obvious question that emerges is why. The cultivation of *milpa* entails a significant opportunity cost: most maize farmers could earn greater returns from their land by cultivating cash crops (von Braun et al., 1989; Annis, 1987) and, as shown in Table 5.4, greater returns to their labor by engaging in full-time wage employment or petty commodity production. Moreover, many *campesinos* use the income that they earn from market activities to subsidize agricultural production: they hire *mozos* when it would be more affordable to simply purchase their food crops in the market or they allocate income to purchase arable land so that they can expand their cultivation of maize. Generally, the income that peasants earn from market activities tends to complement *milpa* agriculture, allowing them maintain its cultivation despite low returns that are often insufficient to sustain all family members.

The widespread practice of cultivating *milpa* at an economic loss (either explicit or implicit) has long frustrated policy-makers and baffled development experts in Guatemala. As early as the 1950s the World Bank cautioned that *milpa* agriculture in the highlands "remains the central problem in Guatemalan agriculture" (IDRB, 1951: 29); in the 1960s development experts advised Guatemalan policy-makers to shift, "the agricultural production goal orientation of farmers to that of a market orientation" (*sic.*) (Beal *et al*., 1967: 3). The anti-*milpa* bias is still prevalent. As an administrator for the Ministry of Agriculture explained:

> Maize isn't profitable. We try to discourage its cultivation. We want the *campesinos* to diversify. We want them to switch to the cultivation of crops like tomatoes, avocados, and potatoes, crops that are more profitable to grow.[16]

The government's frustration with maize farmers was shared by non-governmental organizations operating in the region. For example, one foreign NGO whose purported objective was to improve food security in the highlands tried to implement a micro-credit program in the department of Totonicapán. However, farmers only wanted to borrow so that they could expand their production of *milpa*. Frustrated, the NGO's director complained that they would never be able to repay their loans by growing maize and abandoned the project.

The development experts are correct, growing maize is not profitable. Peasants are well aware of this. There is a common refrain, "*No hay ganancia en sembrar la milpa*," it's not profitable to grow maize. Several farmers provided detailed descriptions of the costs and benefits of cultivating *milpa*. The analysis varied from farmer to farmer, as households used different combinations of factor inputs, cultivated different crops and varieties of a given crop, and, as a result, achieved varying yields. When monetary values were assigned to the costs and benefits, most farmers broke even: the monetary costs were approximately equal to the monetary benefits. Some farmers who relied upon hired labor incurred losses (some of them quite substantial), and none incurred significant gains. After each analysis, I would ask the farmers why they grew maize. Many struggled for an answer. Indeed, when measured by the criteria of market prices,

[16] Personal interview, Guatemala City, February 2003.

cultivating *milpa* is irrational; it would be more profitable to allocate resources to market production and simply purchase food in the market. I soon realized that the context of my question was inappropriate: in my attempt to quantify the value of *milpa* with a market price, I was mistaking measurement for meaning. While the market value of the maize and other crops is certainly an important value produced by cultivating *milpa*, it is only one of many. The practice generates multiple types of values, but only one of these – the use value of the food to be consumed – can be adequately measured in monetary units.

5.5.1 The Pleasure of Cultivating *Milpa*

An obvious reason for cultivating *milpa* is the enjoyment that it offers. Like gardeners throughout the world, the peasants of Nimasac and Xeul take pleasure in working the land, watching their crops grow, and seeing the fruits of their labor at harvest time. They take satisfaction in knowing that their tortillas and tamales were produced by the sweat of their own brow. Many *milpa* tasks such as planting and harvesting are family activities and oftentimes accompanied by picnic lunches. "I like harvesting maize with my family," a peasant/artisan from Nimasac told me. "I get tired making shoes inside every day; this gives me a chance to be outside and breath the fresh air." Like the shoemaker, many peasants do not evaluate the decision to cultivate *milpa* in strictly monetary terms. The joys of family, fresh air, and fulfillment are non-pecuniary and outside the realms of market logic.

5.5.2 The *Milpa* as a Guarantee of Sustenance

The practice of making *milpa* is the foundation of food security in Nimasac and Xeul. Nearly all (99%) of the households surveyed maintained that the practice was important to their family's food security; two-thirds reported that the practice was very important. *Milpa's* contribution to the peasantry's food security represents much more than the calories it generates. It also provides a near *guarantee* that a family's basic sustenance needs will be met. Farmers are well aware of the potential to increase their returns from alternative economic activities. But doing so comes at a risk, the market is unstable. Cultivating *milpa*, in contrast, is a near certain guarantee that a family will not starve. Farmers repeatedly acknowledged the important role that *milpa* played in guaranteeing their family's sustenance:

> "*Milpa* is very important to us. It means security. If we don't have money, we can't buy maize. With *milpa*, it is certain that we will always have maize. It's a part of our lives. It's security for us indigenous people. My people have a secure future if we grow our own maize."

> "By growing maize, we are protecting ourselves. If I were to become ill, for instance, I would not be able to work and we would not be able to buy maize. We would go hungry. But if we have maize stored, we won't suffer."

> "It's not profitable to grow maize. But, no matter what, we are going to survive. It's not the same when you buy."

> "Maize could become scarce, like it did before (imported maize from the southern coast was widely available). If we grow maize, we will always have it. I may not have any business in my pharmacy, but my family will survive without any problems."

> "Thank God that we do not have to buy maize in the market. Many families do not have enough land. They have to buy their maize."

> "If the market were to falter, we would not be able to buy our maize. But, if we grow our own maize, we will always have something to eat. Maize is more stable."

In part, *milpa's* guarantee of food of food security is due to the remarkably hearty nature of maize and its companion crops. As a crop originally derived from wild plant species in the Mesoamerican region, maize has many qualities that allow it thrive in the Guatemalan environment. It is able to withstand limited applications of fertilizers, weeds, drought, and general neglect. "By planting corn," Sheldon Annis writes of Guatemalan peasants, "a family might assure itself of poverty, and possibly even hunger –but it will *not* face starvation" (1987: 33, his emphasis).

The importance of making *milpa* to rural Guatemalan's food security is not only attributable to the biological resiliency of maize. It can also be ascribed to the central role that maize plays in communal safety nets (i.e. "social insurance"). It is a common practice for peasants in the Guatemalan highlands to gift excess maize production to the elderly, sick, and other community members who are in need. Similarly, many peasant households (86%) provide seed – or at least have expressed a willingness to provide seed – to neighbors who have lost their own seed stock to rodents, pests, or decay. The cultivation of *milpa* signifies membership in many rural communities. It also signifies that a household is able – and most likely willing – to participate in such reciprocal exchanges. Not growing *milpa* may signify withdrawal from the community, thereby foresaking the communal safety net that neighbors would otherwise provide.

5.5.3 The *Milpa* as a Meaningful Form of Sustenance

Not only is the practice of cultivating *milpa* a means of sustenance, it is also a meaningful form of sustenance. As discussed in Chapter 2, maize has long played a central symbolic role in Mesoamerican cosmology and many of the practices associated with its cultivation help to fortify social bonds. Such is the case in Nimasac and Xeul. Nearly all of the peasant households surveyed (96%) provide grain as gifts to their neighbors who have suffered the loss of a family member; most (82%) have maize blessed in their church or on an altar; and more than three-quarters reported that they donate maize to community celebrations.

5.5.4 *Milpa* as a Form of Cultural Differentiation

For many highland peasants, the cultivation of maize is an expression of their cultural identity. There is a common refrain in the area: "Somos hombres de maiz," *we are people of maize*. In part, this is a reference to the aforementioned creation myth in the *Pop Wuj*. It is also a reference to the practice of cultivating *milpa*. As Annis (1987) suggests, the cultivation of *milpa* is the reification of indigenous peasant identity in Guatemala. Historically, the ethnic difference of Guatemala's indigenous *campesinos* was used as a justification for their economic subjugation. Indigenous Mayans had their land appropriated by European colonizers and they were forced to provide labor on the plantations of the ruling elite, a practice that persisted in various forms until the 1940s. The cultivation of *milpa* was a response to this subjugation. As the antithesis of accumulation, the practice does not generally produce any excess and the crops that it does produce are typically of limited worth in the marketplace. In short, the *milpa* was an asset that was not likely to appropriated by the politically powerful.

The neo-liberal era has, to some extent, inverted social relations. The indigenous peasantry no longer suffers overt economic subjugation as a result of their cultural difference. In fact, they are now receiving multiple invitations to participate in the market economy. Market-oriented development strategies such as cash-cropping, market-assisted land reform, and wage employment have inundated the countryside. Many peasants now have the option to become heavily integrated into the market economy. To do so, however, would require them to abandon the agricultural practice that has come to symbolize their cultural distinction from the Western world. Rather than being engulfed by the homogenizing forces of the market, peasants continue to make *milpa* as an expression of cultural difference. As a response to Escobar's (1999) problematic of alterity, maize offers peasants the possibility to remain Mayan even as they embrace certain forms of the modern market economy. It also represents a type of "weapon of the weak" (Scott, 1985), a small but symbolic way of resisting efforts by outside actors to convert the peasantry into full market citizens.

5.5.5 The Rationality of Cultivating *Milpa*

In addition to the cultural, social, and psychological motivations for cultivating *milpa*, there is also a very practical reason for engaging in subsistence-oriented agriculture. Some resources – particularly the labor power of women and unirrigated land – have fewer opportunities in the market economy. Many women in Nimasac, for instance, complained that they suffer discrimination in the labor markets. Employers are reluctant to hire them and, due to their traditional household responsibilities that do not conform to the rigidity of most work schedules (e.g. childcare and meal preparation), women rarely search for wage employment. Moreover, as shown in Table 5.4, the returns to "female" forms of market production are appreciably lower than "male" activities. Given their limited opportunities in the labor market, for many the use of female labor power in the *milpa* represents a rational use of household resources. The economic returns of the subsistence agriculture are reasonably competitive with many forms of market activity, and *milpa* provides the flexibility to attend to other household responsibilities.

In addition to absorbing female workers who suffer discrimination in the labor market, *milpa* agriculture also represents a rational use of land that is poorly suited to commercial agriculture. As Table 5.7 documents, the vast majority of land in the highland communities is unirrigated and, consequently, unsuitable for growing most cash crops. Most peasant households lack the resources to transform their land into a suitable growing environment for cash crops. Domesticated from weedy plants endemic to the highlands, *milpa* crops are substantially better suited to the rainfed growing environments and represent an agronomically practical use of arable land.

5.6 Conclusion

As the Guatemalan experience demonstrates, participation in market-oriented economic activities does not necessarily preclude subsistence-oriented agricultural practices like making *milpa* from peasant's livelihood strategies. The market absorbs surplus labor that might otherwise go underemployed if rural households were to rely solely upon agricultural production. Moreover, *milpa* and market activities represent different realms of economic life; each realm fulfills different needs and generates different values. As Gudeman (2002) observes, the market is the domain of what economic theory often describes as the "rational actor." It is the domain of the individualistic, profit-maximizing, and accumulation-oriented peasant; it is typically the realm of more remunerative economic activities, but it is also the realm of risky activities. In many respects, the *milpa* is the opposite of the market. It is the domain of security and sustenance; it is typified by the low monetary value of its output and is the antithesis of accumulation. Although the *milpa* is typically cultivated at the household level, participation in the practice signifies participation in the broader community and is an expression of cultural identity. Thus, even though the market and the *milpa* both represent forms of economic provisioning, the needs and values that they provision are distinct and in many respects incommensurable.

The value of making *milpa* cannot be reduced to the market price of the crops that it produces. In addition to providing calories and a means of sustenance, the practice of making *milpa* also generates many entailments that cannot be quantified. In this chapter, I discussed five distinct types of non-market values that emerge from the agricultural practice. First, making *milpa* is a preferred form of achieving sustenance – as many peasants simply like to grow maize and take pride in the practice of growing their own crops. Second, peasants value *milpa* as a guarantee of food security; the heartiness of maize and the cultural institutions that govern its distribution are a near guarantee that a peasant family will fulfill its most basic nutritional needs. Third, the cultivation of maize is a meaningful form of economic provisioning; making *milpa* can be understood as an expression of cultural identity and is a license to participate in valued forms of community economy like seed exchange and gifting. Fourth, the cultivation of maize can be politically empowering: it is a means for peasants to resist the state and other outside actors who push for more market-oriented agricultural practices and thereby represents an opportunity to express their cultural difference even as they embrace other forms of market engagement. Fifth, the milpa represents a practical use of resources that might otherwise go underemployed in the market economy. In sum, the *milpa* is a multidimensional asset; to reduce its value to the single rubric of a monetary price would sacrifice meaning for measurement.

Even though the practice of making *milpa* is of both material and hermeneutic value to Guatemala's peasantry, most highland *campesinos* complement the agricultural practice with other types of economic activity. Four of the more prevalent alternatives in the region are non-farm employment in the regional labor market, petty commodity production, remittances from transnational migration, and cash cropping. Although they are typically more lucrative, peasants demonstrate a reluctance to allocate all of their resources to these market alternatives. They generally place boundaries on the market so that it does not impinge upon their cultivation of *milpa*. Employing various strategies such as the hiring of field hands and the pursuit of more flexible forms of employment, *campesinos* have managed to continue growing *milpa* despite the seemingly rigid requirements of their market participation. Peasants are not victims of the market. Rather they engage it in creative ways that allow them pursue meaningful livelihood strategies. By drawing upon their income from market activities, they are able supplement their returns from *milpa* agriculture. In so doing, Guatemalan *campesinos* have demonstrated that market forms of economy are not inherently dominant over their non-market counterparts.

Market and non-market activities play complementary roles in the rural livelihood strategies of Guatemala's highland peasantry. The fact that *campesinos* do not necessarily privilege one form of economic activity over the other suggests a need to rethink the ways in which development is pursued in rural areas. Traditionally, the practice of rural development has adopted "all or nothing" strategies that force potential workers to completely abandon their agricultural endeavors. Development programs that accommodate both forms of economic activity are more likely to achieve the development goals of local people who value their participation in both realms of economic life. Japan has successfully followed such a path by encouraging industrialization with flexible employment programs in rural areas, and the country and still has many part-time farmers (Boyce, 2006). The implementation of similar strategies in Guatemala and other centers of crops genetic diversity would likely to generate additional benefits. Not only would it allow Guatemalans peasants to improve their material conditions while maintaining their trademark agricultural practice of making *milpa*, it would also have the additional entailment of conserving maize genetic diversity, thereby fortifying a cornerstone of local food sovereignty and global food security.

Table 5.1: Prevalence and Contributions of Economic Activities in Nimasac and Xeul, 2002

	Total Sample			**Nimasac**			**Xeul**		
	Percent of HHs Engaged	Avg. Value per HH ($USD)	Percent of net HH Product	Percent of HHs Engaged	Avg. Value per HH ($USD)	Percent of net HH Product	Percent of HHs Engaged	Avg. Value per HH ($USD)	Percent of net HH Product
Wage Labor	72.3	1,557.01	53.0	62.7	1,155.79	38.2	81.7	1,951.54	69.1
Petty CD Production	84.9	850.13	28.9	91.5	990.86	32.8	78.3	711.74	25.2
Milpa/Subsistence Ag.	96.7	251.06	8.5	100	374.48	12.4	93.3	96.79	3.4
Remittances	16.0	180.32	6.1	27.1	336.59	11.1	0.1	26.66	1.0
Agricultural Sales	37.8	94.94	3.2	42.4	158.68	5.2	33.3	32.26	1.1
Crop Sales	83.2	7.24	0.3	84.7	8.66	0.3	81.7	5.85	0.2
Total		**2,940.69**	**100.0**		**3,025.06**	**100.0**		**2,824.83**	**100.0**

Source: Survey data collected by author, 2003

Table 5.2: Number of Provisioning Activities per Household, 2002

	Total Sample	Nimasac	Xeul
Average	3.1	3.2	2.9
Median	3.0	3.0	3.0
Percent of Households with…			
5 Activities	4.2	5.1	3.3
4 Activities	27.7	35.6	20.0
3 Activities	41.2	37.3	45.0
2 Activities	25.2	22.0	28.3
1 Activity	1.7	0.00	3.3

Source: Survey data collected by author, 2003

Table 5.3: Size of Arable Landholdings and Dependency upon off-Farm Income Sources

Size of Arable Landholdings	Off-Farm Income as Share of Net Household Production (percent)
1st Quintile	98.6
2nd Quintile	94.3
3rd Quintile	94.8
4th Quintile	94.9
5th Quintile	81.6

Source: Survey data collected by author, 2003

Table 5.4: Daily Returns from Select Economic Activities

	Average Daily Returns ($US)		
	Overall	**Men**	**Women**
Wage Employment			
All Sectors	4.99	5.19	4.25
Agricultural Sector	3.90	3.90	3.85
Manufacturing Sector	4.69	4.86	3.69
Commerce/Marketing Sector	8.59	8.23	12.53
Service Sector	5.59	7.56	4.25
Urban	6.01	6.43	4.09
Rural	4.64	4.73	4.30
Petty Commodity Production			
Woven Goods	5.52	5.52	n/a
Sewn Goods	5.52	5.52	n/a
Shoes	4.49	4.49	n/a
Wood or Clay Goods	3.59	3.59	3.59
Embroidery by Machine	3.85	n/a	3.85
Embroidery by Hand	1.92	n/a	1.92
Amarradores	1.56	n/a	1.56
Maize Agriculture*	3.59	3.59	3.59

Source: Survey data collected by author, 2003

* The returns to maize agriculture only account for the value of the grain produced. These figures do not account for the value of other *milpa* crops (e.g. legumes, squash) that are often tended to during maize farming. Nor do they account for the non-grain use values maize plants such as the husks that are used for wrapping tamales, the cobs that are used for fuel, and stalks which are used as fodder and fencing.

Table 5.5: Petty Commodity Production, 2002

	Total Sample		Nimasac		Xeul	
	Percent of HHs	Percent of Total Income	Percent of HHs	Percent of Total Income	Percent of HHs	Percent of Total Income
Amarradores	40.3	4.0	52.5	5.7	28.3	2.3
Weaving	22.7	8.6	18.6	5.8	26.7	11.2
Small store/Retail	15.1	4.5	13.6	6.6	16.7	2.6
Sewing	12.6	3.0	20.3	6.0	5.0	0.2
Embroidering w/ machine	10.1	2.8	0.0	0.0	20.0	5.4
Embroidering by hand	8.4	0.4	5.1	0.2	11.7	0.5
Shoe-making	7.6	3.2	13.6	5.3	1.7	1.2
Wood and Clay	4.2	1.0	6.8	1.8	1.7	0.3
Milling of maize	2.5	0.5	3.4	0.9	1.7	0.1
Other activity	8.4	1.9	11.9	1.8	5.0	0.9

Source: Survey data collected by author, 2003

Table 5.6: Agricultural Production for Households with Arable Land, 2002

	Percent of Households that Cultivate Crop	Percent of Cultivating Households that Market Crop	Percent of Harvest Marketed	Percent of Agricultural Production (mrkt value)	Percent of Total Agricultural Sales	Cash Crop*
Maize	100.0	18.3	15.3	56.7	20.4	
Scarlet R. Beans	46.1	5.7	6.3	2.3	0.3	
Broad Beans	39.1	15.6	36.3	3.2	2.7	
Peas**	20.0	13.0	64.2	2.0	3.0	
Hard Squash	16.5	5.3	3.2	0.3	0.0	
Chayote	14.8	29.4	50.1	0.6	0.7	
Fig Leaf Squash	10.4	8.3	29.8	0.4	0.3	
Nabo Culix	9.6	36.4	3.4	0.2	0.0	
Black Beans	8.7	10.0	5.9	0.5	0.7	
Zucchini	5.2	33.3	56.7	0.3	0.4	
Cilantro	5.2	50.0	85.9	0.1	0.2	Y
Potato	5.2	83.3	57.5	2.9	3.9	Y
Onion	3.5	75.0	91.3	3.2	6.8	Y
Cauliflower	3.5	100.0	95.6	2.2	5.0	Y
Cabbage	3.5	100.0	91.2	2.5	5.4	Y
Tomato	3.5	100.0	92.6	9.8	21.2	Y
Broccoli	2.6	100.0	91.7	1.1	2.4	Y
Bell Pepper	2.6	66.7	77.3	3.4	6.2	Y
Flowers	2.6	66.7	90.3	1.7	3.5	Y
Beets	2.6	100.0	87.3	0.6	1.2	Y
Carrots	2.6	100.0	94.6	1.0	2.3	Y
Chard	1.7	100.0	93.3	1.1	2.4	Y
Snow Peas	1.7	100.0	96.6	0.7	1.6	Y
Strawberries	1.7	50.0	58.3	0.7	1.0	Y
Mint	1.7	50.0	33.3	0.0	0.0	
Chamomile	1.7	50.0	60.0	0.0	0.0	Y
Radish	1.7	100.0	77.8	0.0	0.1	Y
Celery	1.7	50.0	89.1	0.5	1.0	Y
Chile	0.9	100.0	75.0	0.0	0.0	Y
Green Beans	0.9	100.0	85.0	0.5	1.0	Y
Spinach	0.9	100.0	83.3	1.2	2.3	Y
Parsley	0.9	0.0	0.0	0.0	0.0	
Cassava	0.9	0.0	0.0	0.3	0.0	

Source: Survey data collected by author, 2003

* Cash crops are here defined as crops where at least 50% of the output of that crop is sold in the market *and* at least 50% of the households that grow the crop sell it in the market.

** Some households may have reported the cultivation (and sales) of snow peas (which were classified as a separate crop) as peas. Thus, the statistics for peas may be over-represented and those for snow peas under-represented.

Table 5.7: Prevalence of Irrigation in Guatemala, 2002

	Nation of Guatemala	Dept. of Totonicapán	Dept. of Quetzaltenango	Muni. of Totonicapán	Muni. of Cantel
Percent of Agricultural Land with Irrigation	8.39%	0.22%	27.14%	0.66%	1.22%
Percent of Farms with Irrigation	7.77%	0.99%	9.08%	1.27%	1.57%

Source: INE, 2005

Table 5.8: Cash Crops and Irrigation, 2002

	Percent of Households Cultivating	Percent of Crop Grown on Irrigated Land
Cilantro	5.2	33.3
Potato	5.2	42.9
Onion	3.5	100.0
Cauliflower	3.5	100.0
Cabbage	3.5	100.0
Tomato	3.5	100.0
Broccoli	2.6	100.0
Bell Pepper	2.6	100.0
Flowers	2.6	50.0
Beets	2.6	100.0
Carrots	2.6	100.0
Chard	1.7	100.0
Snow Peas	1.7	100.0
Strawberries	1.7	100.0
Chamomile	1.7	0.0
Radish	1.7	100.0
Celery	1.7	0.0
Chile	0.9	0.0
Green Beans	0.9	100.0
Spinach	0.9	100.0

Source: Survey data collected by author, 2003

Table 5.9: Correlation of Market Activities with *Milpa* Agriculture (Household Level)

	Proportion of Land Allocated to Maize	**Proportion of Maize Consumption Purchased**	**Value of Ag. Production Consumed per Unit of Land**
Hours of Wage Labor per Adult HH Member	0.05	0.00	0.09
Income Share of Petty Commodity Production	-0.05	0.08	0.07
Proportion of Adults Working as Migrant Laborers	-0.15**	-0.04	-0.16
Value of Agricultural Production Sold per Unit of Land	-0.57***	-0.01	-0.01

Source: Survey data collected by author, 2003
*** Significant at 1% level; ** Significant at 5% level

CHAPTER 6

MAIZE: MARKET PARTICIPATION AND THE DIVERSITY OF THE PRINCIPAL *MILPA* CROP

6.1 Introduction

The impact of market expansion upon the *in situ* conservation of crop genetic resources is relatively understudied. While economic models have been developed to explore the impact of market integration upon the practice of diversity management (Goeschl and Swanson, 2000; Swanson and Goeschl, 1999), the actual relationship between peasant farmers' participation in the market economy and their cultivation of crop genetic diversity on the farm has received less attention. Among the few studies that have addressed the question empirically, most have explored the relationship between *distance* from major market centers and the level of crop diversity maintained at the household level (Van Dusen, 2000; Van Dusen and Taylor, 2005; Winters *et al*., 2006); others have investigated the impact of participation in grain markets (Meng 1998 *et al*., 1998; Steinberg, 1999; Smale *et al*. 2001). To date, however, no researchers have thoroughly explored the ways in which different *forms* of market participation shape the cultivation of crop genetic resources on the farm. By exploring the relationship of Guatemalan peasant farmers' participation in different realms of the market economy with their maintenance of maize diversity, this chapter helps to fill that gap. Chapter 7 further contributes to this objective by investigating the impact of different types of market engagements upon the *in situ* conservation of legume and squash diversity.

As documented in the previous two chapters, rural households in Nimasac and Xeul participate in mulitple realms of the market economy. They sell their labor power in regional and international labor markets, they dedicate portions of their land to cash cropping, they allocate time and capital to in-home petty commodity production, they purchase food stuffs produced near and far, and they hire field hands to assist with their agricultural production. Of interest in this chapter is the relationship of each of these forms of market participation with the level of diversity that is maintained at the household level. In particular, does participation in the market economy divert resources away from diversity management? And do households substitute purchased commodities for a diversity of crops maintained in the field? In general, I conclude that the evidence does not support Goeschl and Swanson's (2000) hypothesis that allocating household resources to market production will result in less diversity on the farm. In fact, the evidence suggests that the reverse may hold true in the Guatemalan highlands: most forms of market production are associated with *higher* levels of maize diversity on the farm. The three variables that are most reliably linked to genetic erosion are (1) the use of hired field hands, (2) higher levels of wealth, and (3) smaller quantities of arable land.

The remainder of this chapter is organized as follows. In section 6.2 I present the folk criteria employed by the peasant farmers of Nimasac and Xeul to describe the diversity of maize that they maintain in their fields. Using this taxonomy, in section 6.3 I describe the diversity that is currently present in the two communities and the various attributes that are commonly associated with different types of maize. Farmers' perceptions of the forces that motivate and constrain their cultivation of maize diversity are discussed in section 6.4. In section 6.5 I discuss the challenges of quantifying crop diversity and present several measures of diversity. In section 6.6 I analyze the relationship between the role that peasant households play in maize markets – as sellers, buyers, or non-participants – and the level of diversity that they maintain in their fields. An econometric model that explores that statistical relationship between the level of maize diversity maintained at the household level and various social forces is presented in section 6.7; the results are presented in section 6.8. I conclude the chapter with a preliminary discussion of the impact of market engagements upon the *in situ* conservation of maize diversity in section 6.9. A more in depth discussion of the results is postponed for Chapter 8, where it is combined with an analysis of the forces shaping the diversity of legumes and squash.

6.2 Seed Lots: Folk Criteria for Describing Maize Diversity

While Guatemala is renowned as a center of maize genetic diversity, the peasant farmers who cultivate that diversity do not conceptualize it at the molecular or genetic level. Instead, they understand maize diversity in terms of “seed lots.” Seed lots are groupings of kernels that are unique to a given farmer; they refer to each type of seed that the farmer distinguishes when planting (Louette, 1999). At the community level, diversity is understood in terms of “varieties” or the set of seed lots that share common characteristics and often share a common name. Varieties, in turn, are usually subdivided into either “landraces” that have been selected and managed by farmers over time or “improved varieties” that have been scientifically developed by crop breeders.

Guatemalan farmers typically distinguish maize types according to a handful of physically observable plant characteristics. Classification by grain color is the primary means for differentiating maize types. However, since multiple types of a given color are common (*e.g.* two types of white maize), additional criteria are often applied. Common criteria for differentiating varieties of the same color include the length and thickness of cobs and the size and shape of kernels. A farmer wishing to differentiate between two seed lots of the same color may also do so according their growing environments, distinguishing, for example, between "yellow maize for the mountaintop" and "yellow maize for the village."

As illustrated by the histogram in Figure 6.1, the majority of peasant families cultivate multiple seed lots. On average, peasant households in Nimasac and Xeul grow 2.4 distinct seed lots. Among those households that cultivate maize, nearly half grow three or more seed lots, while 15.7% of maize growing households rely upon a single variety.

6.3 A Description of Maize Diversity in Nimasac and Xeul

6.3.1 Colors of Maize

Rural Guatemalans classify their maize into four different color groups: yellow, white, black, and red. In addition to their solidly colored maize varieties, some farmers plant varieties known as *pinto*, or "spotted," whose individual cobs are a mix of grain colors. Table 6.1 summarizes the prevalence of each color of maize and the attributes that farmers associate with them.

As is typical in all of Guatemala's highland communities (INE, 2004: 29), yellow and white are the most widely cultivated colors of maize in Nimasac and Xeul. The widespread cultivation of yellow is largely attributable to its versatility and its reputation for higher yields. It can be grown in all microclimates and all but the poorest of soils. White maize, in contrast, is more demanding. Farmers say that it doesn't produce well at the highest elevations and, since it tends to have the tallest plants, it cannot be grown in windy environments where it is more susceptible to lodging.[1] Moreover, it has a reputation for requiring more fertilizer than the other colors of maize, having the slowest time to maturation, and as being the least nutritious. Despite these many drawbacks, white maize is widely regarded as the tastiest color of maize and it is customary to serve it for weddings, baptisms, Christmas gatherings, and other celebratory occasions.

Black maize is not nearly as prevalent as its yellow and white counterparts. While many of the surveyed households cultivate black maize, they tend to allocate less area to it than their other varieties. This phenomenon is particularly evident in Xeul where half of the surveyed households cultivated black maize, yet it only accounted for 15% of all maize acreage. Black maize is the most maligned color. Many Guatemalans say that they don't like the taste; others say that it upsets their stomachs. It is supposedly more difficult to sell black maize in the market and operators of electric mills have been known to scold clients who bring black maize that will discolor the maize dough (*masa*) of other clients. Nonetheless, black maize has many qualities to commend it. It is the most environmentally versatile, requires the least fertilizer, and is the most resistant to

[1] Lodging occurs when a plant falls to the ground. It is typically due to a poor root system, high winds, and/or the inability of crops to support their seed.

rot. Moreover, it is believed to be the most nutritious color of maize and many maintain that it has the best aroma and makes smooth tortillas.[2]

6.3.2 Maize Varieties

Regardless of color, most of the maize varieties cultivated in the highlands are local landraces. There is, however, a significant minority of farmers who cultivate improved varieties. Improved maize varieties were introduced to the Guatemalan highlands in the late 1970s. While it is possible to purchase a pound of certified seed for about $0.46 (US) from agricultural supply stores, most of the highland farmers who use improved maize varieties acquired them for free from governmental and non-governmental aid workers. All of the improved varieties that I encountered during my fieldwork were developed by the Guatemalan Institute for Science and Agricultural Technology (ICTA) as part of its "Dynamic System for Maize Improvement" (Fuentes, n.d.). According to the farmers who use them, there are definite advantages associated with the use of improved varieties, most notably higher yields that are due to bigger ears and stronger stalks that are resistant to lodging. However, there are also significant drawbacks with improved maize varieties. Farmers note that they do not produce well in poor soils, require large quantities of fertilizer, and do not perform well after 3-4 years in the field, requiring that the seed be replaced.[3]

Most farmers are unable to distinguish their seed lots by a common varietal name. Among the 293 seed lots identified in the household survey, respondents were only able

[2] Some women say that black maize feels under-appreciated and that it "cries." Its "tears" contribute to its rich aroma and smooth texture.
[3] The Mayan Mam have had a similar experience with improved maize varieties in Quetzaltenango (Hostnig *et al*., 1998).

to assign a common name to 38% of their maize seeds; 10% of the named seed lots (i.e. about 4% of the total) were improved varieties. Without specific names, farmers revert to the aforementioned taxonomy, relying upon color and the growing environment or the physical characteristics of the cob and grain. When asked, most maintain that their seeds do indeed have a name but that they have either forgotten it or that they never knew. This is perhaps not surprising given that most families inherit their seeds from their parents and have grown the same types of maize since the formation of their household: 82% of the seed lots cultivated were acquired from extended family members (usually the husband's parents) and the typical seed lot has been cultivated for more than ten years. In general, men tend to be more familiar with the names of the seed varieties, while women are more likely to describe varieties by their attributes and are more familiar with their culinary qualities.

Table 6.2 lists the maize varieties that were assigned common names in the household survey and the qualities associated with them. However, given that respondents were unable to assign a name to nearly two-thirds of their seed lots, it is quite likely that other varieties are grown and that the list is incomplete. It was also impossible to determine the exact prevalence of each variety. Nonetheless, my fieldwork suggests that the most common named varieties grown in Nimasac and Xeul are *Obispo*, *Salpor* (or *Saqpor*), *Toto Amarillo*, and *Chivarreto*.

The most widely grown variety seems to be a landrace commonly referred to as *Obispo*, or "Bishop." *Obispo* typically has white or yellow kernels, but two survey respondents in Nimasac also reported growing black variants of the variety. Farmers identify *Obispo* firstly by its thin cob and then by its average-sized kernels that are often pointed at the tip. According to a favorite anecdote, previous generations called the variety *Avispa*, or "wasp," since the pointed grain is shaped like a wasp's body. There are no references to either name in the botanical literature. However, its physical characteristics are similar to a "primitive" variety known as *Imbricado* that Wellhausen *et al*. (1957: 45) report was grown in the departments of Totonicapán and Quetzaltenango in the 1950s.

The most celebrated variety of maize grown in the highlands is the landrace *Salpor*. Also known as *Saqpor* in Totonicapán – a K'iche' name that describes its large, white, rounded kernels – it is renowned for its flavor. As a farmer from Xeul explained, "We use *Salpor* for fiestas. It represents exquisiteness; it's giving the best." Indeed, *Salpor* is the preferred variety for preparing the specialty dishes like *talluyos*, *chuchitos*, and *paches*[4] that are typically served for Christmas, weddings, baptisms, and other celebratory occasions. Despite its culinary acclaim, *Salpor* is one of the least hardy varieties of maize grown in the highlands. It requires large amounts of fertilizer and its tall plants and thick cobs render it particularly susceptible to lodging.

A yellow maize known as *Toto Amarillo* was the most prevalent improved variety that I encountered during my fieldwork. Using genetic material acquired from Totonicapán, ICTA developed the variety in the 1970s after it determined that its other improved seeds performed more poorly than local varieties in Totonicapán (Fuentes, n.d.) According to ICTA, the improved variety now has yields that are 8% greater than local

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[4] All three are variants of what Americans refer to as "tamales." A *tulluyo* is a large corn tamale with broad beans intermixed throughout the corn dough. *Chuchitos* and *paches* are both corn tamales with a piece of meat and relish in the middle. The difference is that *chuchtios* are savory while *paches* are sweet.

varieties, a statistic that is corroborated by local farmers who maintain that Toto Amarillo's large kernels have increased their yields. They also note the limitations of Toto Amarillo, specifically that it demands more fertilizer than other yellow varieties and that its cobs are relatively thick.

Chivarreto is another widely grown improved variety. Like *Toto Amarillo*, *Chivarreto* is a yellow maize that was created by ICTA in the 1970s. The improved seed was developed as a "short season" maize, using the genetic material from a landrace grown in a nearby hamlet of San Francisco el Alto, Department of Totonicapán. *Chivarreto* is widely appreciated in Nimasac for its low stature and ability to grow on the 10,000-foot high mountaintop – known as Alaska since it is cold and windy – where many farmers own land. *Chivarreto* has proven to be a remarkably versatile variety as many farmers also use it to seed their land in the village, some 2,000 feet lower in elevation.

6.3.3 Evolving Maize Varieties

Although maize varieties are frequently classified as *Chivarreto*, *Salpor*, or by some other name, it is important to note that the actual boundaries that are used to distinguish varieties are fluid and non-stationary. Consider, for example, the agricultural practices of "Emilia." A couple of years back, an agricultural extension agent gave Emilia one pound of *Toto Amarillo* seed. Given that the seed was insufficient to cultivate an entire plot of land,[5] Emilia planted part of the plot with her newly acquired improved seed and part of it with yellow *Obispo*. Like all of ICTA's improved varieties, *Toto*

[5] Two pounds of seed are typically required to cultivate the standard 1-*cuerda* plot (1 *cuerda* = 0.118 *hectares*).

Amarillo is an open-pollinated variety, so it is likely that the two varieties cross-pollinated. When selecting seed the following year, Emilia was not concerned about propagating the archetypical *Toto Amarillo* nor the archetypical *Obispo*. Instead, she wanted seed cobs with the qualities that fit a particular ideal.[6] Like most *campesinos*, Emilia selected ears with narrow cobs (a quality associated with *Obispo*) and full, rounded kernels (a quality associated with *Toto Amarillo*). Emilia is no longer able to distinguish between the two varieties; now she simply cultivates "yellow" maize.[7]

Maize is a dynamic crop, particularly when it is shaped by the constant pressures of human and natural selection as it is in rural Guatemalans' *milpa* plots. As Morris and Lopez-Pereira (1999) have noted, this dynamic nature makes classifying maize varieties into distinct and well-defined categories a difficult and somewhat arbitrary process. Indeed, many farmers talk about how their seed lots have evolved over time. The result, as illustrated in the photograph in Figure 6.2, is that the seed lots from distinct households may be dramatically different, even if they share the same varietal name.

6.4 Motivations and Constraints for Cultivating Maize Diversity

Like their counterparts in Mexico (Bellon, 1996), Guatemala's peasant farmers mention several reasons for maintaining maize diversity. They also recognize multiple constraints. Economic, environmental, and cultural processes all play an important role in shaping the overall level of diversity managed by a given household. This section

[6] Via an econometric analysis, Smale *et al*. (2001) came to a similar conclusion about maize farmers in Mexico, noting that they are not as concerned with actual varieties of maize as they are with particular attributes.

[7] This process of *creolization* is said to be especially beneficial to small-scale subsistence farmers since it allows them to integrate desirable new traits into their agricultural portfolios (Bellon *et al*., 2006).

provides a brief discussion of the processes that peasants identify as encouraging and constraining the cultivation of maize diversity within their households.

Perhaps the most commonly cited reason for growing multiple varieties of maize is *gusto*, or "pleasure." Peasant farmers note that they enjoy cultivating different varieties of maize; it makes them happy to harvest multiple colors of grain. They also enjoy eating it, as consuming multiple colors of maize is a means of varying an otherwise monotonous diet. As an older peasant from Xeul explained, "We grow many classes of maize because we like colors. Not everyone wants to eat black maize everyday. Guatemalans are people of maize. We eat tortillas all day long, tortillas with chilies. We grow different colors of maize so that we don't get bored with our tortillas."

Culinary purposes provide another motivation for cultivating maize diversity. In addition to tortillas and tamales, which are a staple at every meal, Guatemalans consume a variety of maize-based products. Certain types of maize are better suited for preparing certain types of foods. For example, recipes that have sauces and relishes enveloped in corn dough are made with white maize since, as one *campesina* explained, "The white maize acts like a sponge and absorbs the flavor." All colors of maize are used to make *atoles* (or hot, maize-based drinks), though their tastes and uses are varied: black and yellow *atoles* are salty and consumed on a regular basis, while white *atole* is typically sweetened with cinnamon and sugar and served for celebratory occasions. Similarly, all colors of maize can be used to make tortillas and tamales, though it is said that yellow and white maize are for preparing tortillas while black maize is used to make tamales.

In addition to utilitarian reasons, there are also environmental motives for cultivating multiple maize varieties. In a landscape as varied and heterogeneous as the Guatemalan highlands peasants usually cultivate in a variety of growing environments. "Each place has its own seed," a young *campesino* told me. For example, black maize is said to grow relatively better in poor soils whereas white maize, especially *Salpor*, is typically grown close to home where it can receive more care.

Growing multiple varieties is also a means for managing risk. As a relatively affluent peasant explained, "Some years yellow maize grows well, some years white grows well; that's why I plant both." Nature is unpredictable in the highlands; by growing multiple seed lots that have varying levels of resiliency to environmental threats (*e.g.* pests, pathogens, weather), a household is able to minimize the probability that environmental conditions will destroy its entire harvest. In the language of economics, farmers stabilize their yields by maintaining a portfolio of maize varieties.

There are also strong cultural motivations for cultivating multiple varieties of maize. When asked why they maintain so many varieties of maize, many focus group participants simply stated that it was their tradition to do so; "It's what we Mayans do." Some suggested that the practice is rooted in the Mayan cosmology where the universe is conceptualized as having four corners, each represented by one of the four colors of maize. Balancing all four colors is reflective of the Mayan value of complementarity. For example, red corresponds with the rising sun and symbolizes the beginning of life, while black corresponds with the setting sun and represents peacefulness and death.

Similarly, white symbolizes forces that are invisible to the human eye such as the wind and spirits, while yellow is symbolic of material things that can be touched and seen.

Despite the importance of balance in Mayan spirituality, many rural Guatemalans note a reduction in the number of farmers cultivating red and black maize. A Mayan priest attributed this to the government and aid agencies' focus on yields, adding, "Everything has God in it and those objects should not be sacrificed in the name of production." Indeed, as the priest noted, technical assistance in the Guatemalan highlands has been strongly biased against minority grain colors. In its campaign to develop higher yielding seed varieties, for example, ICTA has focused exclusively on yellow and white varieties since they have traditionally had higher yields; none of its improved varieties are black or red. Agricultural extension agents have further entrenched ICTA's bias by encouraging farmers to replace their local landraces (black, red, or otherwise) with the higher yielding improved varieties.

The most widely mentioned constraint to cultivating maize diversity is insufficient land. Indeed, Guatemala's concentrated agrarian structure and insufficient landholdings for the vast majority of farmers have limited the economic opportunities of the country's peasant farmers in a variety of ways (Barry, 1987; Handy, 1984; World Bank, 1996). Their inability to cultivate more varieties of maize is yet another. Among the households surveyed, the typical family controlled less than 0.5 hectares of arable land. Limited landholdings have discouraged farmers from planting black maize (since it is not widely liked and its culinary qualities are less versatile) and *Salpor* (since it is more susceptible to environmental conditions and, hence riskier to grow).

A final limitation to cultivating maize diversity is the limited ability of some *campesinos* to acquire new seed varieties. Several peasants mentioned a desire to cultivate commonly grown varieties of maize, but maintained that they did not know where to obtain the seed. Nearly two-thirds of survey respondents reported that they engaged in seed exchange, but 92% of it occurred within families. This suggests that the types of seed available to households are typically confined to family networks.

In sum, peasants identify multiple forces that foster the diversification of their household's maize portfolio. The pleasure of cultivating multiple varieties, the enjoyment that comes from diversifying one's diet, distinct culinary qualities associated with different varieties, the necessity of matching seeds with diverse environmental conditions, a desire to hedge against environmental uncertainty, tradition and a respect for their Mayan heritage are all motivating factors for peasant households to cultivate maize diversity. At the same time, however, they note that there are social forces working to constrain their management of maize diversity. In addition to pressures from agricultural extension agents to abandon their more colorful varieties, peasants find their cultivation of maize diversity constrained by insufficient landholdings and limited access to seed varieties that are not cultivated by family members.

Among the many processes that peasants identify as affecting their cultivation of maize diversity, one set of forces is conspicuously absent, namely market engagements. The peasants of Nimasac and Xeul make no mention of a relationship between their market participation and their management of maize diversity. Does this mean that the dire predictions of Goschel and Swanson (2000) were wrong and that market engagements do not affect the level of intra-crop diversity cultivated by peasant households? The following sections provide an econometric analysis of the question.

6.5 Measuring Maize Diversity

While the notion of diversity may seem fairly simple and intuitive, it is rather challenging to measure. Two problems in particular emerge. One is that the science of analyzing and describing crop diversity is "balkanized," as different disciplines have different conceptualizations of diversity and employ technical languages that are specific to their particular understanding of the phenomenon (Brush, 2004: 53). Whereas social scientists often draw upon the folk classification systems used by farmers, scientists typically view diversity through the lens of modernist taxonomies. Even among scientists, crop diversity can be understood with extreme reductionism (*e.g*. DNA, molecules) or general holism (*e.g*. anthropogenic ecosystems) (Brush, 2004: 46-7).

In addition to the challenge of choosing an appropriate unit of analysis, the practice of measuring diversity is further complicated by its multi-dimensional nature. As ecologists studying the spatial diversity of species have noted, diversity manifests itself in two forms: (1) "richness," or the number of species present in a particular area; and (2) "evenness," or the relative distribution of species within a given space (Peet, 1974; Magurran, 1988).[8] Some measures of diversity only capture one of the dimensions while others – known as heterogeneity indices – collapse the two dimensions into a single

[8] To illustrate the importance of both dimensions, consider two farmers, each cultivating two varieties of maize on a one-*cuerda* plot of land. Assume that Farmer A allocates ½ *cuerda* to each variety of maize while Farmer B allocates 0.99 *cuerdas* to variety 1 and 0.01 *cuerdas* to variety 2. Although both fields are equally rich in diversity (they each contain two varieties per *cuerda*), Farmer A's field would be considered more diverse overall since it has a more even distribution of varieties.

value. Both approaches have their limitations. Measures that focus upon a single dimension fail to express the complexity of diversity, while indices that combine the two features into a single measure tend to confound the relative importance of each dimension. Thus, no single measure of diversity is ideal.

Addressing the first problem of choosing the appropriate unit of analysis, I draw upon the folk classification system of "seed lots" as the basis of my diversity measures in this chapter. As described earlier, Guatemalan peasants typically distinguish their seed lots according to a select handful of morphological and utilitarian characteristics: color, growing environment, physical characteristics of the cob and kernels, and culinary qualities. The empirical measures of diversity used in this chapter (and the following) are reflective of the ways in which farmers conceptualize and order their botanical environment. While this approach does not seek to measure diversity at the molecular and biochemical levels, it is consistent with my focus upon the human role in cultivating diversity. As Melinda Smale (2006:8) notes, farmers choose to cultivate seed lots based upon observable traits, not their genetic composition *per se*.

As for the second challenge of accounting for the distinct dimensions of diversity, I develop several measures of diversity in this chapter. All of the measures are adapted from ecological indices, which describe the spatial diversity of biological species (Magurran, 1988). The measures differ from one another according the relative weight that they place upon the "richness" and "evenness" of the maize diversity that is managed by a given household. Table 6.3 summarizes the four diversity indices that I employ and defines their construction. Two of the diversity indices emphasize richness while the other two are measures of proportional abundance. The measures of proportional abundance are also known as "heterogeneity indices" since they account for both richness and evenness, though to varying degrees (Magurran, 1988). By comparing and contrasting these four indices, it is possible to achieve a more nuanced understanding of diversity than if one were to rely upon a single measure alone.

The simplest measure of diversity I use is a count of the maize seed lots cultivated by the household in the 2002 agricultural year. While counts of seed lots provide a relatively straightforward measure of richness, they suffer two important limitations. One shortfall is that the count measures are not weighted according to the area cultivated by a particular household. Thus, a household that cultivates three seed lots on nine *cuerdas* of land has the same diversity score as a household that cultivates three seed lots on three *cuerdas* of land, even though the former manages less diversity per unit of land. A second limitation of count measures is that they do not capture the evenness of a distribution.

The Margalef index is another means for measuring richness. By dividing the number of seed lots by the natural log of the amount of arable land controlled by a household, the Margalef index addresses the first shortcoming of the counting approach. However, like the count measure, the Margalef index fails to account for how evenly a household distributes the distinct varieties of maize that it cultivates.

In order to account for the evenness of crop diversity, two measures of proportional abundance are included in the study. Perhaps the most commonly used index for measuring intra-crop diversity is the Shannon index (Brush, 2004; Smale, 2006). Two particularly appealing factors of the Shannon index are that (1) it makes no assumptions about the shape of the underlying distribution of seed lots, and (2) it combines both the richness and evenness components of diversity into a single measure (Magurran, 1988).

The Simpson index is another popular measure of proportional abundance. Like the Shannon index, the Simpson index accounts for both the richness and evenness of crop diversity. It is distinguishable from the Shannon index, however, by the relatively greater emphasis that it places upon the evenness of a distribution. In general, the Shannon index is more heavily weighted towards uncommon seed lots (and hence richness), while the Simpson index is more heavily weighted towards abundant seed lots. Because of the emphasis that it tends to place upon abundance, the Simpson index is sometimes classified as a measure of "dominance" (Magurran, 1988: 39-40).

Table 6.4 presents descriptive statistics for these diversity measures, calculated from the household survey data.[9]

6.6 Maize Markets and Maize Diversity

As noted in the previous chapter, there is a strong correlation between the amount of land controlled by peasant households and their participation in maize markets. As a general rule, slightly more than one *cuerda* of land (approximately 1.08 *cuerdas*) is required to cultivate enough maize to feed the typical adult. Households that sell maize

[9] Four households that do not own arable land and, hence, do not cultivate *milpa* were not included in the regression analysis. Thus, the sample includes 59 households from Nimasac and 56 from Xeul, for a total of 115 households. Of course, eliminating these four households from the econometric analysis could result in selection bias. However, given that two of these households were comprised of elderly couples who had bequeathed their land to their children and a third household was a newly married couple that had yet to acquire any land, the bias should be minimal, if not nonexistent.

in the marketplace have more than sufficient land to meet their consumption needs; those that purchase maize tend to control less than sufficient land; and households that neither buy nor sell maize control just enough land to be self-sufficient.

The role that a household plays in maize markets – as a seller, buyer, or non-participant – appears to be related to the level of maize diversity that it maintains on the farm. Table 6.5 shows the average and median measures of all maize diversity indices for the three types of households. The group of households that neither sell nor purchase maize in the marketplace has the highest scores for all four of the diversity measures considered. Sellers of maize have the second highest measures, while buyers of maize consistently maintain the least amount of diversity.

On this superficial level, it appears that participation in maize markets is associated with lower levels of diversity on the farm: by all measures, maize buyers and sellers maintain less diversity than non-participants in maize markets. It is important to remember, however, that the engagement of peasants in maize markets is highly contingent upon the amount of arable land that they control. Households with less arable land simply have less space to maintain diversity. More land enables agricultural households to maintain more diversity, but it may be that households with a surplus land have less motivation to maintain diversity than households that are adequately endowed with enough land to meet their subsistence needs.

6.7 The Econometric Model

Having developed quantitative measures of crop diversity in section 6.5, it is possible to estimate the relative effects that different forms of market participation and other potentially relevant forces have upon the on-farm conservation of crop diversity. To do so, the following model was estimated:

$$D_i = \beta_0 + \beta_1 C_i + \beta_2 H_i + \beta_3 S_i + \beta_4 N_i + \beta_5 P_i + \beta_6 E_i + \varepsilon_I,$$

where: D_i = measure of crop diversity of household *i*;
C_i = household characteristics of household *i*;
H_i = human capital variables of household *i*;
S_i = social capital variables of household *i*;
N_i = natural capital variables of household *i*;
P_i = market production of household *i*;
E_i = market expenditures of household *i*; and
ε_i = error term.

In other words, six sets of explanatory variables are tested for their influence upon the level of crop genetic diversity that is maintained at the household level: household characteristics, human capital, social capital, natural capital, market production, and market expenditures. Table 6.7 summarizes each set of explanatory variables and their hypothesized effects.

The set of household characteristics consists of two explanatory variables: age of household heads and wealth. The age of household heads is included to test whether older farmers have a higher propensity to conserve crop genetic diversity due to traditional practices and taste preferences. Since both men and women play important roles in maintaining crop diversity, the average age of both household heads is used. Age is hypothesized to be positively correlated with crop diversity since older households are expected to value tradition more than younger households.

A measure of wealth is included to investigate the potential effects of economic security upon the on-farm level of crop diversity. The wealth measure is calculated as the monetary value of several assets controlled by the household. Assets included in the measure are the value of dwellings, the value of arable landholdings, the value of forested landholdings, the value of all livestock, and the value of consumer durables such as automobiles, sewing machines, and bicycles.[10]

Measures of human capital are included to test the hypothesis that the quantity and quality of a household's labor power affect the level of diversity maintained on the farm. Household labor is simply a count of the number of household members who are fourteen years of age or older. Since managing a diverse *milpa* is assumed to be more labor intensive than a mono-cropped *milpa*, the sign for household labor is expected to be positive. Education is measured as the average years of education per adult household member. Since the educational system in Guatemala tends to teach "modern" values and the opportunity cost of working in the *milpa* increases with education, the sign of this variable is expected to be negative. Technical assistance is a dummy variable indicating whether the household has received agricultural training from governmental and non-governmental agencies. Since agricultural extension agents usually encourage farmers to adopt improved seeds that are able to cover broad growing environments, it is hypothesized to have a negative effect on measures of genetic richness.

The "Female" variable measures the proportion of household labor (individuals who are fourteen years of age or older) that is female. Guatemalan women typically are paid lower wages than their male counterparts, so the opportunity cost of managing crop diversity is presumably lower for women. Additionally, Guatemalan women may be

[10] A full listing of consumer durables considered is provided in Section 6 of the survey instrument in Appendix I.

especially sensitive to the value of diversity and qualities of landrace maize varieties (FAO, 2002). For both reasons, the female variable is expected to be positively associated with the amount of diversity cultivated by a given household.

Three measures of social capital are tested; each is hypothesized to affect crop diversity differently. As discussed in section 6.4, some peasants maintain that limited access to seed has prevented them from cultivating more varieties of maize. Thus, a dummy variable indicating households that obtained seed from outside the family is hypothesized to have a positive effect on maize diversity. It has also been suggested that a declining reverence for Mayan cosmology has reduced interest in cultivating diversity. Protestant religions – whose practitioners are referred to as "evangelicals" in Guatemala – are widely known for their condemnation of Mayan spirituality and have been aligned with fostering "anti-*milpa*" attitudes (Annis, 1987), thus a variable representing the proportion of household members who identify as evangelicals is hypothesized to have a negative affect. A dummy variable that indicates whether a household resides in Nimasac or Xeul is also included and has no expected sign.

Agro-ecological characteristics that are believed to influence the household management of maize diversity are included in a set of natural capital variables. The area of arable land maintained by a household has been said to permit the cultivation of more maize varieties and is expected to have a positive sign. A quadratic of arable land is also included; its sign is expected to be negative, on the standard assumption that diversity is concave with respect to area.[11] Another agro-ecological variable, distinct plot types, is included to measure the variability among a given household's agricultural land. It is calculated as the number of non-contiguous plots controlled by the family that (subjectively) differ in regards to at least one of the following environmental qualities: climate, fertility, and slope. The number of distinct plot types serves as a proxy for the incentive to match different seeds with different agro-climatic niches; it is hypothesized to have a positive effect on the level of on-farm diversity.

The final set of variables, market participation, is included to test the hypothesis that engagements in the market economy create a disincentive to maintain crop diversity on the farm. Six distinct types of market engagement are included: four relate to the household's allocation of resources, two to the household's expenditures.

The value of agricultural output per unit of arable land is a proxy for the allocation of land resources to market activities. Since nearly all land is cultivated, households either allocate their arable land to the cultivation of cash crops that are mostly sold and command high market prices or to *milpa* crops that are typically consumed within the household and fetch relatively lower prices in the market. It follows that households with more agricultural sales per unit of cultivable land are hypothesized to allocate less land to *milpa* agriculture and, therefore, have lower measures of maize and *milpa* diversity.

The model also includes three variables to capture how households allocate their labor power: (1) the number of hours per adult allocated to wage labor during an average

[11] This relationship is illustrated by the "area-species curve" in ecology and population biology. The general idea is that as an area increases, more species are likely to be identified but their discovery is likely to increase at a decreasing rate.

week, (2) the proportion of adult family members engaged in transnational migration and working abroad, and (3) the share of household income earned from in-home petty commodity production. Theoretically, all three activities divert family labor away from the cultivation of *milpa*. They might also decrease the economic relevance of subsistence agriculture since income earned in the marketplace could be used to purchase substitutes for homegrown crops. Thus, one might expect that the amount of labor allocated to the three forms of market engagement would be associated with a reduction in crop diversity. But, given that petty commodity production tends to be a relatively flexible use of labor power that would allow farmers to attend to their fields when they desire, their hypothesized effect on crop diversity could be weak.

The final two market variables are included to test the impact of household expenditures on crop diversity. It has been hypothesized that as households earn more income they will substitute commodities purchased in the market for food crops grown in their fields (de Janvry *et al*., 1991). An index that measures a household's expenditures (in quetzales) per adult equivalent unit on a select basket of consumption goods is employed to test this hypothesis.[12] The impact of hired labor on crop diversity is also tested. On the one hand, hired labor might allow for households to practice labor-intensive diversity management, even if they suffer from a shortage of labor power or its members are otherwise employed. But, given that cultivating a diverse *milpa* requires an intimate knowledge of agricultural inputs (*e.g.* the knowledge of how a given seed performs in a given environment), it might be that be that hired labor represents a "mass

[12] For a listing of the consumption items considered, see section 14 of the survey instrument in Appendix I.

production" mentality for *milpa* cultivation and are associated with lower levels of crop diversity.

6.8 Econometric Findings

Regression results from the four models are presented in Table 6.8. As discussed in section 6.5, dependent variables – which are measures of diversity – differ from one another in the weight that they accord the richness and evenness dimensions of crop diversity. The Count and Margalef indices are the most heavily weighted towards richness; the Simpson index confers it the least amount of importance. To account for the discrete nature of the dependent variable, the count of maize seed lots was estimated with a Poisson regression.[13] Tobit models were used to estimate the remaining three models since they all have limited dependent variables.[14]

6.8.1 Household Characteristics

Among the household characteristics, only wealth is statistically significant in explaining the level of maize diversity cultivated. In general, higher levels of wealth are associated with lower levels of proportional abundance. While estimated wealth coefficients are negative for all of the regression models, one cannot confidently report

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[13] Poisson regressions model the log of the expected count of seed lots as a linear function of the independent variables. The estimates of the coefficients can be interpreted as follows: for a one unit change in the independent variable, the difference in the logs of expected counts is expected to change by the respective regression coefficient, given the other independent variables in the model are held constant.

[14] A number of diagnostic tests were performed to assure that the data fit the various assumptions for each of the regression models. The data passed the Shapiro-Wilk test for a normally distributed residual; the Breusch-Pagan/Cook-Weisberg tests for homoskedasticity; variance-inflation-factor analysis for the absence of multicollinearity; and the Ramsey regression equation specification test and "link test" for model specification. A goodness-of-fit chi-squared test was also performed for the Poisson regression; the hypothesis that the count data are Poisson distributed cannot be rejected.

that wealth affects the richness of maize diversity (as indicated by the statistical insignificance of wealth in the Count and Margalef measures). Thus, given that the Shannon and Simpson measures are "heterogeneity" indices that combine richness and evenness, it is likely that the later component (*viz.* the equitable distribution of seed lots) that is most affected by changing levels of wealth.

The negative relationship between wealth and maize diversity is consistent with two hypotheses. First, it is consistent with the notion that households cultivate a diversity of maize varieties as a means for managing risk. Since wealthier households control more assets, they may be able to manage environmental risks that might affect maize production in other ways than diversifying their seed lots. The negative relationship of wealth and maize diversity might also be explained by the qualitative observation that wealth is associated with previous – as opposed to current – transnational migration. Elizabeth Fitting (2006) found that transnational migration has changed farmers' attitudes about maintaining crop diversity in Mexico. A similar process may be unfolding in Guatemala and is worthy of further research.

6.8.2 Human Capital

None of the human capital variables are statistically significant. Although positive, the statistical insignificance of household labor – combined with its relatively small marginal effects – suggests that greater availability of household labor does not have a notable impact on the level of maize diversity cultivated on the farm. For the same reasons, higher levels of education do not necessarily translate into less diversity managed on the farm. The positive and relatively large coefficients for the female variable in the richness measures suggest that, as predicted, households with a greater proportion of adult females tend to manage a greater number of seed lots. This finding is not particularly reliable, however, since large standard errors have rendered it statistically insignificant. Nonetheless, future research upon the role of gender in the cultivation of crop genetic resources may prove illuminating.

6.8.3 Social Capital

While none of the results fall within the established confidence intervals, it is worth noting the signs of the coefficient estimates for the set of social capital variables. In general, agricultural households in Nimasac may manage a less diverse collection of seed lots than their counterparts in Xeul, a result that is somewhat surprising given that Nimasac comprises a larger number of growing environments. Also, the relatively large marginal effects of the religion variable suggests that there may be a strong (negative) relationship between the practice of evangelical Christianity and the cultivation of crop genetic diversity. Once again, however, it is important to note that these findings are not statistically significant, implying considerable variation in the sample.

6.8.4 Natural Capital

Among the natural capital variables, the amount of arable land controlled by households is significantly and positively associated with three of the four measures of maize diversity. In general, the null hypothesis that the number of seed lots managed by a household is positively associated with the size of its arable landholdings cannot be rejected. As the amount of arable land controlled by a household increases, it is more likely to cultivate a larger number of seed lots. It is also more likely to allocate the additional maize varieties that it cultivates a share of land that is relatively equal to that of existing varieties. The increased maize diversity that is associated with the expansion of a household's arable landholdings is likely to increase at a decreasing rate, as indicated by the negative and statistically significant sign of the "land squared" variable.

Surprisingly, the number of distinct plots was not found to have a substantive or statistically significant effect on any of the measures of maize diversity. This finding may be attributable to the low levels of environmental heterogeneity (subjectively) reported by survey respondents; the survey may have failed to capture the extent to which farmers match seeds to environmental conditions. It might also suggest that the availability of *Chivarreto* and other environmentally versatile maize varieties may reduce the need for farmers to use different seeds in distinct environmental niches, at least within a given community.

6.8.5 Market Production

A primary objective of this dissertation is to examine the relationship between different forms of market engagement – especially the allocation of household resources to market production – and the level of on-farm crop diversity. In general, the allocation of household resources to market production (*viz*. wage labor, petty commodity production, cash cropping, and transnational migration) does not play a statistically significant role in explaining crop diversity on the farm. Nonetheless, it is worth noting that the coefficients for most of this subset of market engagement variables are not negative – as predicted – but *positive*. Rather than contributing to the loss of crop genetic resources, allocating productive resources to market activities is potentially associated with an increase in intra-crop maize diversity.

6.8.6 Market Expenditures

Even as allocating productive resources to market activities is generally associated with higher levels of on-farm maize diversity among the sample, at least one form of market expenditure is found to be negatively associated with the diversity of maize cultivated on the farm. The hiring of field hands is shown to be negatively associated with three different measures of maize diversity. As more days of field labor are employed, a household is likely to plant a *milpa* that is less rich in maize diversity (Margalef Index) and where a smaller number of maize varieties are dominant (Shannon Index, Simpson Index). The negative relationship between hired labor and crop diversity might be attributable to field hands' limited ability to match seeds with a given plot of land. Diversity management requires an intimate knowledge of seed qualities and the environmental characteristics of each plot of land. Since households that rely upon hired labor may be less likely to have such knowledge – or are unable or unwilling to convey that knowledge to the workers that they hire – they might be more likely to plant a "generalist *milpa*" that performs well enough rather than a "specialized *milpa*" that conforms to the particular qualities of the land and tastes of household members.

6.9 Preliminary Discussion: The Impact of Market Engagements

The econometric results identify three key variables that can be reliably associated with lower levels of maize diversity at the household level: (1) the small size of arable landholdings that constrain farmers from planting more maize varieties and limits the area that they allocate to minority varieties; (2) higher levels of wealth (holding the land endowment constant); and (3) greater use of hired field hands. These findings are consistent with investigations conducted by other researchers in the field (Van Dusen and Taylor, 2005; Winters *et al*., 2006) and carry important policy implications, as will be discussed in the concluding chapter. One of the more noteworthy results of the regressions, however, is the statistical insignificance of most of the market variables, particularly the market production variables (the hours of wage labor per adult household member, the value of agricultural sales per unit of land, the income share of petty commodity production, and the proportion of adult household members engaged in transnational migration). The limited explanatory power of these variables suggests that, contrary to conventional economic wisdom, allocating productive resources to market activities is not associated with a reduction in the level of crop genetic diversity on the farm. Indeed, the signs on these variables, albeit statistically insignificant, are generally positive.

There are at least four possible explanations for the positive (or at least non-negative) market production coefficients. One reason is the balance of factor endowments in the Guatemalan highlands. In relation to their typically meager landholdings, most peasant households have a relative abundance of labor. Excluding one notable outlier, the average family in Nimasac and Xeul controls approximately six *cuerdas* (or two-thirds of a hectare) of arable land. Given that it is possible to adequately cultivate a *cuerda* of maize with seven days of labor, the average family would only need to allocate some 42 person-days of labor to maize agriculture in order to produce an acceptable harvest in a given year. Additional time in the fields allows peasants to attend to minor *milpa* crops and to improve maize yields. Nonetheless, given that the average household has four adults of working age, most families have a "surplus of labor" in that attending to their *milpa* requires only a small percentage of their available labor supply.

Another possible explanation is market segmentation. While maize is always readily available in the numerous local markets of the highlands, the preferred maize varieties are not. Marketed maize is categorized as either coastal maize or highland maize; highland maize, in turn, is subdivided into white maize, yellow maize, black maize, and *Salpor*. As its name implies, coastal maize is grown on Guatemala's western coast and piedmont; usually it is the product of modern agricultural practices. Coastal maize is available year-round in highland markets and is relatively cheap, costing about 20% less than yellow, white, and black maize from the highlands and 35% less than *Salpor*. But highland peasants have a strong preference for their local maize varieties. Most are willing to pay the price premium for highland maize that they maintain is more aromatic and produces tortillas that are "smooth like bread" in comparison to the notoriously hard and tough tortillas made from coastal maize. Maize from the highlands is not always available in local markets, however; at least 8% of all maize consumed comes from sources outside the communities. Thus, while coastal maize is an inferior substitute, households that rely upon markets for their maize may have no choice but to purchase it. The limited availability of preferred maize varieties in local markets may help to discourage the substitution of market activities for traditional agricultural practices.

A third possible explanation for the non-negative impact of market variables might be the unique role that maize plays in the social lives of rural Guatemalans. Most of the literature on crop genetic diversity conceptualizes the agricultural output of peasant farmers as a mere commodity whose value can be imputed and measured in market prices. For many Guatemalan peasants, however, maize is no ordinary good. Although it has many characteristics of a commodity – it is bought and sold in markets and sometimes even discussed in terms of its profitability – maize also generates a number of non-market entailments for Guatemalan farmers. For example, many farmers mentioned that the enjoyment that came from working the land was just as important to them as the food that they produced. Growing maize is also understood as an expression of cultural identity. It is a commonality shared by all households. Working the land and cultivating *milpa* is associated with a sense of community; donating maize to community celebrations or to families in need helps to fortify social networks. Growing maize also connects the predominantly K'iche' Mayan farmers to their creation myth, the *Pop Wuj*, which explains how *Ixmucane*, the Grandmother of Day, created humans from the four colors of maize; in reference to this, Guatemalan highlanders frequently note, *Somos hombres de maíz*, "We are people of corn." In general, growing *milpa* and participating in the market are viewed as equally important but distinct aspects of rural Guatemalan's economic lives. As a male participant in one focus group explained, "A person may have a job – he might work in construction or make shoes in his home – but that is to earn money. One grows maize to sustain the family with food." The women from another focus group concurred, "They are different types of activities, different aspects of our lives." This conception helps to account for the limited impact of market engagements upon the level of crop diversity that is cultivated on the farm.

Finally, the statistical insignificance of the market participation variables in the regression results may be attributable to the absence of longitudinal data. The models only measured how market engagements related to crop diversity for a given year; a lack of suitable data precluded a statistical examination of how market engagements affect the conservation of crop genetic resources over time. This is a key limitation of the study. Qualitative observation suggests, however, that at least one form of market engagement is likely to have contributed to the erosion of crop genetic resources over time: the growing prevalence of transnational migration.

The practice of migrating and working abroad has become increasingly prevalent in Guatemala over the past ten years (OIM, 2002); it has dramatically transformed the rural landscape. Migrants often choose to flaunt their new wealth by building large cinderblock homes that dwarf the adobe homes of their non-migrant neighbors. In doing so, they tend to take already scarce land out of agricultural production and put pressure upon other families who are "trying to keep up with the Rosales" to do the same. Should this loss of habitat continue, it could contribute to significant losses of crop genetic resources, including genomic erosion (Wilkes, 1992: 13). Moreover, as Fitting (2006) has observed in Mexico, the practice of transnational migration has the potential to transform intergenerational attitudes such that young people lose interest in maize agriculture and discontinue its practice. This, of course, returns us to our original question: is it possible to achieve rural development in a way that fortifies – rather than threatens – the on-farm conservation of crop genetic resources? I will address this question in the concluding Chapter 8. First, however, it is worth exploring the relationship between market participation and the diversity management of minor *milpa* crops.

Table 6.1: The Prevalence of Maize Colors and Their Perceived Attributes

Color	Proportion of Households who Cultivate		Proportion of Maize Area		Perceived Qualities
	Nimasac	Xeul	Nimasac	Xeul	
Yellow	100.0	85.7	54.8	40.3	• Highest yielding color • Environmentally versatile: can be grown in a variety of environments • More calories and vitamins than white maize, less than black • More resistant to pests than white • Matures more quickly than white, but not as quickly as black • Tortillas do not go hard as quickly as white tortillas
White	90.0	87.5	31.6	44.2	• Plants grow very tall, rendering them susceptible to lodging • Does not grow well at the highest elevations • Requires more fertilizer than other colors • Believed to contain fewer calories and vitamins than other colors • Matures more slowly than yellow and black • Widely touted as the tastiest color • Used for celebrations (*e.g.* weddings, Christmas, birthdays) • Primary ingredient for specialty dishes like *chuchitos*, *paches*, and *talluyos*
Black	35.0	50.0	12.5	15.0	• Most environmentally versatile: said to grow in any environment, including those with poor soils • Requires the least amount of fertilizer • Most resistant to rot • Matures more quickly than

					yellow and white • Believed to have more calories and vitamins than yellow and white • Many note claim that it has the best aroma and makes smooth tortillas • Many claim that they do not like the taste of black maize and that it upsets their stomachs • Used to make *atoles* and for medicinal purposes (*e.g.* treating measles) • Requires the greatest quantity of lime to remove the pericparp during the nixtamalization process. • Difficult to sell surplus in the market • Must use the *masa* (dough) the day that it is milled, otherwise it goes bad • Owners of electric mills are reluctant to process black nixtamal since the dough discolors the lighter colors of maize • A preferred color of Mayan priests
Red	1.7	0.0	1.2	0.0	• Not typically cultivated as it is said to appear spontaneously, usually among yellow maize • Appearance is said to be a "work of God," symbolizes birth • Makes tasty, smooth tortillas • Used for medicinal purposes • A preferred color of Mayan priests
Pinto	0.0	3.6	0.0	0.6	• Typically a mix of black and white kernels

Source: Data collected by author, 2001 – 2006.

Table 6.2: Maize Varieties and Their Perceived Qualities

			Grown in…		
Variety Name	**Color(s)**	**Improved/ Landrace**	**Nimasac**	**Xeul**	**Qualities**
Chivarreto	Yellow	Improved	Y		• Improved variety that was introduced to Nimasac 15 years ago • Low-statured plant that is resistant to lodging • Produces at higher altitudes where other varieties are unable • Can be grown in lower altitudes, but has smaller cobs/lower yields than other yellow varieties • Developed by ICTA with genetic material from the neighboring municipality of San Francisco el Alto, Department of Totonicapán • Certified seed costs $0.46/lb.
Compuesto Blanco		Improved		Y	• Developed using genetic material from Chimaltenango (Fuentes, n.d.: Table 2) • Better adapted to lower altitudes than other improved varieties • Certified seed costs $0.46/lb.
Cuarenteño	Yellow/ White	Landrace	Y		• Shorter growing cycle than most varieties (cultivated in May instead of March)
Obispo	Yellow, White, Black	Landrace	Y	Y	• Thin cob with pointed grains • Difficult to shell • Possibly a hybridization of the landrace *Imbricado* (see Wellhausen *et al.*, 1957: 45) • Predominantly yellow, but white and black versions are also cultivated
Salpor/Saqpor	White	Landrace	Y	Y	• Known as salpor in Xeul and saqpor in Nimasac. • Saqpor is K'iche' for "big white" • Kernels are large and rounded

					• Floury variety • Tall plants and large cobs render the plant susceptible to lodging • Requires relatively large quantities of fertilizer • Grain costs 25% more than other white landraces in local markets • Widely regarded as the tastiest variety • Used for *paches*, *talluyos*, and other celebratory dishes • Grains are toasted to make *pinole*, a type of meal that is often mixed with sugar and cinnomon. • Dough swells when cooked
San Marceño	Yellow/ White	Both	Y	Y	• ICTA developed an improved variety of San Marceño with genetic material from a landrace of the same name • Does not produce as well as local landraces in Totonicapán
Saqxol	Pinto	Landrace?		Y	• Mix of black and white kernels
Semilla de Mayo	Yellow	?	Y		• Shorter growing cycle than most varieties (cultivated in May instead of March)
Toto Amarillo	Yellow	Improved	Y		• Has thick cobs and large kernels • Requires more fertilizer than other yellow varieties • Created by ICTA from a local criollo variety after it was determined that San Marceño does not produce well in Totonicapán • Certified seed costs $0.46/lb.
Xilom	Pinto	Landrace?		Y	

Source: Data collected by author, 2001 – 2006.

Table 6.3: Measures of Crop Diversity at the Farm Level

Index	Concept	Construction	Explanation
Count	Richness	$D = S$	S = Number of farmer-managed units of diversity
Margalef	Richness	$D = (S-1)/\ln A$ $D \geq 0$	A = Total arable landholdings controlled by household
Shannon	Proportional abundance, equitability	$D = -\Sigma \alpha_i \ln \alpha_i$ $D \geq 0$	α_i = Area share occupied by *i*th variety managed by household
Simpson	Proportional abundance, dominance	$D = 1 - \Sigma \alpha_i^2$ $1 \geq D \geq 0$	α_i = Area share occupied by *i*th variety managed by household

Adapted from Smale, 2006: Table 1.2

Table 6.4: Indices of Maize Diversity

Diversity Measure	Mean	SD	Minimum*	Maximum
Count of Seed Lots	2.478	0.958	1	5
Margalef Index	0.316	0.201	0	0.935
Shannon Index	0.739	0.418	0	1.609
Simpson Index	0.457	0.238	0	0.800

* The Margalef, Shannon, and Simpson Indices all have a lower limit of zero if only one variety is cultivated.

Table 6.5: Participation in Maize Markets and Measures of Maize Diversity at the Household Level

	Role in Maize Markets			All Agricultural Households (n=118)
	Non-participants (n=37)	**Sellers** (n=19)	**Buyers** (n=62)	
Count of Seed Lots				
Mean	2.838	2.750	2.081	2.415
Med.	3.000	3.000	2.000	2.000
std	0.986	1.020	0.946	1.024
Margalef Index				
Mean	0.389	0.321	0.273	0.316
Med.	0.385	0.336	0.234	0.298
std	0.212	0.189	0.190	0.202
Shannon Index				
Mean	0.910	0.732	0.645	0.739
Med.	1.017	0.823	0.693	0.693
std	0.379	0.459	0.408	0.419
Simpson Index				
Mean	0.549	0.432	0.412	0.457
Med.	0.614	0.530	0.500	0.500
std	0.197	0.262	0.243	0.239

Source: Survey data collected by author, 2003.

Table 6.6: Arable Landholdings and Measures of Maize Diversity at the Household Level

	Size of Arable Landholdings per Adult Equivalent Unit (cuerdas)			All Households (n=118)
	0 – 0.83 (n=61)	**0.84 – 1.53** (n=29)	**> 1.53** (n=28)	
Count of Seed Lots				
Mean	2.066	2.931	2.643	2.415
Med.	2.000	3.000	3.000	2.000
std	0.943	0.884	0.989	1.024
Margalef Index				
Mean	0.274	0.388	0.299	0.316
Med.	0.258	0.401	0.320	0.298
std	0.215	0.176	0.187	0.202
Shannon Index				
Mean	0.604	0.943	0.742	0.739
Med.	0.693	0.975	0.846	0.693
std	0.425	0.325	0.437	0.419
Simpson Index				
Mean	0.386	0.568	0.446	0.457
Med.	0.500	0.591	0.538	0.500
std	0.254	0.157	0.253	0.239

Source: Survey data collected by author, 2003.

Table 6.7: Definitions of Explanatory Variables and Hypothesized Effects on Diversity

Category	Variables	Description	Mean	Hypoth Effect
Household Characteristics	Age of HH Heads	Average age of the head of household and the head's spouse	41.13	+
	Wealth	Value of household assets (quetzales**)	128,654	-
Human Capital	Household Labor	Number of household members 14 years of age and older	4.13	+
	Female	Proportion of Household Labor that is female	0.53	+
	Education	Years of education per adult household member	4.36	-
	Technical Assistance	Household members have received agricultural training (dummy)	0.10	-
Social Capital	Community	Household is in Nimasac (dummy)	0.51	?
	Religion	Proportion of evangelical household members	0.36	-
	Seed Exchange	Household has received seed from outside extended family (dummy)	0.23	+
Natural Capital	Arable Landholdings	Area of arable landholdings (*cuerdas**)	6.46	+
	Arable Landholdings Squared	Area of arable landholdings squared (*cuerdas*)	102.16	-
	Distinct Plots	Number of arable plots that differ in terms of their fertility, climate, and/or slope	1.70	+

Market Production	Labor Market Participation	Weekly hours of wage labor per adult household member	12.10	-
	Petty Commodity Production	Proportion of household income earned from in-home petty commodity production	0.38	?
	Commercial Agriculture	Value of agricultural output sold per *cuerda* of land (quetzales[**])	6.51	-
	Transnational Labor	Proportion of adult household members working abroad	0.05	-
Market Expenditures	Consumer Goods	Monthly expenditures per adult equivalent unit on a basket of consumer goods	10.78	-
	Hired Labor	Number of field hand days hired per year	19.89	?

[*] 1 *cuerda* = 0.118 hectares
[**] 7.6 quetzales ≅ $1.00 (USD)

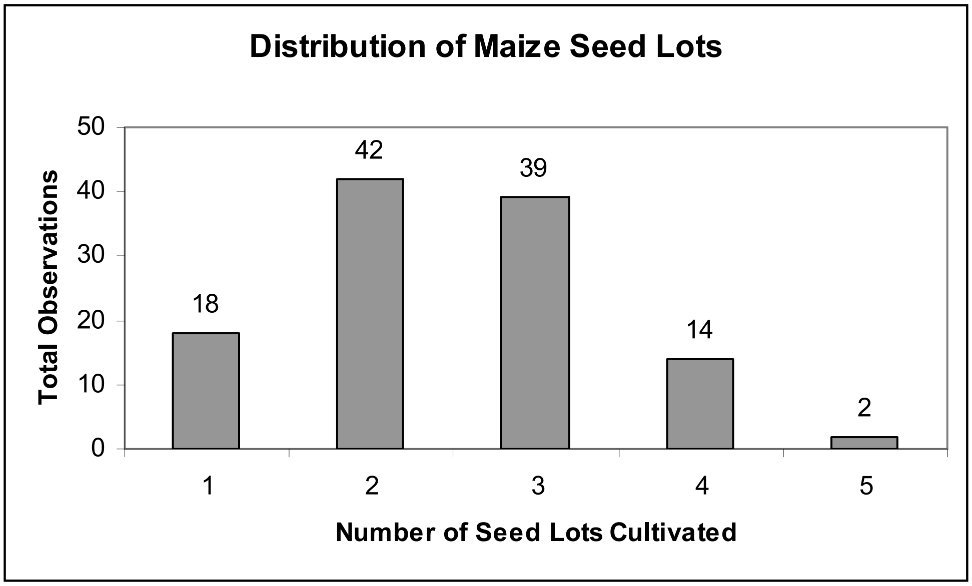
Table 6.8: Factors Influencing the on-Farm Cultivation of Maize Diversity

		Poisson Regression		Tobit Regressions					
		Count of Seed Lots (Richness) (n = 115)		**Margalef Index** (Richness) (n = 115)		**Shannon Index** (Proportional abundance) (n = 115)		**Simpson Index** (Proportional abundance) (n = 115)	
		Coeff.	**t-ratio**	**Coeff.**	**t-ratio**	**Coeff.**	**t-ratio**	**Coeff.**	**t-ratio**
	Constant	0.4987	1.11	0.0683	0.45	0.1971	0.64	0.1641	0.94
HH Characteristics	Age of HH heads	0.0035	0.64	0.0027	1.46	0.0051	1.34	0.0027	1.23
	Wealth	-7.70e-07	-1.28	-6.81e-07	-1.49	-1.25e-06*	-1.69	-6.70e-07*	-1.90
Human Capital	Household labor	0.0060	0.16	0.0069	0.51	0.0208	0.77	0.0158	1.03
	Female	0.1656	0.39	0.1176	0.82	0.0707	0.24	0.0161	0.10
	Education	0.0086	0.28	0.0035	0.34	0.0126	0.60	0.0067	0.57
	Tech. assistance	0.0181	0.07	-0.0039	-0.04	-0.0796	-0.40	-0.0600	-0.53
Social Capital	Community	-0.0756	-0.52	-0.0307	-0.62	-0.0653	-0.65	-0.0224	-0.39
	Religion	-0.1216	-0.81	-0.0772	-1.53	-0.1536	-1.51	-0.0821	-1.42
	Seed exchange	0.0163	0.10	0.0166	0.30	-0.0647	-0.59	-0.0572	-0.91
Natural Capital	Arable land	0.0389*	1.73	0.0136	1.41	0.0429***	2.39	0.0220**	2.26
	Arable land sqrd.	-0.0005	-1.37	-0.0001	-1.19	-0.0005**	-2.10	-0.0002*	-1.88
	Distinct plots	0.0176	0.21	-0.0002	-0.01	0.0010	0.02	-0.0061	-0.18
Market Production	Labor market	0.0029	0.33	0.0024	0.81	0.0068	1.12	0.0037	1.07
	Petty CD Production	0.0188	0.07	0.0219	0.25	0.1275	0.73	0.0783	0.79
	Commercial Agriculture	0.0013	0.33	0.0008	0.57	0.0018	0.63	0.0011	0.67
	Migrant labor	-0.1489	-0.24	0.0219	0.11	0.2974	0.74	0.2625	1.14
Market Expenditures	Consumer goods	0.0036	0.33	0.0037	1.04	0.0056	0.78	0.0038	0.92
	Field hands	-0.0019	-1.18	-0.0012**	-2.11	-0.0029***	-2.64	-0.0018***	-2.87
	Deviance R-Squared	0.03[1]		0.62		0.16		0.40	

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

[1] There are no reliable goodness of fit tests for Poisson regressions; the measure reported here is a Pearson chi-squared statistic. Given that such measures become increasingly unreliable as the degrees of freedom increase, the goodness of fit measure should be interpreted with a large grain of salt (Scribney, 1997).

Figure 6.1: Number of Maize Seed Lots Cultivated per Agricultural Household



Source: Survey data collected by author, 2003

Figure 6.2: Seed Lots of Yellow *Obispo* from Three Different Households in Nimasac

Photo taken by author during focus group discussions, July 2006.

CHAPTER 7

LEGUMES AND SQUASH: MARKET PARTICIPATION AND THE DIVERSITY OF THE SECONDARY *MILPA* CROPS

7.1 Introduction

In his memoir *Plants, Man, and Life*, the distinguished botanist Edgar Anderson (1969: 136-142) describes his first encounter with the Guatemalan *milpa*. At first sight, he thought the *milpa* plots to be "nothing but dump heaps and a few trees." In time, however, he discovered that the plots are, in fact, multi-functional spaces where apparent chaos is actually ordered by "fairly definite crosswise rows." While mapping a garden, he identified an abundance of plants, all useful to the owner. In addition to two varieties of maize, he documented an assortment of fruit trees, squash, beans, coffee, chamomile, herbs, flowers and ornamental plants, avocado, and fruit-bearing cacti. In one corner of the garden was a small beehive. He marveled that, "In terms of our American and European equivalents the garden was a vegetable garden, an orchard, a medicinal garden, a dump heap, a compost heap, and a beeyard" (140) and concluded that, "If one were to make a careful time study of such an Indian garden, one would find it more productive than ours in terms of pounds of vegetables and fruit per man-hour of square foot of ground" (*sic*.) (141).

Despite the apparent efficiency of the polycrop *milpa*, the long-term viability of the agricultural system has long been in doubt. In his classic *Transforming Traditional Agriculture*, Theodore Schultz (1964) argued that peasant agriculture in Guatemala represents an efficient use of resources, but only to the extent that farmers lack the technology and skills to earn a greater return on their resources. If given greater opportunities, he maintained, peasant farmers would behave "rationally" and alter their agricultural practices in order to maximize their expected reward.

Nearly three decades later, Marcel Fafchamps (1992) echoed Schultz's thesis. Using a quantitative model to make his case, Fafchamps claimed that Third World farmers cultivate multiple crops because they operate in thin and isolated markets. As access to markets improves, he maintained, farmers will cease to cultivate multiple crops for subsistence purposes, opting instead to increase their incomes by specializing in a single crop in which they have a comparative advantage.

This chapter provides an empirical test of Fafchamps' hypothesis. Combining an ethnographic analysis with a series of econometric regressions, I explore the impact of market integration upon the cultivation of infra-crop *milpa* diversity. In particular, I focus upon the social forces shaping the combined diversity of the three quintessential crops of the *milpa* – maize, beans, and squash, otherwise known as the "three sisters." While there is some support for the notion that peasants substitute purchased food for a diversity of *milpa* crops (particularly squash), there is substantially more evidence that – rather than undermining crop diversity – allocating household resources like labor power and land to market production is complementary to *milpa* diversity on the farm. I also find that infra-crop *milpa* diversity is linked to the size of arable landholdings controlled by the household and its religious composition. Larger landholdings are associated with higher levels of crop diversity on the farm, while evangelical Protestantism tends to undermine it.

7.2 *Milpa* Diversity in Nimasac and Xeul

The Guatemalan highland's prominence as a "megacenter of diversity" arises not only from the great diversity of maize cultivated by the region's farmers, but also from the abundance of different agricultural crops in general. While most peasants will describe their *milpa* as a "cornfield," the plots frequently – though not always – consist of much more than maize. *Milpa* plots may be structured by crosswise rows of maize, but they are also typically interspersed with beans, squash, fruit trees, leafy greens, herbs, and medicinal plants. Given that multiple varieties of most of these plants are cultivated within a community, the landscape of the highlands is renowned for its rich *infra*- and *intra*-crop diversity.

Table 7.1 lists the crops most commonly cultivated alongside maize in the *milpa* plots of Nimasac and Xeul.[1] Most households intercrop with at least one type of legume. Scarlet runner beans (*Phaseolus coccineus L.*), broad beans (or fava beans) (*Vicia faba*), and peas (*Pisum sativum*) are the most prevalent legumes, while some farmers cultivate black beans (*Phaseolus vulgaris*) despite the common belief that they perform poorly in the high mountain environment. Fruit trees often shade *milpa* plots. Totonicapán has a regional reputation for its apples, which along with plums and peaches are widely grown in both communities. Several species of squash (genus *cucurbita*) are also grown,

[1] While the list of minor *milpa* crops may seem relatively meager when compared with the diversity described by Anderson, it is important to note the Anderson (1969) was describing a backyard garden from located in the central valley region of Antigua, located about 3,500 feet lower in elevation. Coffee, avocado, banana, and other crops identified by Anderson could not survive in the higher altitudes of Nimasac and Xeul. Moreover, there is reason to believe that the diversity described here is underspecified. Unlike Anderson, I did not conduct a detailed mapping of each household's *milpa* plots. Rather I simply asked a representative from each household to identify the different plants that they cultivated on their land. Respondents often failed to mention herbs, minor crops, and semi-weedy plants like epazote and amaranth greens that are used for seasoning food and medicinal purposes.

including fig leaf squash (*c. ficifolia*), chayote (*s. edule*), zucchini (*c. pepo*), and a hard squash known as "*ayote*" (possibly *c. moschata*).[2]

While the overall landscape of the Guatemalan highlands is rich in crop diversity, not all *milpa* crops are equally diverse. Whereas the vast majority of rural households practice intercropping, a small handful (7% of those surveyed) grow nothing but maize in their *milpa* plots. Whether or not a household augments its *milpa* with other plants could be driven by any number of factors, including the characteristics of its arable landholdings, the availability of labor, the gender of the household member who manages the plot, and the perceived advantages and disadvantages of intercropping minor *milpa* crops with maize.

7.3 Advantages and Disadvantages of Intercropping: The Farmers' Perspective

During focus group discussions, highland farmers identified a variety of advantages and disadvantages associated with cultivating minor crops in the *milpa*. Among the many advantages discussed were the pleasure that farmers derive from growing multiple crops and the environmental benefits of intercropping. But for the majority of farmers, the advantages of intercropping were related to its ability to help fulfill their family's consumption needs. Perhaps the most widely mentioned advantage of cultivating minor crops were that they complemented maize in the family diet and ensured that basic nutritional needs would be met. As one female participant explained, "When I grow beans I know that my family will eat, even if we don't have meat." Other farmers noted that they could sell the crops in the market for a cash income. They did not

[2] The biological names of legumes and squash species represent my best attempt to derive their scientific and English equivalents from the common folk names. The Spanish names provided in Table 5.1 are consistent with the popular taxonomy used in both communities.

perceive the selling of *milpa* crops as a profitable activity, but rather as an *intercambio*, or exchange that allowed them to obtain goods like sugar and coffee that they could not produce at home.

Focus group participants also identified several drawbacks associated with intercropping. Several male participants complained that cultivating beans, squash, and other plants in the *milpa* complicates weeding and other agricultural tasks and is, ultimately, more labor-intensive. Another common complaint was that intercropping lowers maize yields. The beans that grow up the cornstalks tend to weigh the maize plants down, making them more susceptible to lodging; the roots of squash plants "disturb" the roots of the maize plants; and a popular leafy green known as *nabo culix* has a reputation for consuming moisture and drying the soil.

7.4 Gender and Infra-crop Milpa Diversity

Relative attitudes about the advantages and disadvantages of intercropping differ among men and women. In general, women tend to have a more favorable impression of intercropping, while men tend to recognize more of the disadvantages. There are several possible explanations for the differing values that men and women place upon the cultivation of *milpa* crops.

One reason that women tend to value intercropping more than men relates to the gendered dimensions of household responsibilities. In general, women play a significantly more active role in food preparation than their male counterparts. While 79.4% of females over the age of fourteen contribute to domestic tasks within their households, less than 15% of males do. Since men are less active in food preparation, they are less familiar with the challenges of providing a varied diet. As the female participants in one focus group explained, men tend to evaluate *milpa* only according to the quantity of tortillas on their plate and they fail to recognize the role that the minor crops play in sustaining their families.

For their part, men assume greater responsibility for working in the fields. More than three quarters of all males over the age of fourteen work in the *milpa*, while half of females over the age of fourteen do so. Since more males tend to work in the *milpa*, they may have a greater awareness of the drawbacks – particularly the greater labor expenditures – associated with maintaining minor *milpa* crops.

Another possible explanation for the differing values that men and women place upon intercropping may result from the varying opportunity costs associated with the allocation of male and female labor. Men tend to have an easier time finding employment in the labor market and nearly always earn higher wages. Given the greater opportunities available to them, men might place a greater monetary cost on the time spent attending to minor *milpa* crops.

Despite the greater importance that women place upon intercropping, that preference is not manifest in the use patterns on male and female landholdings. As documented in Table 7.2, there are no significant differences between the cropping practices on male and female-owned arable lands. Nearly all arable land is cultivated with maize, the quintessential *milpa* crop, while approximately two-thirds of maize plots are intercropped with at least one other crop species. Of course ownership of a piece of land is not always synonymous with *control* over that piece of land (Agarwal, 1994; Deere and Leon, 2001). Rural women in the Guatemalan highlands have very little control over cropping decisions within their households (Katz, 1995). While the nearly equal rates of intercropping on male and female-controlled lands may indicate similar attitudes towards cultivating minor *milpa* crops, they might also be indicative of the limited control that women have over their own landholdings.[3]

7.5 Market Participation and Infra-crop *Milpa* Diversity - An Econometric Model

A primary objective of this chapter is to identify the processes affecting the level of infra-crop milpa diversity. In particular, I am interested how peasant farmers' participation in different realms of the market economy is related with the combined diversity of the "three sisters" of the *milpa*: maize, beans, and squash. Utilizing a two-stage "hurdle" model, this section provides an econometric analysis of the forces shaping the overall diversity of the milpa trilogy.

While the practice of cultivating maize for family consumption is universal among all of the surveyed households with arable landholdings in Nimasac and Xeul, the decision to intercrop with beans and squash is not. Among the 115 households with arable land, twenty-six – or 22.6% – do not cultivate the secondary crops in their milpa plots; more than two-thirds do not grow any squash.[4] Given that such a significant proportion of the households do not grow the minor *milpa* crops, it is helpful to distinguish between two different decisions: (1) the decision of whether to cultivate minor *milpa* crops; and (2) among those farmers who decide to plant minor *milpa* crops, the choice of how much diversity to cultivate. If the processes that affect these two choices are different, it is necessary to use a two-stage "hurdle" technique that separately

[3] In general, the relationship between gender and the on-farm conservation of crop genetic diversity is understudied and deserving of future research.

[4] Though they do not grow legumes or squash, the households may still cultivate fruits, vegetables, and/or herbs on their land.

models each decision. Otherwise, estimates of the forces governing the overall level of diversity cultivated at the household level will be biased (Kennedy, 1998).

7.5.1 The Two-Stage Hurdle Model

It is possible to conceptualize farmers' decisions about intercropping as occurring in two steps. This is the approach of the two-stage "hurdle" model. In the first stage, farmers make the decision of whether to intercrop their maize fields with beans and squash. A dichotomous dummy variable is used to indicate whether the household practices intercropping and, thereby, crosses the hurdle. Only households that intercrop proceed to the second stage, where they determine how many minor crop species to include in their *milpa* plots.

There are two advantages to using a hurdle model for identifying the processes that affect the on-farm conservation of infra-crop *milpa* diversity. As mentioned above, one advantage is that it corrects for selection bias if the decision of whether to cultivate minor *milpa* crops is driven by different processes than those that govern the actual level of diversity cultivated (i.e. it does not include households that have chosen to not intercrop in regressions that attempt to identify forces affecting the particular amount of diversity that is managed). Another advantage is that, unlike most studies that focus exclusively upon the processes governing the level of diversity maintained, the two-stage hurdle also addresses the equally – if not more – important issue of the processes contributing to farmers' complete abandonment of the intercropping practice (Van Dusen, 2000).

7.5.2 Description of Dependent Variables

As discussed in the previous chapter, diversity is characterized by two components: richness and evenness. Richness reflects the quantity of species present in a given area; evenness accounts for the spatial distribution of each species. It is especially challenging to account for both of these dimensions when measuring the diversity of minor *milpa* crops. Unlike maize plants that are consistently planted in rows, one meter apart from one another, the appearance of minor *milpa* crops in farmers' fields is more random. Unless detailed mappings are conducted, it is difficult to account for the amount of area a farmer allocates to minor *milpa* crops. Given that such mappings were not conducted for this study, it is not possible to estimate the area cultivated with beans and squash and, thus, calculate measures of evenness. Consequently, in this chapter I use only a measure of richness, specifically a simple count of crop species, when discussing the diversity of the secondary *milpa* crops.[5]

Three sets of dependent variables are tested in this chapter. The first set is a measure of overall *milpa* diversity that accounts for the combined richness of maize varieties, legume species, and squash species. The second and third sets of variables focus upon the respective intra-crop richness of legume and squash species. The histograms in Figure 7.1 and Figure 7.2 illustrate the structure of the dependent variables for the first set of variables: Figure 7.1 represents the sum of maize seed lots, legume species, and squash species that are managed at the household level; Figure 7.2 excludes the number of maize seed lots and represents the combined count of legume and squash species. The histogram in Figure 7.3 describes the distribution of legume species among

[5] It is not possible to use the Margalef index since, like the evenness measures, its calculation is also dependent upon the amount of area allocated to each crop.

the households sampled. The distribution of squash species is described in Figure 7.4. As illustrated in the histograms, all 115 households cultivate maize, but among those households only 76.5% choose to intercrop with beans and only 30.4% choose to intercrop with squash. Among the households who cultivate squash, all but one also intercrop with legumes.

All three sets of variables were submitted to the two-stage hurdle process. Probit regressions were used for the first stage, since the dependent variable is a binary 0-1 measure of whether the household maintains legumes and/or squash in its milpa plots.[6] The second stage only included households that had crossed the first hurdle; truncated Poisson regressions were used to account for the discrete count nature of the richness measures. A normal Poisson regression of all households is also included for each set of dependent variables. If there is no difference between the processes governing the decision to intercrop and the decision of how many minor species to cultivate, the normal, untruncated Poisson regression would also help to identify the forces influencing the level of intercrop diversity found in farmers' fields.

Tables 7.3, 7.4, and 7.5 provide descriptive statistics for each set of dependent variables. Table 7.3 summarizes the measures of overall infra-crop *milpa* diversity, Table 7.4 summarizes the measures of intra-crop legume diversity, and Table 7.5 summarizes the measures of intra-crop squash diversity.

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[6] The coefficient estimates for the Probit models measure the change in the probability that the household will intercrop as a result of a unit change in the value of the respective regressor.

7.5.3 Independent variables

Each of the dependent variables is regressed upon the same set of independent variables. The independent variables are the same regressors that were used to identify the social factors affecting intra-crop maize diversity in the previous chapter (see Table 6.7). All of the independent variables are hypothesized to have the same effects on infra-crop *milpa* diversity as they were expected to have upon intra-crop maize diversity.

7.6 Market Participation and *Milpa* Diversity – Findings from the Econometric Analysis

This section reports the estimated impacts of the various social forces upon the combined diversity of the "three sisters" as well as their role in shaping the diversity of the two secondary *milpa* crops, legumes and squash. All three measures of *milpa* diversity are submitted to the two-stage hurdle process, which distinguishes the decision of whether to intercrop from the decision of how much diversity to cultivate. In general, the decision to intercrop is found to be linked to five variables: receipt of technical assistance, participation in non-familial seed exchange, proportion of adult labor allocated to wage labor, value of agricultural sales, and the religious composition of the household. But, the level of diversity for each component of *milpa* diversity is found to be shaped by somewhat different sets of social processes.

7.6.1 Infra-crop Milpa Diversity

Results from the regressions that address overall *milpa* diversity are reported in Table 7.6. The first regression estimates the coefficients for factors affecting the combined richness of maize seed lots, legume species, and squash species among all households in the sample. The decision of whether to intercrop maize with beans and squash is modeled in Regression 2. The third and fourth regressions are truncated Poisson regressions that help to identify the forces governing the level of infra-crop richness among households that engage in the practice of intercropping with beans and squash: Regression 3 estimates the forces shaping the combined number of legume and squash species among intercropping households; Regression 4 identifies the processes affecting the overall richness of maize, beans, and squash diversity among the group of intercroppers.

7.6.1.1 Household Characteristics

Among the household characteristics, only wealth is statistically significant in explaining the level of infra-crop milpa diversity maintained at the household level. In general, wealth is found to be negatively associated with all models of *milpa* richness and the probability of intercropping. The result is especially reliable as it relates the count of *milpa* crops among all 115 households in the sample. This finding is consistent with focus group participants' claim that intercropping is a means of assuring food security at the household level. Growing a larger number of *milpa* crops improves a peasant household's ability to survive unexpected crises and guarantees that a minimal level of subsistence will be met (Lipton, 1968). But, with greater assets in the form of landholdings, livestock, and consumer durables, wealthier households have more options for managing such risks and, consequently, more coping mechanisms during times of distress.

7.6.1.2 Human Capital

Among the set of human capital variables, the dummy indicating whether a household is the recipient of technical assistance provides the only reliable outcome. Interestingly, all households that received technical assistance – some 10% of the sample – intercropped legumes in their *milpa* plots. This finding runs counter to the expectation that contact with agricultural extension agents will result in less intercropping since (a) the agents typically encourage farmers to abandon *milpa* agriculture and grow cash crops on their land, or (b) they push the use of chemical fertilizers that upset the nutrient balance of the "three sisters" and impede the growth of minor *milpa* crops. But, on the other hand, all households with arable land dedicate at least a portion of it to *milpa* agriculture. Since households that receive technical assistance tend to dedicate at least a portion of their land to cash cropping, they may find a need to grow more subsistence crops in the remaining plots where they cultivate *milpa*. Such a strategy would allow them to produce a desirable amount of subsistence crops even as they take a portion of their land out of *milpa* agriculture (i.e. they may find a need to grow more subsistence crops in a given space since they have allotted less land to *milpa* production).

In addition to technical assistance, estimates for two other human capital variables provide noteworthy results. First, despite my casual observation during group interviews, one cannot claim within the commonly accepted confidence intervals that households with a greater proportion of adult females are any more likely to intercrop their *milpas* with beans or squash; nor do they tend cultivate a greater number of the minor *milpa* crops. Second, while more educated households are less likely to intercrop, those that do tend to grow a larger number of *milpa* crops. Once again, however, this finding is not statistically significant ithin the usual confidence intervals.

7.6.1.3 Social Capital

All three of the social capital variables play statistically significant – though functionally different – roles in shaping infra-crop *milpa* diversity. The probability of whether a household will intercrop with beans and squash can be reliably linked to the religious composition of the household and the extent to which household members engage in seed exchange outside family networks. Consistent with Sheldon Annis' (1987: 10) claim that, "The rise of Protestantism is an expression of 'anti-*milpa* forces,'" households with a greater proportion of evangelical Christians are less likely to intercrop.[7] Meanwhile, households that have received maize seed outside of their family networks are more probable to cultivate legumes and squash in their *milpa* plots. This somewhat unexpected result may suggest that the initiative to seek seed outside normal networks is indicative of a broader interest in agricultural diversity.

While religion and seed-sourcing are the social capital variables that are most confidently linked to a household's decision to intercrop, the community in which the household is located plays a consistent role in affecting the actual level of diversity that is cultivated. The community variable is positive and statistically significant in both of the truncated Poisson regressions, implying that households in Nimasac tend to cultivate richer *milpas* than their counterparts in Xeul. The marginal effect is particularly strong as it relates to the number of legume and squash species that are cultivated.

[7] As Annis goes on to explain, practitioners of evangelical Christianity are more likely to reallocate their resources away from traditional practices – like making *milpa* – that are associated with a poor but self-sufficient community economy to activities that are more conducive to individual accumulation.

The religion variable is also statistically significant in the normal Poisson. Its significance may suggest that, in addition to discouraging the practice of intercropping, a greater proportion of evangelicals in the household is associated with lower levels of infra-crop *milpa* diversity. Of course, the significance of the religion variable in the untruncated Poisson might also result from a confounding of the decision of whether to intercrop with the decision of how many *milpa* crops to plant, as distinguished in the two-stage hurdle regressions.

7.6.1.4 Natural Capital

As with the level of intra-crop maize diversity (presented in the previous chapter), the size of a household's arable landholdings plays a statistically significant role in explaining the level of overall *milpa* diversity maintained by peasant households. Although the result is not as reliable when the number of maize seed lots is excluded, the hypothesis that infra-crop *milpa* diversity increases with the size of arable landholdings cannot be rejected. Indeed, the arable land variable is positive and significant in both the pre- and post-hurdle Poisson regressions. The increase in *milpa* diversity that arises from more land, however, is increasing at a decreasing rate, as indicated by the negative – and statistically significant – land-squared variable. Once again, the number of distinct plots managed by a household (a variable that is included to explore farmers' practice of matching agricultural practices to different farming environments) cannot be said to affect the level of crop diversity, at least within the commonly accepted confidence intervals. None of the natural capital variables have a statistically significant impact upon the decision of whether to intercrop maize with beans and squash.

7.6.1.5 Market Production

Perhaps the most interesting results for this set of regressions relate to the estimates for the market production variables. In general, the decision of whether to intercrop appears to be strongly influenced by the amount of resources allocated to market production. Contrary to the expected results, however, the probability that a household will intercrop tends to *increase* – not decrease – as household land and labor are apportioned to market production. An increase in the amount of adult labor allocated to labor market production is significantly associated with an increase in the likelihood that a household will intercrop, as is an increase in the amount of agricultural output sold per unit of land. The later finding is consistent with focus group participants' observation that minor *milpa* crops can be sold to acquire cash for purchasing necessary consumer goods. The former, however, is more perplexing. Perhaps households that sell a greater proportion of their labor power in the labor market tend to be more enterprising in all of their economic endeavors, including maintaining a diverse *milpa*.

In addition to the statistically significant results for labor market participation and commercial agriculture, the proportion of adults working as transnational migrant laborers and the share of household income earned from petty commodity production both play important roles in the decision of whether to intercrop. The marginal effects of both variables are positive and substantively large. Due to relatively large standard errors, however, neither result is statistically reliable.

While they all play an important role in shaping the decision of whether to intercrop, none of the market participation variables have statistically significant results for determining the actual level of diversity that is cultivated in the *milpa*. (That is, the market participation variables are statistically significant in the first hurdle, but not the second.) Nonetheless, as with the measures for intra-crop maize diversity, it is worth noting that the estimates for nearly all of the variables in all of the Poisson regressions are positive. Thus, the null hypothesis that allocating resources to market production is associated with lower levels of infra-crop diversity on the farm must be rejected. As will be discussed in the following chapter, this challenges the notion that farmers substitute market activities for *milpa* agriculture. In fact, the two realms of economic life may be complementary.

7.6.1.6 Market Expenditures

Among the market expenditure variables, only the use of hired field hands is found to be statistically significant. In general, an increase in the use of hired field hands is associated with a reduction in levels of overall *milpa* diversity and the probability that a household will engage in intercropping. However, the negative relationship only falls within the established confidence intervals in the untruncated Poisson. When tested in the two-stage hurdle process, the result is less reliable. Thus, while the null hypothesis that the use of hired field hands is associated with a reduction in crop diversity cannot be rejected, the failure to reject may be attributable to a conflation of the decision of whether to intercrop with the decision of how many crops to cultivate that occurs in the pre-hurdle Poisson.

As discussed in the previous chapter, hired labor can be understood to be poorer quality than family labor. Hired field hands may lack the patience and knowledge of – and concern for – the hiring family's consumption preferences and the environmental attributes of each plot of land. Moreover, households that rely upon hired labor to care for their *milpa*, are likely to take less pleasure in the joy of intercropping. They might also prefer to simply purchase foods in the market rather than growing them in the fields, though the amount of expenditures on consumer goods is not found to have a discernable impact on the number of *milpa* crops that are cultivated.

7.6.2 Beans and Squash: The Intra-crop Diversity of the Secondary *Milpa* Crops

In the previous section it was found that eight of the eighteen variables tested are statistically associated with shaping infra-crop *milpa* diversity. It is possible, however, that the different processes have differential effects on each of the *milpa* crops. By separately looking at the social forces that shape the richness of legume and squash diversity, this section explores that possibility.

The regression results for the social forces shaping legume diversity are presented in Table 7.7; Table 7.8 presents the results for squash diversity. The first regression in each table represents the untruncacted, pre-hurdle Poisson. The decision of whether or not to cultivate legumes or squash is modeled in the second regression of each respective table. The post-hurdle, truncated Poisson for households that choose to cultivate the minor *milpa* crop is represented in the third regression of each table.

7.6.2.1 Factors Affecting the Decision to Intercrop

In the section 7.6.1, a variety of human capital, social capital, and market production variables were estimated to be statistically significant in explaining the probability that a household will decide to intercrop its maize with either beans or squash. In particular, the likelihood that a peasant household will intercrop was found to decrease with a rising proportion of evangelical Christians in the home. It was also found to increase with the receipt of technical assistance, participation in seed exchange outside family networks, participation in the labor market, and the sale of agricultural output.

7.6.2.1.1 Legumes

The decision to intercrop appears to be driven firstly by the decision to cultivate legumes. A comparison of Regression 2 in Table 7.6 and Regression 6 in Table 7.7 illustrates that all of the factors that can be reliably linked to the decision to intercrop in general also play a statistically significant role in the decision to intercrop with legumes in particular. But, as shown in Regression 9 of Table 7.8, none of the variables that were statistically significant in explaining a household's decision to intercrop are statistically significant in explaining the probability that a household will cultivate squash. This is not to say that the processes that govern the decision to intercrop are irrelevant to the decision to cultivate squash. On the contrary, all but one of the 35 households that cultivate squash also grow legumes in their *milpa* plots, suggesting that there may be a hierarchy of crops grown in the *milpa*.[8] Without first deciding to cultivate legumes, the choice of planting squash may not be considered.

In addition to the five variables that were found to affect the general decision of whether to intercrop, the probability that a household will cultivate legumes can also be confidently linked to its reliance upon income from petty commodity production. As shown in Regression 6, as the share of household income earned from in-home production of commodities increases, the household is substantially more likely to grow

[8] The hierarchy of *milpa* crops might play itself out in the following manner: (1) farmers decide whether to grow maize on a particular piece of land; (2) once the decision has been made to grow maize, the farmer decides whether to cultivate beans; (3) after the decision has been made to grow beans, the farmer considers the question of growing squash. It should be noted that this theory of a hierarchical *milpa* is based entirely upon my quantitative data. I did not encounter any supporting evidence in my qualitative analysis.

legumes. This finding is unique to the decision to cultivate beans. Altogether, three of the four market production variables in Regression 6 are statistically significant and positively associated with the decision to grow legumes. Moreover, though statistically insignificant, the proportion of household labor allocated to transnational migrant labor is estimated to have a substantively large increase in the probability of planting beans in the *milpa*. These findings suggest, once again, that rather than displacing *milpa* agriculture, participation in the market economy may complement the practice of cultivating traditional crops for household consumption.

7.6.2.1.2 Squash

While the decision to cultivate legumes is reliably associated with a number of factors, only one variable is statistically significant in explaining the decision to grow squash. As shown in Table 7.8, households located in Nimasac are significantly more likely to cultivate squash in their *milpas*. Three of the four market production variables have negative coefficients in Regression 9; the estimated impact of participation in transnational labor markets is substantively large, but none of these coefficients is statistically significant. Ultimately, the null hypothesis that rural Guatemalans choose to participate in the market economy rather than growing squash must be rejected.

7.6.2.2 Factors Affecting the Level of Diversity Cultivated

Tables 7.7 and 7.8 show the regression results for the estimated impacts of the selected variables upon the number of minor *milpa* crops planted in household *milpas*. Regression 5 and Regression 8 show the pre-hurdle, normal Poisson results for legumes and squash respectively. Results for the post-hurdle, truncated Poisson models are provided in Regression 7 and Regression 10.

Interestingly, none of the variables are statistically significant in the truncated Poisson regressions. Once a household has made the decision to intercrop beans or squash it cannot be stated with confidence that any of the selected regressors play a particular role in governing the number of crop species grown. Thus, though the results may be biased, any inference about the forces shaping the richness of legumes or squash must be gleaned from the pre-hurdle Poisson models.

7.6.2.2.1 Legumes

As shown in Regression 5, a household's social capital, natural capital, and market activities all help to explain the diversity of legumes cultivated. In total, five variables were found to be statistically significant. Given that they are components of the untruncated Poisson, however, it is important to remember that the estimates may conflate the decision of how many legume species to cultivate with the decision of whether to even plant the crop. Since they are also significant in the decision to cultivate beans (Regression 6), two of the statistically significant variables in Regression 5 – namely the religious composition of the household and its participation in the labor market – might, in fact, have an indeterminant effect on the actual number of beans planted.

Among the remaining statistically significant variables, two are the land variables: households with larger landholdings tend to manage more legumes, but they do so at a decreasing rate. The null hypothesis that size of arable landholdings and the number of legumes planted are positively correlated cannot be rejected and, once again, it appears that improved access to land plays a positive role in promoting the cultivation of crop genetic diversity. Finally, farmers from Nimasac manage more bean diversity than farmers from Xeul.

7.6.2.2.2 Squash

Relative to legumes, only a small number of variables are confidently linked to the amount of squash diversity cultivated. As shown in Regression 8, only three of the regressors were found to have a statistically significant relationship with the number of squash species grown in the *milpa*: community, consumer goods, field hands. The significance of community may indicate that farmers in Nimasac tend to grow more squash varieties than farmers in Xeul. But, given that the variable is also significant in the first regression of the hurdle model, it may be that the pre-hurdle regression has conflated the decision to cultivate squash with the decision about the number of squash to cultivate.

Both of the market expenditure variables play a statistically significant role in explaining the number of *cucurbita* cultivated. In general, households that spend more on consumption goods tend to cultivate a smaller number of squash species. The null hypothesis that households will substitute purchased goods for a diversity of homegrown squash cannot be rejected.

The richness of squash diversity is also found to decrease as households hire an additional day of field labor. There are at least three possible explanations for the negative relationship between the use of hired field hands and the number of *cucurbita* planted. One is that households that rely upon hired labor might take less joy in maintaining a diverse *milpa* or have determined that the additional benefit of squash in the *milpa* are not justified by the cost of the hired labor that would care for it. Another possible reason is that purchased labor is simply lower quality than family labor and hired fields fail to properly care for squash plants. The third potential explanation for the negative and significant sign of the hired labor variable is that households that purchase the labor power of field hands may simply consider the hoe to be a better means of weed control than the shade of squash leaves.

7.7 Conclusion

As a "mega-center" of crop diversity, Guatemala is renowned not only as a center of maize genetic diversity, but also as a center for infra-crop diversity. While most of the concern about genetic erosion in Guatemala is focused upon the principal food crop, the future of minor food crops like beans and squash may also be threatened by the modernization of rural economies. In this chapter I have explored the processes that shape both the practice of intercropping and level of infra-crop diversity that is maintained in the household *milpas* of Nimasac and Xeul. As the outcomes from a two-stage hurdle model suggest, the processes that govern the decision of whether to cultivate legumes and squash in the *milpa* are different from the forces that shape the actual number of minor crops that are maintained. Moreover, differential processes affect the distinct levels of legume and squash diversity. Depending upon the realm where it is performed, participation in the market economy either facilitates or discourages the cultivation of infra-crop diversity. In general, higher levels of market expenditure are associated with lower measures of infra-crop richness while the allocation of land and labor to market production is associated with higher measures of *milpa* diversity.

The *milpas* of Nimasac and Xeul are sites of rich infra-crop diversity. In addition to planting maize, peasant farmers cultivate a variety of legumes, squash, fruit trees, herbs, medicinal plants, and greens in their subsistence plots. Rural residents associate a number of benefits with intercropping. Like agriculturalists throughout the world, they take pleasure in cultivating a variety of crops and they note the agro-ecological synergies that emerge from cultivating crops that complement one another's development in a given space. They also praise the dietary contributions of minor *milpa* crops: not only do they improve the nutritional content of peasant meals, but they also serve as a guarantee that farmers will have something other than maize to eat. A final advantage of minor *milpa* crops is that they can be sold for cash, thereby enabling homemakers to purchase consumption goods that cannot be produced on the farm.

Despite the numerous advantages associated with intercropping, peasants also note two disadvantages. One is that caring for – and working around – the minor *milpa* crops creates more work, making the practice of maintaining a *milpa* more labor-intensive. Another commonly mentioned shortcoming is that the minor crops may actually decrease maize yields by causing the corn stalks to lodge or by competing with maize for nutrients and moisture in the soil.

Despite my observation that women have a relatively more favorable attitude toward intercropping than males, the claim is not supported by empirical data. There are no notable difference between the agricultural practices on male and female-owned land: rates of *milpa* agriculture and intercropping are similar for both gender groups. Moreover, the variable representing the proportion of females in the household is substantively small, statistically insignificant, and frequently negative in the regression analysis of this chapter. Of course, both of these "facts" may obscure the ways that power relations are played out in the household. Although women may prefer to cultivate minor *milpa* crops, they may lack the power to fully implement their preferences when the use of household resources is contested.

An econometric analysis was used to identify the processes that shape the diversity of the "three sisters" of the *milpa*: maize, beans, and squash. Since nearly a quarter of the households do not intercrop with legumes or squash, I utilized a two-stage hurdle model that distinguishes the decision of whether to intercrop from the decision of how many legume and squash species to cultivate. The results suggest that each decision is, in fact, governed by a different set of processes.

Five variables were found to be statistically significant in explaining the general decision to intercrop. The probability that a household will intercrop increases if household members receive technical assistance from agricultural extension agents, engage in seed exchange outside family networks, allocate more resources to wage labor, or increase sales of agricultural output; the probability is inversely related with the share of evangelical Christians in the household. Among these five variables, only one – the religious composition of the household – also plays a statistically reliable role in shaping the actual level of infra-crop diversity maintained. Otherwise, *milpa* richness is found to increase among households with more arable land (though at a decreasing rate) and those located in Nimasac; it tends to decrease among wealthier households.

The decision of the whether to intercrop is most strongly represented in the decision to grow legumes. All five of the aforementioned variables that are reliably associated with the decision of whether to intercrop are also statistically significant in the decision to grow legumes, yet none of them can be reliably associated with the decision to plant squash. Given that 34 of the 35 households that cultivate squash also cultivate legumes, it is possible that there is a hierarchy for cultivating milpa: households only consider growing squash once they have considered growing legumes.

In terms of the level of diversity cultivated by those households that engage in intercropping, the number of legume species cultivated and the number of squash species cultivated were found to be shaped by differential processes. The two market expenditure variables (i.e. expenditures on consumer goods and hiring field hands) are statistically significant in explaining the number of squash species grown, while the count of legume species is most reliably linked to the size of the household's arable landholdings, its religious composition, and its participation in the labor market. The implication is that social forces shape the diversity of different crops in different ways.

The differential impact of social processes is particularly noteworthy as it relates to the role of markets in shaping infra-crop *milpa* diversity. As hypothesized by Fafchamps (1992) and others, participation in certain realms of the market economy is associated with a reduction in the cultivation of some crops. The finding, however, is far from consistent and only minimally substantiated by the econometric results. Depending upon the crop and the type of market engagement, certain forms of market participation are *positively* associated with intercropping and the cultivation of minor milpa crops.

In general, the allocation of household resources to market production is associated with an increase in the probability of intercropping and in the number of *milpa* crops grown while market expenditures have the opposite effect. Depending upon the measure of diversity, however, the results are mixed. The hiring of field hands is the only market variable whose effect is consistent across all of the infra-cropping regressions: it is negatively associated with all measures of intercropping and with the number of *milpa* crops cultivated (though it is statistically significant only in two of the ten regression models.) Expenditures on consumption goods (the other expenditure variable) also tend to be associated with less intercropping, but this result is far less consistent. The notion that households substitute purchased commodities for *milpa* crops is only, weakly supported. Meanwhile, the hypothesis that participation in the market economy diverts household resources away from maintaining infra-crop *milpa* diversity is not only rejected, but turned on its head. The four variables representing market production are found to be generally positive across eight of the ten regressions tested, suggesting that allocating household resources to market production tends to complement the on-farm conservation of *milpa* diversity. The weak or contrary results for squash, however, suggest that care should be exercised in generalizing this result.

Table 7.1: Crops Most Commonly Intercropped with Maize

Local Name in Spanish	**English Translation**	**Percent of Households that Cultivate the Crop in their *Milpa* Plots**
Piloy	Scarlet Runner Bean	63.5%
Haba	Broad Bean/Fava Bean	38.2%
Manzana	Apple	34.8%
Ciruela	Plum	31.3%
Durazno	Peach	30.4%
Arveja	Pea	19.1%
Ayote	Hard Squash (?)	15.7%
Fríjol Negro	Black Bean	14.8%
Güisquil	Chayote/Mirliton	13.0%
Chilacayote	Fig Leaf Squash	9.6%
Nabo Culix	Field Mustard; Rape (?)	8.7%
Pera	Pear	5.2%
Cilantro	Cilantro	4.3%
Güicoy	Zucchini	3.5%
Cereza	Cherry	3.5%

Source: Survey data collected by author, 2003

Table 7.2: Gendered Use of Land for *Milpa* Agriculture

		Owned by…			
		Male	**Female**	**Jointly**	**Total**
Area	Percent of total landholdings owned by…	60.7	26.6	12.7	100.0
	Percent of arable land cultivated w/ maize (by group)	93.9	95.2	51.5	87.4
	Percent of maize land w/ polycrop *milpa* (by group)	62.6	58.6	36.7	59.1
Plots	Percent of total landholdings owned by…	63.2	29.5	7.3	100.0
	Percent of arable land cultivated w/ maize (by group)	96.3	96.2	83.3	95.2
	Percent of maize land w/ polycrop *milpa* (by group)	64.1	67.1	55.0	64.3

Source: Survey data collected by author, 2003

Table 7.3: Dependent Variables – Infra-Crop *Milpa* Diversity at the Household Level

	Description of Dependent Variable	**Regression Type**	**N**	**Mean**	**SD**	**Min**	**Max**
Regression 1	Count of *milpa* crops cultivated among all HHs (sum of maize seed lots, legume species, and squash species)	Normal Poisson	115	4.2087	1.8614	1	9
Regression 2	Dummy Variable: 1 = HH intercrops with legumes or squash; 0 = HH does not intercrop with legumes or squash	Probit	115	0.7739	0.4201	0	1
Regression 3	Count of legume and squash species cultivated among HHs that intercrop	Truncated Poisson	89	2.2360	1.2883	1	6
Regression 4	Count of *milpa* crops cultivated among HHs that intercrop (sum of maize seed lots, legume species, and squash species)	Truncated Poisson	89	4.7978	1.6458	2	9

Table 7.4: Dependent Variables – Intra-Crop Legume Diversity at the Household Level

	Description of Dependent Variable	Regression Type	N	Mean	SD	Min	Max
Regression 5	Count of legume species cultivated among all HHs	Normal Poisson	115	1.2609	0.9467	0	3
Regression 6	Dummy Variable: 1 = HH intercrops with legumes; 0 = HH does not intercrop with legumes	Probit	115	0.7652	0.4257	0	1
Regression 7	Count of legume species cultivated among HHs that cultivate legumes	Truncated Poisson	88	1.6477	0.7278	1	3

Table 7.5: Dependent Variables – Intra-Crop Squash Diversity at the Household Level

	Description of Dependent Variable	Regression Type	N	Mean	SD	Min	Max
Regression 8	Count of squash species cultivated among all HHs	Normal Poisson	115	0.4696	0.8411	0	3
Regression 9	Dummy Variable: 1 = HH intercrops with squash; 0 = HH does not intercrop with squash	Probit	115	0.3043	0.4621	0	1
Regression 10	Count of squash species cultivated among HHs that cultivate squash	Truncated Poisson	35	1.5429	0.8168	1	3

Table 7.6: Factors Influencing Overall *Milpa* Diversity – Econometric Results

		Regression 1: Count of *Milpa* Crops (n = 115)		**Regression 2: Intercrop w/ Legumes *or* Squash?** (n = 115)		**Regression 3: Count of Legumes & Squash** (n = 89)		**Regression 4: Count of *Milpa* Crops** (n = 89)	
	Variable	**Coeff.**	**t-ratio**	**Coeff.**	**t-ratio**	**Coeff.**	**t-ratio**	**Coeff.**	**t-ratio**
	Constant	0.9179***	2.64	0.6238	0.53	0.123656	0.22	1.1042***	2.88
HH Characteristics	Age of HH heads	-0.0007	-0.17	-0.0129	-0.87	-0.00502	-0.71	-0.0012	-0.27
	Wealth	-8.56e-07*	-1.69	-1.85e-06	-1.11	-3.59e-07	-0.23	-5.23e-07	-0.49
Human Capital	Household labor	0.0281	0.95	0.0275	0.25	0.0580	1.23	0.0207	0.65
	Female	0.0400	0.12	0.1452	0.14	-0.2075	-0.39	0.0341	0.09
	Education	0.0043	0.18	-0.0571	-0.81	0.0263	0.62	0.0209	0.72
	Tech. assistance	0.0299	0.15	τ	τ	-0.2243	-0.74	-0.0915	-0.44
Social Capital	Community	0.1770	1.57	0.2488	0.68	0.5403***	2.85	0.2127*	1.68
	Religion	-0.2335**	-1.97	-0.9053***	-2.40	-0.1556	-0.78	-0.1082	-0.81
	Seed exchange	0.1452	1.21	1.4190***	2.38	0.04364	0.24	0.0345	0.28
Natural Capital	Arable land	0.0491***	2.90	-0.0641	-0.36	0.0319	1.04	0.0373*	1.76
	Arable land sqrd.	-0.0007***	-2.39	0.0112	0.84	-0.0004	-0.98	-0.0005*	-1.69
	Distinct plots	0.0234	0.37	-0.1904	-0.78	0.0850	0.84	0.0483	0.71
Market Production	Labor market	0.0089	1.30	0.0608***	2.36	0.0053	0.48	0.0022	0.31
	Petty CD Production	0.1528	0.77	1.0063	1.52	0.2431	0.74	0.0581	0.26
	Commercial agriculture	0.0011	0.41	0.1029*	1.67	0.0027	0.61	0.0014	0.47
	Migrant labor	0.1482	0.33	2.7856	1.49	0.0541	0.08	-0.0949	-0.21
Market Expenditures	Consumer goods	0.0012	0.15	-0.0080	-0.29	-0.0014	-0.10	0.0004	0.04
	Field hands	-0.0028**	-2.16	-0.0055	-1.18	-0.0039	-1.60	-0.0025	-1.58
	Deviance R-Squared	0.07		0.27		0.09		0.05	

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

τ - Technical Assistance successfully predicted all cases of intercropping with legumes.

Table 7.7: Factors Influencing Legume Diversity – Econometric Results

		Regression 5: Count of Legume Species (n = 115)		**Regression 6: Intercrop w/ Legumes?** (n = 115)		**Regression 7: Count of Legume Species** (n = 88)	
	Variable	**Coeff.**	**t-ratio**	**Coeff.**	**t-ratio**	**Coeff.**	**t-ratio**
	Constant	-0.3861	-0.60	0.7546	0.64	-0.0687	-0.11
HH Characteristics	Age of HH heads	-0.0087	-1.08	-0.020	-1.35	-0.0039	-0.46
	Wealth	-9.69e-07	-0.97	-1.82e-06	-1.06	4.47e-08	0.02
Human Capital	Household labor	0.0696	1.29	0.0226	0.21	0.0578	1.05
	Female	0.0091	0.01	0.3136	0.30	-0.1203	-0.19
	Education	-0.0169	-0.38	-0.0872	-1.20	0.0142	0.28
	Tech. assistance	0.2892	0.83	τ	τ	-0.0158	-0.05
Social Capital	Community	0.3572*	1.70	0.2427	0.65	0.3478	1.59
	Religion	-0.6091***	-2.62	-0.9654***	-2.53	-0.2762	-1.17
	Seed exchange	0.2622	1.19	1.5025***	2.47	-0.0109	-0.05
Natural Capital	Arable land	0.0622**	2.04	-0.0199	-0.12	0.0206	0.55
	Arable land sqrd.	-0.0010**	-1.92	0.0088	0.72	-0.0004	-0.71
	Distinct plots	-0.0121	-0.11	-0.1748	-0.70	0.0411	0.36
Market Production	Labor market	0.0220*	1.77	0.0634***	2.43	0.0078	0.64
	Petty CD Production	0.2119	0.58	1.1166*	1.68	0.0549	0.15
	Commercial agriculture	-0.0036	-0.68	0.1073*	1.78	-0.0018	-0.34
	Migrant labor	0.6810	0.88	2.0977	1.19	0.3980	0.54
Market Expenditures	Consumer goods	0.0125	0.80	-0.0063	-0.23	0.0089	0.57
	Field hands	-0.0016	-0.74	-0.0048	-1.05	-0.0016	-0.60
	Deviance R-Squared	0.09		0.30		0.05	

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

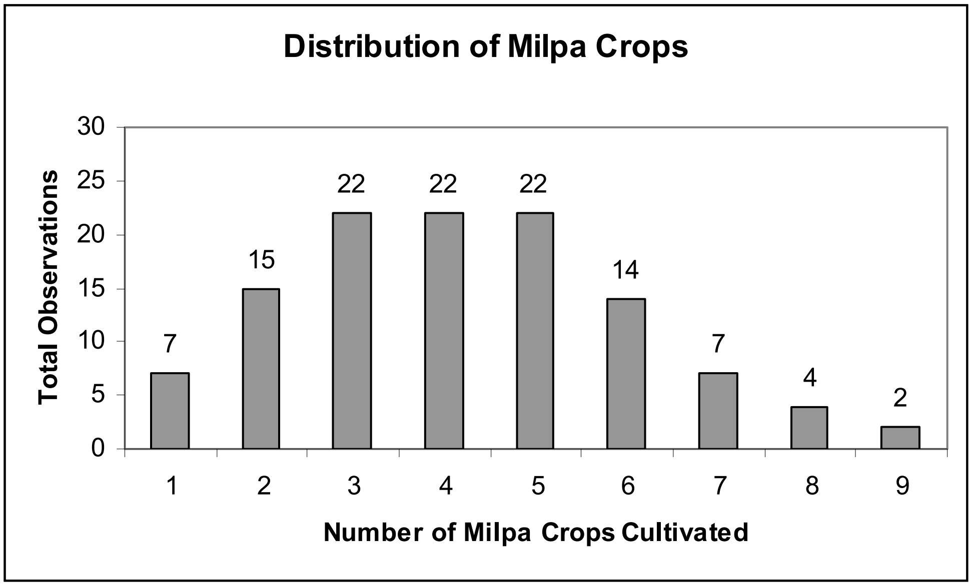
τ - Technical Assistance successfully predicted all cases of intercropping with legumes.

Table 7.8: Factors Influencing Squash Diversity – Econometric Results

		Regression 8: Count of Squash Species (n = 115)		**Regression 9: Intercrop w/ Squash?** (n = 115)		**Regression 10: Count of Squash Species** (n = 35)	
	Variable	**Coeff.**	**t-ratio**	**Coeff.**	**t-ratio**	**Coeff.**	**t-ratio**
	Constant	-1.6032	-1.40	-1.3247	-1.24	0.0481	0.03
HH Characteristics	Age of HH heads	-0.0035	-0.24	-0.0003	-0.03	-0.0058	-0.31
	Wealth	-1.59e-06	-0.55	-2.94e-06	-0.89	1.09e-06	0.16
Human Capital	Household labor	0.0508	0.54	0.0590	0.67	0.0143	0.10
	Female	-0.5762	-0.57	-0.2382	-0.25	-0.0140	-0.01
	Education	0.0673	0.93	0.0816	1.19	0.0067	0.04
	Tech. assistance	-0.6427	-0.90	-0.5088	-0.75	0.1487	0.13
Social Capital	Community	1.2766***	3.29	1.1174***	3.23	0.0873	0.11
	Religion	0.0961	0.26	0.1237	0.38	0.0427	0.09
	Seed exchange	0.4837	1.40	0.2090	0.59	0.2909	0.64
Natural Capital	Arable land	0.0571	0.95	0.0642	1.01	-0.0013	-0.01
	Arable land sqrd.	-0.0004	-0.35	-0.0007	-0.70	0.0002	0.09
	Distinct plots	0.1903	0.87	0.1580	0.78	-0.0177	-0.04
Market Production	Labor market	-0.0048	-0.20	-0.0116	-0.55	0.0210	0.59
	Petty CD Production	0.3265	0.48	-0.3440	-0.57	0.8081	0.88
	Commercial agriculture	0.0103	1.31	0.0060	0.57	0.0051	0.58
	Migrant labor	-0.8793	-0.60	-2.1464	-1.53	0.6555	0.36
Market Expenditures	Consumer goods	-0.0580**	-1.67	-0.0158	-0.57	-0.0373	-0.74
	Field hands	-0.0150**	-1.73	-0.0073	-1.31	-0.0036	-0.36
	Deviance R-Squared	0.17		0.16		0.08	

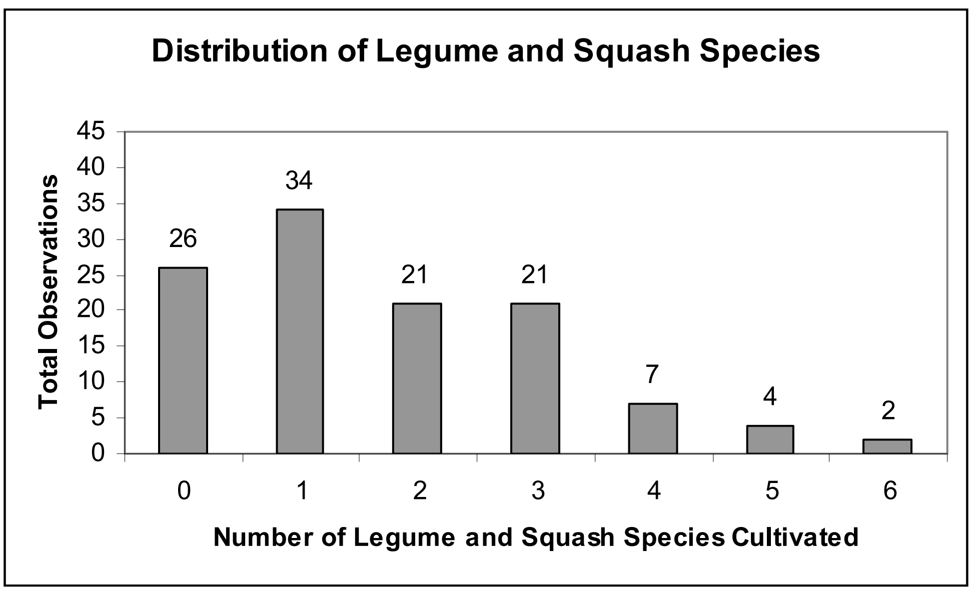
*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

Figure 7.1: Number of *Milpa* Crops Cultivated per Agricultural Household (sum of maize seed lots, legume species, and squash species)



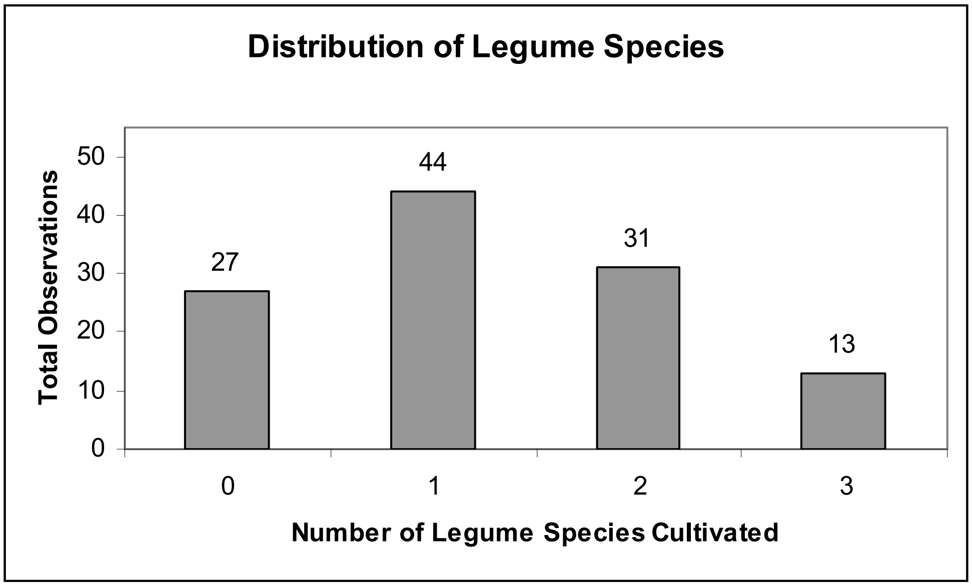
Source: Survey data collected by author, 2003

Figure 7.2: Number of Secondary *Milpa* Crops Cultivated per Agricultural Household (sum of legume species and squash species)



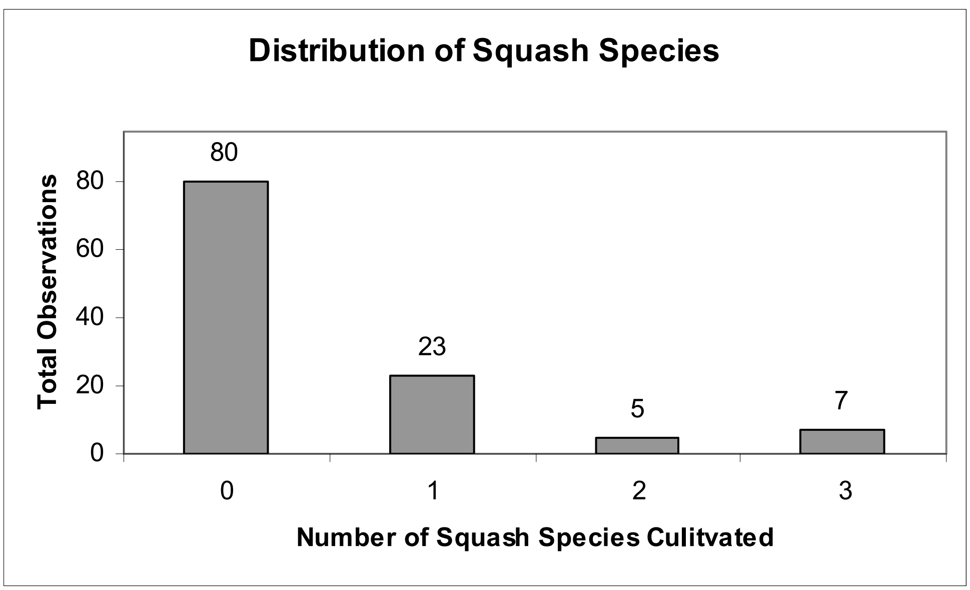
Source: Survey data collected by author, 2003

Figure 7.3: Number Legume Species Cultivated per Agricultural Household



Source: Survey data collected by author, 2003

Figure 7.4: Number of Squash Species Cultivated per Agricultural Household



Source: Survey data collected by author, 2003

CHAPTER 8

TO THE MARKET OR THE *MILPA*? CONCLUDING OBSERVATIONS ON PEASANT LIVELIHOODS, MARKET ENGAGEMENTS, AND THE ON-FARM CONSERVATION OF CROP GENETIC DIVERSITY

8.1 Introduction

Economic theorists have hypothesized that economic development in centers of crop genetic diversity will inevitably undermine the institutions that support the cultivation of crop genetic resources, thereby contributing to the process of genetic erosion. The theory carries the distressing implication that the economic lives of peasant farmers can be improved only at the risk of destabilizing a cornerstone of global food security. If so, the only way to conserve crop genetic resources, it might seem, is to stymie the development ambitions of small-scale farmers in centers of genetic diversity.

With this dissertation, I have contributed to an unraveling of this paradox. The theoretical models positing that the process of development will contribute to the loss of crop genetic resources have conflated not only "development" with market integration, but also market integration with the displacement of subsistence production. The findings reported here suggest the Guatemalan peasantry is pursuing an alternative path, one that is neither purely market nor purely subsistence-oriented *milpa* agriculture. They also hint at the possibility of development strategies that both improve the socio-economic well-being of the Guatemalan peasantry and encourage the continued *in situ* conservation of crop genetic resources in the Mesoamerican "megacenter" of biological diversity.

8.2 The Complementarity of Market and *Milpa*

Like their counterparts throughout Latin America (Deere, 1990; Brass, 2003; Barkin, 2001; Shelly, 2003; Reardon 2001), rural Guatemalans are neither the archetypical entirely self-sufficient peasantry nor full-market citizens who have become completely integrated into the market economy. Instead, they are a viable entity with one foot in the market and another in their *milpa* plots. There is a complementarity among the two forms of economic provisioning. As discussed in Chiriboga et al. (1996) and developed in Chapters 4 and 5 of this dissertation, the vast majority of Guatemalan households lack sufficient land to fulfill all of their consumption needs via agricultural production. Income earned from market activities allows peasants to purchase additional consumption needs and at the same time helps to finance the continued practice of *milpa* agriculture, which would otherwise be unviable.[1] For its part, the *milpa* provides the security that allows rural households to weather the variability and insecurity of market forms of income generation. It also absorbs the "surplus" resources of most peasant households, including weeding hours before work or after school and the labor time of women and the elderly who often suffer discrimination in rural labor markets.

It is common to view *milpa* agriculture solely through the lens of market values. *Milpa* agriculture and market forms of income generation like wage labor and petty commodity production are, after all, all means for obtaining consumption goods. Peasants sometimes sell their surplus *milpa* crops and they frequently purchase the maize grown by others. They themselves often use the language of money to measure the costs

[1] Of course, reforming Guatemala's highly concentrated agrarian structure would also improve the viability of peasant agriculture. This option is described in section 8.5.

of their expenditures and the value of their product and, ultimately, to explain that "*No hay ganancia en sembrar la milpa*," there is no profit in growing *milpa*.

Despite their similarities, however, there are important distinctions between market activities and *milpa* production. Both are forms of economic provisioning, but peasants ascribe different meanings to their performance. Market activities like transnational migrant labor and cash cropping are viewed as little more than a means for earning money and improving the household's material well-being. Meanwhile, Guatemala's predominantly indigenous peasantry view *milpa* agriculture as an economic activity that allows them to connect to their Mayan heritage; much of its value cannot be captured in a monetary price. In response to Escobar's (1999) "problematic of alterity," the subsistence-oriented agricultural practice can be understood as a means of expressing cultural difference. Peasants obtain pleasure, pride, and a sense of meaning from its production. Cultivating *milpa* is not just a means of economic provisioning, it is also a *meaningful* form of economic provisioning.

The distinction between market forms of economic provisioning and *milpa* agriculture is evidenced in the practice of transnational migration. When they talk about migrating, Guatemalan *campesinos* rarely mention the "adventure" of crossing the Sonora desert into the United States or the many sights that they will see abroad. Instead, they invariably dwell upon the "*mucho dólar*" that they will earn during their 3-7 years of working abroad. The money that they earn allows the temporary migrant workers to improve their family's economic situation and, ultimately, return to their rural residence where they continue to cultivate *milpa* on household land. Some might use their newly acquired wealth to hire field hands to assist with their *milpa* cultivation. In doing so, they typically pay the field hands more than the value of their product. In other words, they "lose" money by growing *milpa*. The income earned from their market participation augments – and even subsidizes – insufficient monetary returns from *milpa* agriculture. *Milpa* agriculture, in turn, provides rural Guatemalans with a secure food source and a means for expressing community identity. Indeed, as the several *campesinos* explained, the market and the *milpa* are both important but distinct aspects of their economic lives.

8.3 Forces Shaping *Milpa* Diversity

The complementarity of market activities and *milpa* agriculture is confirmed in the econometric analysis of Chapters 6 and 7. The results of the analysis suggest that rather than undermining the on-farm conservation of crop genetic resources, many forms of market participation are associated with higher measures of crop genetic diversity on the farm. Several dimensions of crop diversity were examined; some pertaining to the within-crop diversity of maize (Chapter 6), others to the multi-crop diversity of the three *milpa* sisters (maize, beans, and squash) (Chapter 7).

8.3.1 Forces Shaping Within Crop Maize Diversity

In general, three forces were confidently linked to the level of maize diversity maintained by Guatemalan households. The size of landholdings offered one of the most consistent results. In general households with larger landholdings tend to manage a more diverse collection of maize seed lots and grant a more equitable proportion of land to all of their maize varieties than households with relatively less land. The increases in maize diversity occur at a decreasing rate, however. Indeed, as illustrated in Tables 6.5 and 6.6, households with landholdings that are just large enough to fulfill their subsistence needs tend to have the highest measures for maize diversity while those with less than sufficient landholdings have noticeably lower indices for maize diversity.

A household's wealth was also confidently linked to the levels of maize diversity maintained on the farm. In general, rural households with more assets tend to maintain a less equitable distribution of seed lots than their poorer counterparts. This finding is consistent with the notion that households manage risks through maintaining a diversity of seed lots. With greater resources that allow them to weather unexpected changes in the environment, wealthier households have less need to spread their risks across a diversity of maize varieties.

Finally, households that are more reliant upon hired field hands to assist with their *milpa* cultivation tend to maintain fewer maize seed lots and to allocate a disproportionate share of their maize land to a handful of varieties. The hiring of field hands was the only type of market transaction associated with lower levels of maize diversity. Though relatively high standard errors rendered the results statistically insignificant, all other forms of market participation were *positively* associated with measures of maize diversity. Indeed, other than the use of hired labor, one must reject the hypothesis that market engagements are associated with lower levels of maize diversity.

8.3.2 Forces Shaping Infra-crop *Milpa* Diversity

As discussed in Chapter 7, a number of variables can be confidently linked to level of diversity among the three principal *milpa* crops: maize, legumes, and squash. As with maize, the overall richness of a household's *milpa* is statistically associated with the size of its landholdings: the more arable land that a household controls, the richer the diversity of its *milpa*. The infra-crop diversity of a household's *milpa* also appears to be closely linked to the decision of whether or not to cultivate legumes. The vast majority of households do not cultivate squash unless they cultivate legumes. The decision to intercrop with legumes, in turn, was linked to a number of processes, many of them market-oriented. Allocating household resources to wage labor, petty commodity production, and commercial agricultural are all associated with an *increase* in the probability that a household will intercrop. One cannot reject that hypothesis that intercropping and several forms of market production are complementary; rural Guatemalans augment their market income with homegrown legumes.

Identification with evangelical Christian religions is associated with a decreased probability of intercropping. As Annis (1987) and Goldin (1992) have argued, the modern and individualistic values of Christian evangelism are often counter to the traditional Mayan values of complementarity, community, and working the land, all of which are embodied in *milpa* agriculture. Indeed, with their detachment from the socio-cultural benefits that are typically associated with *milpa* agriculture, evangelicals would likely associate with the modernist notion that traditional agricultural practices represent an irrational use of household resources. This finding hints at the importance of cultural continuity and change to the future *in situ* conservation of crop genetic resources.

8.4 Markets and the *In Situ* Conservation of Crop Genetic Diversity

The results from my econometric analysis suggest that households that dedicate a greater share of their resources to market production cultivate just as much, if not more, diversity as their neighbors who allocate fewer resources to the market economy. While this may be true from a cross-sectional perspective, the econometric results are unable to address how market participation shapes the on-farm conservation of crop genetic resources over time. Indeed, a key shortfall of the econometric analysis is its lack of longitudinal analysis.

8.4.1 Commercial Agriculture and Crop Genetic Resources over Time

As discussed in Chapter 3, structural adjustment policies initiated in the 1980s have significantly undermined Guatemala's self-sufficiency in maize. By pushing the cultivation of non-traditional agricultural exports in the highland regions where maize diversity was historically concentrated, the neo-liberal transformations might have also contributed to the loss of invaluable crop genetic resources. How does this theory regarding changes over time stand-up in light of the cross-sectional econometric finding that households who cultivate cash crops maintain levels of *milpa* diversity that are comparable to purely subsistence-oriented neighbors?

As discussed in Chapter 4, cash cropping was not especially prevalent in either of the communities where the survey was administered. Other than selling surplus *milpa* crops, commercial agriculture was non-existent in Xeul. In Nimasac, a mere 3.6% of households engaged in cash-cropping and those who did so allocated a relatively small proportion of their land to commercial agriculture.[2] While the adoption of cash crops resulted in the loss of *milpa* habitat, the proportion of land that was reallocated to commercial agriculture was so minor that it is unlikely to have had much impact upon the health of crop genetic resources in the community. In short, the minimal level of

[2] Four cash-cropping families were included in the random household survey. On average, they allocated 22% of their arable land to commercial crops. There is reason to believe, however, that these were not representative of the 22 cash-cropping households. The "typical" cash croppers in Nimasac dedicate some 10-15% of their land to commercial agriculture.

commercial farming in Nimasac and Xeul has probably not affected the *in situ* conservation of crop genetic resources at the community level.

Whereas the adoption of cash crops has been relatively minimal in Nimasac and Xeul, commercial agriculture is much more widespread in the central highlands departments of Chimaltenango, Sacatepéquez, and, to a lesser extent, Sololá. The significant change in overall land use in these genetic hotspots has likely resulted in genomic erosion, or the complete displacement of crop species in their center of diversity. The shift to cash-cropping in the central highlands was not simply a result of market forces, but rather a coordinated campaign by structural adjustment lenders and international development agencies. In short, foreign actors have *subsidized the creation of a new market* (Conroy et al., 1996). The result has been the displacement of traditional agricultural practices that are associated with the generation of invaluable ecological services (Hernández-Xolocotzi, 1993; Boyce, 1996) by chemically-intensive cash-cropping that has deteriorated the local environment and contributed to worsening public health (Arbona, 1998; Conroy et al, 1996). Although the expanding cultivation of non-traditional crops has likely contributed to the loss of crop genetic resources over time, the growth of commercial agriculture is less attributable to the functioning of the free market than to the pressures of external actors.

8.4.2 Transnational Migration and Crop Genetic Resources Over Time

Like cash-cropping, the increasingly popular practice of transnational migration may also shape land use practices over time. According to the results from my econometric analyses, households who allocate labor resources to foreign labor markets are no less likely to maintain diversity than their non-migrant neighbors, at least while their members are abroad. Yet, as discussed in Chapter 6, returning migrants often choose to flaunt their wealth by constructing large cinder block homes that dwarf the traditional adobe homes of their neighbors. The result is loss of *milpa* habitat. The overall loss of agricultural land in Nimasac to the new larger homes has been noticeable, but not alarming, over the past six years. Nonetheless, it hints at the danger that urbanization – fueled by market income and population growth – poses to the conservation of crop genetic resources. Moreover, as Fitting (2006) has observed in Mexico, the practice of transnational migration has the potential to transform intergenerational attitudes towards *milpa* agriculture such that young people lose interest in maize agriculture and discontinue its practice. Goldin (1992) has also suggested that participation in wage labor and commercial agriculture has undermined traditional values in other areas of the Guatemalan highlands. These observations allude to the original dilema: is it possible to achieve rural development in a way that fortifies – rather than threatens – the on-farm conservation of crop genetic resources?

8.5 Development Goals and Policy Implications

Milpa agriculture generates multiple types of values for the Guatemalan peasantry. In addition to providing a preferred and secure foodstuff, it is also the source of important socio-cultural entailments (Chapters 2 and 4). When valued at the market prices of grain and labor, the returns from *milpa* agriculture are noticeably less than most market forms of income generation. This observation has led many economists and crop researchers to predict that market integration will displace peasant agricultural systems and hasten genetic erosion. In part, socio-cultural attachments to *milpa* agriculture help to insulate the practice from market expansion. This is not to suggest that cultural values consistently trump market values, but rather that they have helped to temper their effects. What happens, however, if participation in the market economy – as Fitting (2006) and Goldin (1992) have observed – or religious conversion – as Annis (1987) has observed – change traditional values?

The future conservation of crop genetic resources in Guatemala is contingent upon reinforcing and augmenting the multiple types of values associated with *milpa* cultivation. Guatemalan *campesinos* should be recognized and rewarded for the important role that they play in maintaining a cornerstone of global food security. Pecuniary rewards that enhance the economic returns to *milpa* farming should be combined with non-pecuniary rewards that recognize the peasantry's stewardship of an invaluable ecological service.

As this research has shown, markets are not necessarily antithetical to peasant values or to the on-farm conservation of crop genetic resources. At the same time, the peasants of Nimasac and Xeul have indicated that their development goals are not synonymous with market subsumption. As discussed in Chapter 4, they have an interest in broader social initiatives, including improved infrastructure, empowerment of women, and better infrastructure. They are not opposed to markets *per se*, but their interests are more focused on the creation of new *forms* of market engagement that allow them to earn a cash income and attend to valued household (re)productive activities like child care and *milpa* agriculture, particularly more flexible employment opportunities. In other words, they engage with the market not to substitute for subsistence-oriented agriculture, but to complement it.

The challenge in Guatemala is to create the means by which rural communities can achieve their development objectives in a way that is consistent with the *in situ* conservation of crop genetic resources. Strategies that reward and empower the farmers who cultivate crop diversity would help to realize both sets of objectives. As the literature on "natural assets" demonstrates, the conservation of natural resources and rural development can, in fact, go hand-in-hand (Boyce and Shelley, 2003; Rosa *et al*. 2003). The following is a brief outline of seven policies and institutions that would contribute to both the realization of rural development objectives and the on-farm conservation of crop genetic diversity.

i) Participatory Plant Breeding: Focus group participants expressed a desire for improved agricultural technology, particularly technologies that offer better harvests and a diversity of tastes and textures. A strategy known as participatory plant breeding (PPB) would allow farmers to achieve this goal in a way that is consistent with the on-farm conservation of crop genetic resources. PPB offers an alternative to conventional plant breeding strategies where crop scientists create broadly adapted seeds with no input from farmers and little concern for conserving genetic resources (Brush, 2004).[3] The participatory approach, by contrast, is a collaborative process where farmers and plant breeders work together and use local plant materials to develop seeds that are well-suited to local environmental conditions and manifest qualities desired by farmers. This approach could be especially useful in improving an array of seeds that fill farmers' various use needs.

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[3] With its focus on yields and seeds that conform across a variety of environments (Fuentes, n.d.), the Guatemalan Institute of Agricultural Science and Technology's maize improvement program is no exception. Like most improved seeds, ICTA's varieties require relatively large amounts of fertilizer that, as the farmers explain, "burns" minor *milpa* crops like legumes and squash.

ii) Regional Seed Fairs: Despite an interest in cultivating new maize varieties, most farmers have little access to seeds outside their family networks. Less than a quarter of survey respondents reported receiving seed from a non-family member. Yet, as Louette (1999) explains, the introduction of new plant material plays an important role in the evolution and conservation of crop genetic resources. Regional seed fairs where farmers can display crop varieties of which they are particularly proud and engage in seed exchange have been shown to facilitate farmers' access to new genetic material and to enhance the prestige of agricultural activities (Gonzales, 1999).

iii) Agricultural Easements and Community Trusts: Although rural Guatemalans would like *milpa* agriculture to remain a defining characteristic of their local landscape, they are concerned about the pressures that residential construction and population growth are putting upon their limited agricultural land. As biologist Garrison Wilkes (2007) has noted, the loss of agricultural habitat is one of the greatest threats to crop genetic resources. Agricultural easements could contribute to slowing this trend. Easements could be sold by communities or individual farmers who would forgo the development rights to their land and promise to continue practicing *milpa* agriculture. As a similar scheme in the United States has shown, the returns from selling easements could provide farmers with the financial resources that would enable them to continue cultivating their land in a way that is personally enjoyable and culturally meaningful while improving their economic well-being and ensuring the continued provisioning of ecological services (Isakson, 2002). Guatemalan communities that conserve crop genetic resources could invest the returns from such easements in community trust funds that distribute benefits over time and/or use them to finance public goods like potable water projects, schools, and community health care centers.

iv) Land Redistribution: Guatemalan peasants often lament the small area of their agricultural landholdings. Indeed, most farmers expressed a desire to expand their arable land. Their want is not due to lack of land in the country as a whole, but to its inequitable distribution. Guatemala has one of the most concentrated agrarian structures in the world, and holds the dubious distinction of having the second most unequal distribution of arable land in Latin America (World Bank, 1995). The country's current agrarian strategy of market-assisted land reform is woefully insufficient to change this pattern (CONGCOOP, 2001; CAR, 2006) and essentially requires that recipients cultivate cash crops instead of growing maize and other crops for household consumption. An alternative approach that redistributes unproductive plantation land to peasants who want to cultivate *milpa* would open new land for maize agriculture and create the possibility of genetically enriching – as opposed to eroding – the landscape of Guatemalan maize. As the empirical analysis of Chapter 6 suggests, households with sufficient land to fulfill their maize needs tend to maintain more diverse *milpa* plots than those with insufficient land.

v) Empowerment of Women: While the empowerment of women is an intrinsically worthwhile development goal, it also offers the positive entailment of facilitating the on-farm conservation of crop genetic resources. Among their objectives, women expressed a strong desire for greater control over the reproductive aspects of their lives; expanding their reproductive rights could help to slow population growth and, thereby, the loss of agricultural land. Women also expressed a desire for greater educational opportunities, an improvement that is often associated with higher levels of crop diversity (Smale *et al.*, 2006). Finally, Guatemalan women prefer the quality and diversity of tastes offered by landrace maize (FAO, 2002) and place relatively greater value upon intercropping *milpa* plots. Providing them with a greater voice in household decision-making could help to ensure the continued cultivation of maize landraces and other under-appreciated *milpa* crops.

vi) Flexible Employment: Rural Guatemalans would like better jobs. Specifically, they would like jobs with higher wages and greater flexibility. While the labor market in the highlands is flexible – workers are hired and fired at the whim of employers – the workday is not. Many highlanders expressed frustration that their long work weeks and inflexible work schedules prohibited them from attending to household duties like childcare, food preparation, and cultivating crops for household consumption. Policies that generate part-time employment off the farm could facilitate the cultivation of crop genetic resources on it (Boyce, 2006).

vii) Niche Markets: Guatemala is a tourist mecca. Visitors from around the world come to experience its natural beauty and unique Mayan culture. Most leave, however, without experiencing the high-quality landrace maize varieties that are the hallmark of traditional Mayan cuisine. Unless they have the opportunity to eat in the homes of peasant farmers, most visitors assume that Guatemala's staple is a tasteless, stale tortilla made from modern hybrid maize varieties, or worse, instant corn dough. Restaurants that showcase the high quality and culinary diversity of Guatemala's landrace maize varieties and minor *milpa* crops could be very successful in the country's urban and tourist regions. Such restaurants could raise awareness about the importance of crop genetic diversity and the fundamental role that Guatemalan *campesinos* play in securing global food security, thereby enhancing the prestige associated with *milpa* cultivation.[4] Moreover, the restaurants could assist farmers economically by paying them a price premium for traditional crop varieties.

The policies sketched above point to the possibility of a rural development strategy that is consistent with the on-farm conservation of crop genetic resources. Improving the welfare of peasant farmers need not be synonymous with a reduction in long-term food security. Moreover – as the proposed policies of niche markets, flexible employment, and agricultural easements suggest – selectively instituted markets can play an important role in fulfilling these dual objectives.

The relationship between markets and the conservation of crop genetic diversity is complex. As the econometric analysis in this study has shown, higher rates of market participation are not necessarily associated with a loss of crop genetic resources and may, in fact, facilitate their on-going conservation. Yet, as the qualitative analysis suggests, market engagements have the potential to unleash forces that contribute to genetic erosion over time. Whether or not market engagements actually undermine this cornerstone of global food security will be contingent upon the broader social framework in which they are nested. Without the appropriate protections in place, self-interested actions in the marketplace in the end may produce the unwanted result of displacing *milpa* agriculture. Alternatively, the creation of markets and other institutions that reward farmers for provisioning crop genetic resources would not only empower them to

[4] Mann (2004) describes the contributions of a similar type of restaurant in Oaxaca, Mexico.

achieve their development objectives, but also ultimately help to guarantee a resilient food supply for generations to come.

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