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Maize Diversity, Market Access, and Poverty Reduction in the Western Highlands of Guatemala

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The western highlands of Guatemala lie within the area where maize was first domesticated, and maize remains central to farmers' livelihood security. Over 50% of the population in the region are in poverty, and over 48% suffer from chronic malnutrition. Development efforts have focused on improved land management, crop diversification, and improved access to markets, especially for high-value vegetable crops such as snow peas. As a result of successful initiatives worldwide, more attention is being directed at the extent to which farmers can benefit from market opportunities for indigenous crops by receiving a price premium for providing the environmental service of conserving agricultural biodiversity. Such an approach bridges the gap between poverty alleviation and in situ conservation. We explored this potential development pathway through both qualitative and quantitative research. Focus groups were conducted in 5 communities in the maize-growing highlands of Guatemala, followed by a survey of 989 farm households in 59 locations. Our results show that most farmers in the western highlands of Guatemala are severely maize deficient; on average, farm households produce enough maize for only 6.9 months of consumption a year and are forced to purchase maize to meet basic consumption needs. The results are in sharp contrast to research conducted in highland communities in neighboring Mexico, where many farmers are able to sell their maize in relatively lucrative specialty maize markets. In the context of renewed interest in reducing poverty in Central America, our research suggests that rather than focus on market development for local maize varieties, development efforts should target other types of interventions.

Keywords: *Guatemala; poverty reduction; maize; agricultural diversity; farmers' livelihoods; conservation through use.*

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Introduction

Poverty in the Guatemalan highlands

Rural poverty and food insecurity are endemic in Guatemala, and the overwhelming majority of the impoverished population lives in rural areas. Guatemala is known for its ethnic diversity. Indigenous groups typically have less access to education and suffer from higher rates of poverty and malnutrition; these communities make up 38% of the total population and live mainly in highland areas (United States Agency for International Development 2010). Guatemala has the fourth highest level of child undernutrition in the world (World Food Programme 2014).

The overwhelming majority of indigenous communities are engaged in smallholder agriculture, largely subsistence but with some market-oriented production. Over 90% of farmers in Guatemala farm on 20% of the country's arable land, contributing to the high levels of inequality in Guatemala. The mountainous landscape and underdeveloped infrastructure in the western highlands mean that rural communities tend to be isolated from the rest of the country. Furthermore, indigenous populations often farm marginal land that is very susceptible to soil and land degradation (Figure 1).

Poverty in the western highlands affects over 50% of the population while 48% suffer from chronic malnutrition. Poverty is also closely connected to Guatemala's 36-year civil war, which ended in the mid-1990s (Steinberg and Taylor 2008). This was a particularly brutal war in which indigenous communities were targeted and tens of thousands of people were murdered; its legacy continues to impact the agroecological, social, and political landscape of the western highlands. A report commissioned by the United States Agency for International Development concluded that "historical patterns of structural exclusion, internal armed conflict, and unresolved social conflict reinforce and intensify social inequality, discrimination, and violence in

FIGURE 1 Maize farmer in the department of Huehuetenango. The farmer's plot is typical of those in the western highlands of Guatemala in terms of its small size, rocky soil, and steep slopes (Photo by Jon Hellin)

interrelated and systemic ways. … Without means to address these patterns systemically, violent social conflict will likely continue to escalate, undermining overall development in the Western Highlands" (Democracy International 2015: i).

Importance of maize

Maize is endemic to Mesoamerica (which includes the western highlands of Guatemala), and farmers have cultivated the crop for millennia. The ongoing evolution of maize diversity is closely linked with cultural traditions that include farmers' preferences, knowledge, and management practices (Pressoir and Berthaud 2004). Many studies have discussed the role of maize in the spectrum of Mesoamerican farmers' livelihood activities (eg van Etten 2006; Isakson 2009; Keleman et al 2013). In 2013 over 850,000 hectares of maize were harvested in Guatemala (FAOStat 2013). Yields in Guatemala are low, at under 2 tons/ha for maize (World Food Programme 2014).

Many of Guatemala's farmers practice a traditional system known as milpa, in which they intercrop maize with crops such as beans, chilies, and squash (Isakson 2009). Even though many farmers also periodically work off-farm, the milpa remains an important cultural foundation in rural communities in Guatemala. Despite this, there are concerns that maize varieties have been and will continue to be lost in the face of livelihood, climatic, technological, and political changes. Steinberg and Taylor (2002), for example, argued that the political violence in Guatemala in the 1970s and 1980s led to a decline in maize diversity in the highlands because of the severe and often violent disruption of traditional agricultural practices.

There have also been accusations that commercial interests are seeking to introduce genetically modified crops (including maize) as part of the 2005 Dominican Republic, Central American United States Free Trade Agreement (Grandia 2014). However, given the absence of seed companies operating in the western highlands and farmers' interest in only growing local maize varieties, it is not clear if genetically modified maize would indeed threaten traditional maize varieties.

Maize and farmers' livelihood security

Maize-producing households in the western highlands have to deal with trade-offs between growing maize and

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other livelihood options. The latter include shifting to alternative crops, working off-farm, and exiting agriculture completely (Isakson 2009). These livelihood changes are already affecting maize diversity. Some farmers, especially in the department of San Marcos, have turned to the illegal production of poppy (Steinberg and Taylor 2007). Since the 1980s, development organizations have promoted the cultivation and marketing of high-value vegetables, including broccoli, cauliflower, and snow peas, which have a market in the United States (Immink and Alarcón 1993; Julian et al 2000; Krznaric 2006).

With an increasing shift toward export crops, maize and the milpa system have played less of a role in the landscape (Hamilton and Fischer 2003), although many farmers in the Guatemalan highlands cultivate both maize and vegetable export crops. While large-scale producers tend to plant the majority of their land with export crops, smallholders who cultivate export crops often continue to grow maize as well (Isakson 2009). This choice is linked to the cultural importance of the crop and to the desire to reduce the risk of crop loss or price reductions for the export crops.

Farmers' maintenance of maize landraces also creates the potential for new development initiatives, such as market access for these landraces. There is interest in the extent to which market opportunities for maize landraces can increase farmers' incomes while promoting in situ crop conservation. The maintenance of crop diversity through market opportunities is known as "conservation through use" (Keleman and Hellin 2009). The interest in this approach is partly in response to concerns that asking poor farmers to conserve diversity for diversity's sake, without significant commercial or livelihood benefit, can help to perpetuate poverty.

Crop genetic diversity has 3 key types of value: private value to the farmer; value to the local public, such as the resistance to pests and diseases; and global value, such as the availability of diverse germplasm for future plant-breeding efforts (see Lipper and Cooper 2009). Maintenance of crop diversity can be costly for farmers (Gruère et al 2006; Bellon et al 2015). In the western highlands, other crops, such as vegetables, offer better income opportunities than maize, so farmers need a cultural or economic incentive to maintain maize diversity (Bellon and Smale 1998).

Over the past 25 years, there has been growing interest in strengthening the links between on-farm conservation, access to markets, and farmers' livelihood security. Since market-based trade by definition involves private-value goods, a market-based conservation strategy is targeted only to perpetuating activities or crops that offer private value to the farmer. An early proponent of these links observed:

> *Market options are among the least expensive conservation tools because they can rely on existing institutions and on farmer choice. . . . In areas of diversity, small amounts of traditional crops reach the market and generally receive premium prices. Income from producing traditional crops as specialty crops is an incentive to conserve them, and this incentive is available in most areas of diversity*
>
> *(Brush 1991: 163)*

There are many examples of price premiums being paid to farmers who provide the environmental service of conserving agricultural biodiversity. These include potatoes in the Andes (Devaux et al 2009), minor millets in India (Gruère et al 2009), laurel in Syria (Kruijssen et al 2009), and maize in Mexico (Keleman and Hellin 2009; Hellin et al 2013; Keleman et al 2013). A key research question is whether facilitating the emergence of niche markets for local maize varieties in the western highlands of Guatemala could contribute to poverty reduction (van Etten 2006). Addressing this question is the focus of our research.

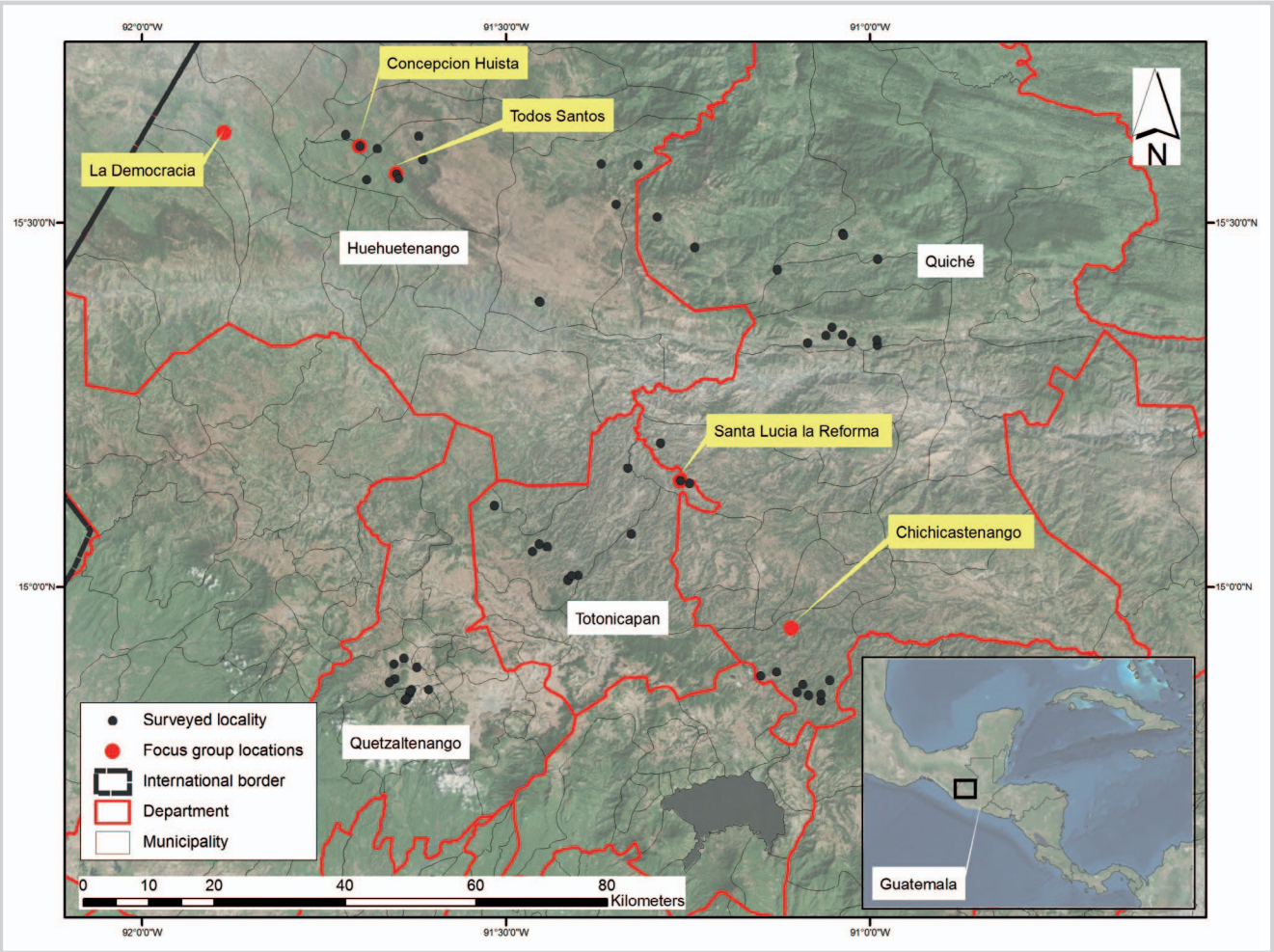
The rest of this article is structured as follows. In the methodology section we outline the mixed methods used in the study, consisting of focus group discussions with farmers and interviews with people selling maize in 2 urban markets (qualitative research) and a baseline survey (quantitative research). We then present the results of the research, which demonstrate that farm households do not produce enough maize to meet basic needs, let alone a surplus that could be sold. We discuss the results in terms of the potential to develop markets that would allow farmers to benefit from maintaining maize diversity, a form of payment for environmental services. We conclude that such potential is unlikely to be realized in the western highlands because of the maize deficit, caused in large by the small size and poor quality of the landholdings.

Methodology

The research was conducted as part of a research-for-development project in the western highlands of Guatemala. The main objectives of the project are to contribute to the reduction of poverty, food insecurity, and malnutrition, while increasing the sustainability and resilience of maize-based farming systems. The project is designed to decrease environmental degradation, improve the livelihoods of small-scale and resource-poor farmers, strengthen research and extension activities, and establish links with strategic partners including nongovernmental organizations (NGOs), public agencies, and extension agents.

We adopted a mixed-methods approach that involved both quantitative and qualitative research—focus group discussions, semistructured interviews, and a survey. Such an approach had been successfully used by the first author while researching market opportunities for maize producers in Mexico (Hellin et al 2010).

FIGURE 2 Map of the study area. (Cartography by Santiago López-Ridaura; data sources: Esri, Esri China [Hong Kong], Esri Japan, Esri Thailand, Garmin, GIS User Community, HERE, INCREMENT P, Interman, MapmyIndia, METI, NRCAN, © OpenStreetMap contributors, USGS)



Throughout the qualitative research phase, we received logistical support from local NGOs in terms of the selection of communities and farmers. There is a slight danger that these NGOs may have inadvertently favored some communities and farmers over others, thus introducing some bias into the results. However, a single research method seldom sheds adequate light on a phenomenon. Using multiple methods can help facilitate deeper understanding, and for this reason, we complemented the qualitative research with quantitative research in the form of an extensive survey.

Qualitative research sheds light on the link between farmers' decisions and broader cultural and social pressures. It can be a fast and cost-efficient way to gather data. Interviews with groups of farmers often generate richer information than those with individual farmers because the former approach often allow for dynamic discussions that build on collective knowledge and experiences. We first conducted focus group meetings, 1 each in 5 representative maize-based farming communities in the western highlands in the departments of Huehuetenango, Quiché, and Totonicapán (Figure 2). This was followed by semistructured interviews with randomly selected maize sellers in markets in the towns of Huehuetenango and Chichicastenango.

In our study area, partner organizations identified 5 communities where farmers grow maize, typically in subsistence farming systems. A local extension worker, from the predominant partner organization active in each of the 5 communities, arranged for 10–20 farmers to participate in each focus group (Figure 3). Each group had approximately equal numbers of men and women and took place in the community hall. The same extension agent introduced the research team to the participating farmers. Each focus group was conducted by a member of the research team who is also a maize farmer in Mexico, using semistructured questions that had been designed based on the research team's knowledge of maize-based

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FIGURE 3 Focus group meeting in the department of Quiché. (Photo by Jon Hellin)

farming systems in the region. Topics included family size, landholding size, maize production, maize consumption, and how farmers cope with maize deficits.

A baseline survey complemented and helped to enrich the results from the qualitative research. The survey was designed to capture the diversity of maize-based farming systems in the western highlands in terms of farmers' resources, their main agricultural (crop and livestock) activities and practices, and their main sources of technical advice. It also included questions related to management of the milpa, types of maize planted, and postharvest practices. The survey instrument was pilot tested with 20 farmers; after adjustments, a team of 20 enumerators conducted the survey with 989 farm households in 59 maize-producing locations in the 3 aforementioned departments and in the department of Quetzaltenango (Figure 2). The following criteria were used to select the 59 locations:

1. They were within 16 municipalities targeted by the research-for-development project of which this study was a part.
2. Each was within 1 of the 4 meso-watersheds within the 16 municipalities.
3. They covered the different elevational levels at which maize is grown within those watersheds.
4. Reputable local partners of the research-for-development project (NGOs and state agencies) were available to facilitate the implementation of the survey.

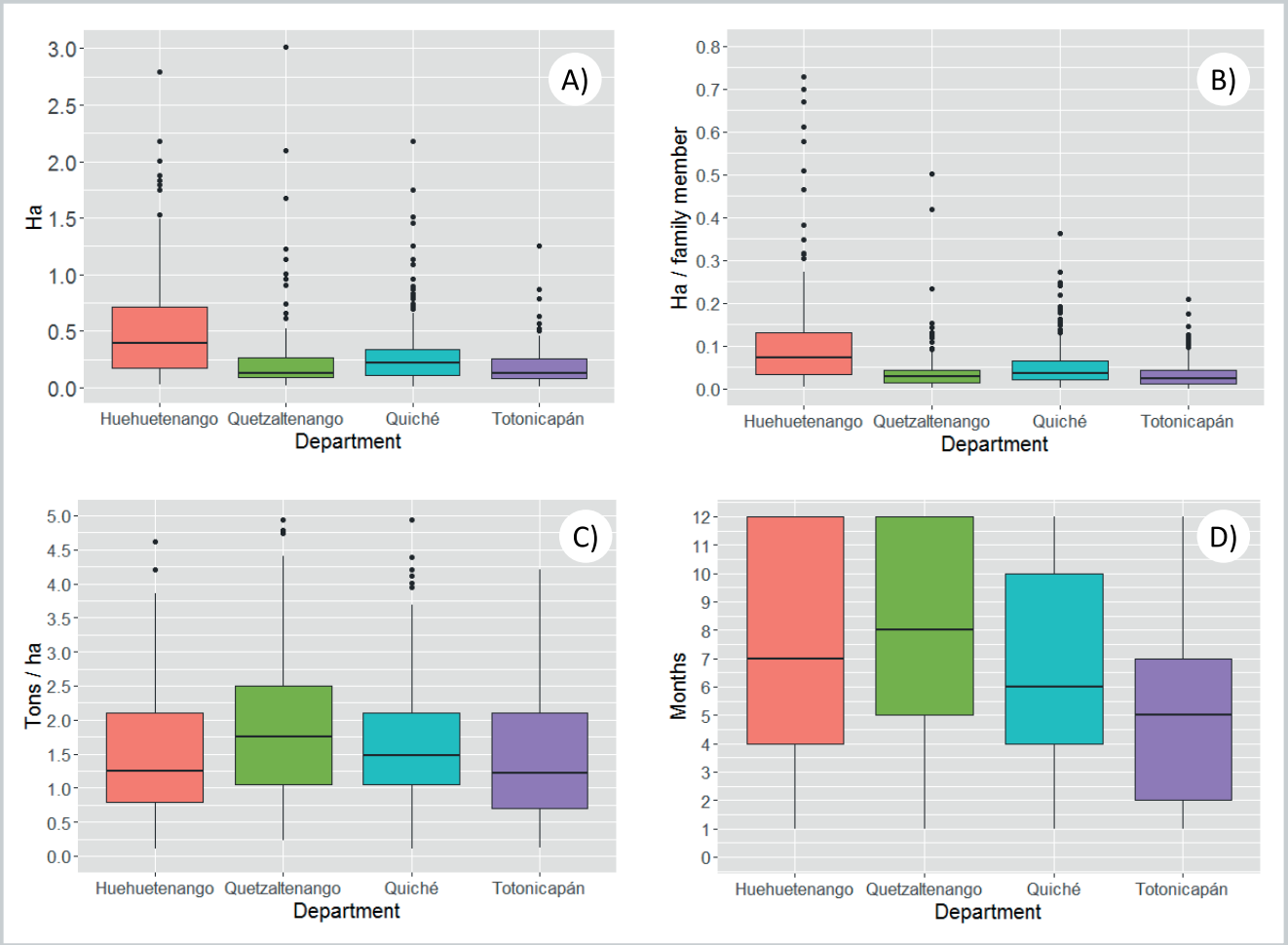
At each surveyed location, small teams of enumerators walked radial transects, when possible, in order to implement the survey. Confidentiality was ensured by identifying participants with numbers rather than names. Of the 989 households surveyed, 226 were in Totonicapán, 350 in Quiché, 187 in Quetzaltenango, and 226 in Huehuetenango.

Results

In the western highlands, farmers tend to measure land area in *cuerdas* rather than hectares. The size of a *cuerda* varies but in many communities in the western highlands, 23 *cuerdas* are equivalent to 1 ha. Farmers who participated in the focus group meetings said that farmers had on average about 100 *cuerdas* (4.3 ha) in the 1980s but less than 10 *cuerdas* (0.4 ha) now. Often only a fraction of this meager land area is sown with maize; the remaining land is used to produce firewood, potatoes, broad beans, and broccoli.

The survey data showed that landholdings are very small in the western highlands and that at the same time, there is a large variability in maize farmers' average landholdings. In our study area, average arable land per farm household was 0.31 ha, but the median was 0.19 ha, suggesting a skewed distribution with a few farmers having relatively large landholdings and many having very small ones. There was some variation between

FIGURE 4 Average agronomic characteristics of the 989 surveyed farm households in 4 departments in the western highlands of Guatemala. (A) landholding area; (B) arable land per person; (C) maize yield; (D) months of maize self-sufficiency



departments: households in Huehuetenango had the largest average landholdings (average 0.39 ha, median 0.17 ha), followed by Quiché (average 0.22 ha, median 0.11), Quetzaltenango (average 0.13 ha, median 0.8 ha), and Totonicapán (average 0.13 ha, median 0.8 ha) (Figure 4A). The average family size in the survey was 6 people per household and the average land availability per person ranged from 0.07 ha/person (median of 0.03) in Huehuetenango to 0.02 ha/person (median of 0.01) in Totonicapán (Figure 4B). In our study area, average land availability throughout the western highlands was 0.06 ha per person (median of 0.04). This figure coincides with a study by the World Bank (2006).

Farmers participating in the survey grow maize at elevations ranging from 1145 to 3557 meters above sea level (masl), with an average elevation of 2290 masl. The average elevation was the highest in the department of Quetzaltenango (2627 masl), followed by Huehuetenango (2230 masl), Quiché (2229 masl), and Totonicapán (2166 masl). Land above 2600 masl is known locally as *tierra fria* (cold land). In low temperatures, maize often requires at least 10 months to mature; farmers often sow it in January and harvest it in November and December. In the lower-lying *tierra caliente* (hot land), there is a shorter growing season; maize is sown in April or May and harvested between October and December.

The maize crop throughout the highlands is rain-fed; very few farmers (including only 14% of the farm households surveyed) have access to irrigation. In many communities, farmers grow yellow, black, and white maize, and to a lesser extent red maize. Yellow maize is the most popular and is used to make tortillas (a thin, unleavened flat bread made from maize and a staple in almost every meal), tamales (meat wrapped in maize dough and steamed or baked in maize husks), and *atole* (a maize drink), which is often consumed at formal events.

According to farmers interviewed, during the past 20 years, reduced rainfall and increased incidences of hail storms have caused considerable crop losses. Farmers also reported that *la canícula,* a short dry spell that occurs during the growing season, has been more protracted than in previous years and less predictable in its timing.

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This has resulted in more pronounced crop losses. Maize yields are very low throughout the region. In the community of Todos Santos in the department of Huehuetenango, focus group participants reported that yellow, white, and red maize can yield 1.6 tons/ha and that black maize yields about 1.0 tons/ha but its value as a specialty and culturally important food crop often makes up for the lower yield. Isakson (2011) also reported that while black maize may have lower yields, it is still attractive to farmers because it is more resilient to environmental stresses and can grow in poorer soils where other types of maize often fail.

Average maize yield for farmers participating in the survey was 1.7 tons/ha (with a median of 1.5 tons/ha). Average yields per department showed great variability, with the highest maize yield found in Quetzaltenango (average 2.3 tons/ha, median 2.1 tons/ha), followed by Quiché and Huehuetenango (with averages of 1.7 tons/ha and 1.6 ton/ha respectively and both with a median of 1.0 tons/ha), and Totonicapán (average 1.5 tons/ha, median 1.2 tons/ha) (Figure 4C). As discussed earlier, the overwhelming majority of farmers in the western highlands grow maize on far less than 1 ha.

Our survey data suggest that the western highlands have a severe net deficit in maize (Figure 4D). Our data indicate that family size varies from 4 to 12 people, and 6 people consume about 1.2 kg of maize a day or just under 450 kg a year. Survey data also suggest that, on average, farm households produce enough maize for only 6.9 months of consumption per year and thus need to buy maize at some point. Maize self-sufficiency ranges from an average of 8.2 months (median = 8) in Quetzaltenango to 7.4 months (median = 7) in Huehuetenango, 6.9 months (median = 6) in Quiché, and 5.1 months (median = 5) in Totonicapán. Similar figures were obtained during the focus group meetings.

Even farmers who have a maize deficit may have to sell some maize immediately after the harvest in order to earn needed cash, although this was true for only 6% (57 of 989) of the farm households participating in the survey. Focus group participants in Concepción Huista in the department of Huehuetenango, reported that they had to sell some of their maize in a community some 30 km away. Farmers in the western highlands use the term *quintal* when referring to the weight of maize sold and consumed. Quintal is a historical unit of mass that is defined in various parts of the world as 100 lb or 100 kg. In Guatemala, 1 quintal is 100 lb, that is, the measurement used is the international avoirdupois pound, which is legally defined as 0.454 kg. In this article the authors use pounds and quintals.

In this community, farmers can sell local maize varieties for 160 quetzales (US$21.30) per quintal. Local maize varieties command a higher price than the "improved" white maize that is sold in the western highlands to make up for maize deficits. Improved maize consists of varieties that are the result of formal crop breeding programs, they are seen as improved as they are often higher yielding than farmers' local varieties. The improved maize comes from lowland commercial maize production areas in Guatemala and from neighboring Mexico and sells in the western highlands for 130 quetzales (US$17.30) per quintal.

For many farmers who are not self-sufficient in maize, the main time when they purchase maize is from June until they are able to harvest their maize toward the end of the year. In the city of Huehuetenango, we spoke to people selling maize and they said that it costs them 120 quetzales (US$16) to buy 1 quintal of maize at the frontier between Guatemala and Mexico. They can then sell the same maize for 125–130 quetzales (US$16.70–17.30) per quintal. Profit margins are meager, and many of those selling imported maize also sell agricultural inputs because these provide a higher profit margin.

In the western highlands, there are markets for maize landraces, but they are small and ad hoc in comparison with many parts of Mexico. In the town of Chichicastenango, we spoke to maize sellers in the local market. They sell local maize varieties for 5 quetzales (US$0.70) per pound and imported, commercially grown white maize for 1.5 quetzales (US$0.20) per pound. This difference in price mirrors the results of research in neighboring Mexico, where Keleman and Hellin (2009) documented 2008 sale prices of 4 pesos (US$0.40) per pound for local maize varieties and 1 peso (US$0.10) per pound for commercial ones.

The difference in sale price is due to a culinary and cultural preference for native maize. This suggests a potentially lucrative market for those in a position to sell their local maize varieties, but with maize deficits in many parts of the western highlands, this is not an option for most farmers. Furthermore, the volumes of local maize varieties being sold are not very large. In Chichicastenango, we met a maize seller who sells local maize varieties at 200 quetzales (US$26.70) per quintal, but he only sells about 1 quintal every 20 days. It is bought by local producers of tortillas, who mix it with imported white maize and then sell the tortillas at a higher price, marketing it as made from local maize.

The maize that farmers in the western highlands buy when their own harvest is exhausted is often not a local variety but improved maize from commercial maize-growing regions in Guatemala and, increasingly, Mexico (Figure 5). Local traders whom we interviewed in June reported that the then price of 125 quetzales (US$16.70) per quintal of imported maize fluctuates; it goes up in August and then drops at harvest time. Those selling maize are Guatemalans who have tended to buy maize from Mexico, in some cases as far away as the northern Mexican state of Sinaloa. Maize from western Guatemala cannot compete with cheaper maize from the commercial maize-growing areas in Mexico and El Petén, a

FIGURE 5 Native and improved maize varieties at the Chichicastenango market. (Photo by Jon Hellin)

department in the north of Guatemala). Maize from El Petén is largely consumed in that region, and most of the maize purchased in the western highlands originates in Mexico.

Discussion: maize diversity, market access, and poverty reduction

In the western highlands of Guatemala, maize remains central to many farmers' livelihoods, although it is not a major element in the market economy. Farmers often grow maize for cultural and social purposes (Bellon 2004), and this, together with the food security that it offers, explains its perseverance. This is not unique to Guatemala's western highlands; for example, researchers in Mexico have also documented the continued cultivation of maize for cultural reasons (Esteva and Marielle 2003; Bellon and Hellin 2011). Barkin (2002: 83) commented that, in the case of Mexico, maize cultivation is very closely linked to farmers' "collective search for mechanisms to reduce their vulnerability to many of the negative impacts of international economic integration …. implementing their own strategies as part of their search for alternatives to protect and reinforce their own social structures and lifestyles."

Farmers in the western highlands of Guatemala also mirror the behavior of many Mexican maize producers by continuing to grow maize while also engaging in off-farm labor. A recent study in the Guatemalan highlands found that even though off-farm activities and/or cultivating export crops may provide farmers with the majority of their income, they may still prioritize milpa agriculture over wage employment, and "even as peasant farmers engage in market forms of provisioning they are simultaneously instituting social protections to reinforce their subsistence-oriented agricultural practices and the attendant conservation of crop genetic diversity" (Isakson 2009: 728).

Other studies have also documented that farmers' choices are often rational, even though they may not make sense from a purely economic perspective. Mayer (2002), for example, found that in the Peruvian Andes, farmers often treat subsistence and commercial activities as separate components of the household economy, despite the fact that off-farm income often subsidizes agricultural activities. Many participants in this study's focus groups reported working off-farm for part of the year.

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The situation in the western highlands of Guatemala supports the "functional dualism" thesis, proposed by de Janvry et al (1989) and expanded on by Blaikie (1989), that farmers in Latin American rely on income from part-time off-farm labor because their landholdings are too small to enable them to be self-sufficient. In the case of farmers surveyed in our study, arable land per household averaged 0.31 ha with a median of 0.19 ha—for most, too little for maize self-sufficiency. This in part reflects the historic discrimination against indigenous communities and long-standing legacy of social exclusion. The functional dualism thesis also suggests that even though farmers increasingly depend on off-farm labor, they are unable to find sufficient employment to enable them to exit agriculture entirely. Subsistence-oriented agriculture thus provides an important safety net, protecting farmers from low and irregular wages linked to off-farm labor.

The continued importance of maize to farmers' livelihoods in this region justifies maize-focused development initiatives. Van Etten (2006:707) studied maize diversity and farmers' livelihoods in the same region and concluded that

> *use-based opportunities to conserve maize biodiversity should be amplified. … regional or new products based on native maize biodiversity could be inserted in commercial contexts. These could be transformed into less perishable forms or convenience goods. Especially the rapidly growing acquisitive power of Guatemalan emigrant workers living in the US provides new channels for culturally specific products.*

Markets for traditional maize varieties exist in many parts of Mexico (eg Keleman and Hellin 2009), but our results suggest that, in Guatemala's western highlands, the potential links between on-farm conservation of native maize, agricultural markets, and livelihood improvement are unlikely to be realized for most farmer, because there is such a maize deficit that farmers are unable to meet basic subsistence needs. Many farm households have to buy maize from outside the region to meet consumption requirements. In the case of the western highlands, the evidence suggests that the market cannot drive in situ maize conservation.

Conclusions

There is growing interest in the extent to which markets can contribute to in situ conservation of crop diversity and improved farmer livelihoods. Our results show that most farmers in the western highlands of Guatemala conserve local maize varieties for cultural and social purposes, and that this effort is economically supported by off-farm income-generating activities. Most of these farmers, rather than being net sellers of maize, are forced to purchase maize for several months of the year. This is in sharp contrast to highland communities in neighboring Mexico, where many farmers are able to sell their local maize in relatively lucrative specialty maize markets.

The research reported in this article is part of a larger research-for-development project that is also addressing issues of soil and water conservation and crop and farm diversification in the western highlands of Guatemala. In the context of renewed interest in reducing poverty in Central America, in part to reduce the flow of immigrants (especially young people) to the United States, the research reported here demonstrates that low maize production in the western highlands is caused by land shortages and marginal land quality. Short of wholesale land reform (something that is highly unlikely in the political context of Guatemala), our research suggests that rather than focus on market development for local maize varieties, development efforts target other types of interventions.

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