

Market Provisioning and the Conservation of Crop Biodiversity: An Analysis of Peasant Livelihoods and Maize Diversity in the Guatemalan Highlands

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Summary. — This paper queries the common assumption that market linkages contribute to the loss of agricultural biodiversity, thereby threatening long-term food security. Drawing upon empirical data collected from two villages in the Guatemalan highlands, it documents how various types of market engagements are related to the on-farm conservation of maize diversity. While some market activities are associated with lower measures of diversity, most forms of market provisioning—including the allocation of resources to market production—are not. The quantity of land controlled by farmers is positively correlated with maize diversity and is an important determinant of their participation in the market economy.

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Key words — agricultural biodiversity, food security, peasant livelihoods, rural development, Latin America, Guatemala

1. INTRODUCTION

Do higher rates of market participation exacerbate market failure? In this paper I investigate this question by focusing upon a positive externality of global significance: the on-farm conservation of crop biodiversity. Crop biodiversity is a cornerstone of long-term food security, as it provides the genetic raw material that enables food crops to adapt to ever-changing environmental conditions, including emerging pathogens, evolving pests, and climate change. While it is possible to preserve some genetic resources *ex situ* in seed banks, the most dynamic and arguably the most valuable dimensions of agricultural biodiversity are sustained in the field, primarily by poor farmers in the global South. As market processes reshape the livelihood strategies of these farmers and their agricultural practices, however, the on-going conservation of agricultural biodiversity and, ultimately, the resiliency of humankind's food supply have come into question.

As the Russian botanist Nikolai Vavilov (1992) observed in the 1920s, the centers of diversity for humankind's principal food crops are located in the global South. Wheat diversity, for example, is heavily concentrated in the Fertile Crescent area of Iraq, Turkey, and Syria; meanwhile the Mesoamerican region of central and southern Mexico and northwestern Guatemala is the center of diversity for maize. Similarly, the centers of diversity for rice lie on the Indian subcontinent and southwestern China and in the southeastern Asian nations of Thailand, the Philippines, and Indonesia. The cultivation and conservation of crop biodiversity is strongly linked to the agricultural practices of the peasant farmers in these Vavilovian centers (Hernández-Xolocotzi, 1993; Wilkes, 1992). Despite their invaluable contributions to global food security, however, the peasants who maintain this diversity tend to be among the poorest and socially marginalized members of society.

Given that the stewards of agricultural biodiversity receive no compensation for their services, there is a common fear that market expansion will transform land use practices and spur the erosion of crop genetic resources. For many, the concern is rooted in the belief that the subsistence-oriented agri-

cultural practices of peasants are an inferior form of economic provisioning. If given a choice, the logic continues, the farmers 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 underpin the evolutionary potential 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.

Focusing upon the relatively understudied Guatemalan “hotspot” of crop biodiversity, this paper contributes to the unraveling of this paradox. Combining qualitative data with multivariate regression analysis, I find that the impact of market activities upon the on-farm conservation of crop genetic resources is contingent upon the distribution of resources and the broader social relations that govern market outcomes. As researchers studying other centers of diversity have observed (Perales, 1998; Smale, 2006; Van Dusen, 2000), some forms of market provisioning are indeed associated with lower measures of crop biodiversity, but not all market activities are equally pernicious. Moreover, I maintain that the lower diversity associated with one particular form of market provisioning—namely participation in grain markets—is not necessarily the result of market choice, but the underlying agrarian structure. I conclude that if strategically instituted, markets could in fact play a positive role in helping farmers to achieve their development goals in a way that is consistent with the on-farm conservation of maize diversity.

* I am grateful for helpful comments from James Boyce, Carmen Diana Deere, Mwangi wa Githinji, Jacqueline Morse, Garrison Wilkes, and four anonymous reviewers; technical assistance from Michael Ash, Michael Carr, and Melissa Gonzáles-Brenes; and research assistance from Yolanda Menchú Tzul. The Political Economy Research Institute funded portions of this research, for which I am very appreciative. The usual disclaimers apply. Final revision accepted: December 7, 2010.

2. THE GUATEMALAN MEGACENTER OF CROP BIODIVERSITY

Although their contribution is seldom recognized, peasant farmers in the Guatemalan highlands play a crucial role in safeguarding global food security. Along with neighboring southern and central Mexico, Guatemala is known by ecologists as a “megacenter of diversity” (Perales, Benz, & Brush, 2005). The region is the historic center of origin and the modern center of diversity for a number of crops, including the common bean, squash, chilies, avocados, and, most importantly, maize. Some 6,000 years ago, Mayan farmers in this Mesoamerican region domesticated what is now, along with rice and wheat, one of humankind’s principal food crops (Wilkes, 2004). Over the millennia, the descendants of these Mayan farmers have developed a rich diversity of maize, yielding several thousand varieties adapted to a wide range of environmental microhabitats.

As they have done for thousands of years, Guatemalan peasant farmers practice a poly-cropping system known as *milpa*, where maize is intercropped with beans, squash, chilies, and other useful plants. While one might suspect such a time-honored practice as making *milpa* to be stagnant, it is anything but. On the contrary, it is a highly dynamic system producing a constant flow of new maize varieties (Louette, 2000; Maxted, Ford-Lloyd, & Hawkes, 1997). Via the practice of diversity management, peasant farmers plant many different varieties of maize, adapted to diverse local environmental conditions, such as soil type and climate, and to desired traits, such as reliability, time of harvest, and taste (Bellon, 1996). The proximity of domesticated maize varieties to their wild and weedy relatives allows introgression—the back-and-forth hybridization between related species—that along with natural mutation brings new raw material into the crop’s genetic profile. Farmers identify desirable traits and encourage their development via selective breeding, seed exchange, and manipulation of the local environment. Under the combined pressures of human and natural selection in the face of biotic and abiotic stresses, these “evolutionary gardens” (Wilkes, 1992) of *milpa* agriculture provide a steady flow of new maize varieties.

In contrast to the rich genetic diversity found in Guatemalan *milpas*, the “modern” agricultural practices that are pervasive in industrialized countries and many areas of the global South are characterized by a high degree of varietal uniformity. While this uniformity serves the objective of short-run profit maximization, it also renders crops vulnerable to insect and disease epidemics. This risk was dramatically illustrated in 1970 when a leaf blight destroyed one-fifth of the United States maize harvest (National Academy of Sciences, 1972). More recently, though on a much less dramatic 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-Packza, Crops, Maxted, Ford-Lloyd, & Hawkes, 1997). To combat this vulnerability, 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). As the source of the genetic raw material for this relay race between plant breeders and nature, traditional agricultural practices are a pillar of global food security.

3. MARKET LIVELIHOODS AND GENETIC EROSION

As botanists Hernández-Xolocotzi (1993) and Wilkes (1992) have observed, the *in situ* conservation of crop biodiversity is largely attributable to the agricultural self-provisioning of peasant farmers in the global South. Consequently, many crop scientists have reasoned that the expansion of markets into centers of diversity will displace not only peasant farmers, but also the agricultural practices that sustain a cornerstone of global food security (Altieri, 2004; Wilkes, 1992). As the literatures on “new rurality” (Bebbington, 1999; Kay, 2008; Reardon & Germán Escobar, 2001) and the “semi-proletarianization” of the peasantry (Bryceson, Kay, & Mooij, 2000; Deere, 1990, 2005; Warman, 1980) have shown, however, participation in markets does not necessarily preclude the subsistence-oriented practices that are the hallmark of peasant agriculture. In fact, certain forms of market provisioning might actually facilitate and enable peasant agriculture (Bar-kin, 2006; De Frece & Poole, 2008; Isakson, 2009). The question that emerges, then, is which forms of market provisioning facilitate the cultivation of crop biodiversity and which forms impede it. Since the late 1990s, several empirical studies have emerged that shed light on this question.

(a) Proximity to market centers and the availability of infrastructure

A common explanation for the persistence of peasant agriculture and diversity management, particularly among economists, is that rural markets are incomplete and difficult to access. Rather than expending resources to access distant markets or producing for thin and isolated markets where input and output prices can be volatile, it is argued that poor farmers minimize risk through agricultural self-provisioning, which necessarily requires cultivating a diversity of crops (Fafchamps, 1992; Goeschl & Swanson, 2000; Van Dusen & Taylor, 2005). In order to test this hypothesis, several researchers have investigated how distance from market centers and/or the availability of infrastructure relate to the level of diversity maintained on the farm. Most studies confirm the hypothesis that crop diversity is positively correlated with market isolation. The intercrop diversity of *milpa* plots in the Sierra Norte de Puebla, Mexico, for example, tends to increase with the distance from market centers as does the intracrop diversity of beans and maize (Van Dusen, 2000; Van Dusen & Taylor, 2005). In the Peruvian Andes, farmers who reside closer to potato markets cultivate fewer potato varieties than their more isolated counterparts, suggesting that farmers tend to substitute purchased commodities for diversity in the fields (Winters, Hintze, & Ortiz, 2006). Moreover, the value that farmers place on traditional seed varieties—which tend to have a larger pool of germplasm than modern seed varieties (Wilkes, 1992)—increases with the distance from market centers in Turkey, (Meng, Taylor, & Brush, 1998), Mexico (Arslan & Taylor, 2009), and Hungary (Birol, Smale, & Gyovai, 2006). Remoteness is not a guarantee of agrobiodiversity, however, as farmers who cultivate in close proximity to market centers in central Mexico (Perales, Brush, & Qualset, 2003) and Zimbabwe (Cromwell & van Oosterhout, 2000) were found to maintain relatively higher levels of crop diversity.

Whereas the bulk of empirical studies suggest that proximity to urban areas and markets is correlated with lower levels of diversity on the farm, the impact of infrastructure development is mixed. Access to roads in Ethiopia, for example, is positively correlated with the diversity of some crops but

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