

Article

Post-NAFTA Changes in Peasant Land Use—The Case of the Pátzcuaro Lake Watershed Region in the Central-West México

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Received: 8 January 2020; Accepted: 26 February 2020; Published: 5 March 2020



Abstract: Rural life in México has changed drastically over the past several decades in the wake of structural reforms in the 1980s and the North American Free Trade Agreement (NAFTA) implemented in 1994. Researchers predicted dire consequences for smallholder farmers following trade liberalization and in certain respects the prophecies have been fulfilled. Indeed, many regions experienced significant out-migration as smallholders, unable to compete with global maize imports without price subsidies, sold or abandoned their lands, making way for the expansion of industrial agriculture into forests, secondary vegetation and primary crops. Nevertheless, many smallholders have adapted to the new economic environment with farming systems that manage risk by diversifying portfolios to incorporate commercialized maize and livestock production. This article examines the evolution of smallholder farming systems since the mid 1980s, when the impact of neoliberal reforms emerged, using data collected from field research on 130 smallholder farms in the Pátzcuaro Lake Watershed (PLW) in the State of Michoacán. Farmers in the PLW have been characterized as traditional peasant farmers, planting crops for subsistence, including a diverse array of domestic maize varieties and practicing limited animal husbandry with chickens, turkeys, pigs, an oxen and a cow or two for milk. But the results presented in this article show that the traditional peasant farming systems in the region have changed substantially to a highly diversified agriculture-cattle-forest system. Most notable changes include the use of fertilizers and pesticides; and the increase in livestock herd and reorientation to beef production. The results demonstrate the resilience of smallholder farmers, while at the same time raising potential concern that increased reliance on livestock and beef production specialization, might lead to shifts in farming systems that replace domestic maize varieties with hybrid corn used primarily for animal feed and thereby leaving vulnerable the genetic reservoir of traditional maize landraces.

Keywords: peasant livelihoods; post NAFTA México; neo-liberal reforms; global cattle economy

1. Introduction

Serious concerns about the deleterious effects of trade liberalization on México's food security and living conditions for smallholders, in particular for maize producers, were raised by critics of neoliberal reforms [1,2]. In fact, most analysts predicted falling domestic maize production. For example, Yúñez-Naude [3] estimated that a 40% reduction in maize prices would result in a decline in maize output in smallholder communities ranging between 18% and 29%, depending on the productivity gains due to liberalization. Levy and van Wijnbergen [4] estimated a displacement of 492,000 to 692,000 jobs and a 20% decline in output due to liberalization [5]. Despite such grim predictions, maize output has more than doubled above pre-reform levels and maize cropland areas have increased slightly, in spite of a ~70% decline in prices when compared with pre-reform levels.

Corn is now the most important commodity traded between the US and México by volume [6]. With an average of 10 million MT of corn imported every year since 2010, México is now one of the largest grain markets for US producers, second only to Japan. Given the myriad of maize varieties, from this point on we use the word *corn* to refer to varieties of yellow maize grown domestically and imported and *maize* as a generic designation for all other varieties. In a sample of ejido households interviewed between 1990 and 1997, Davis [7] reports a two-fold increase in maize production. Eakin et al. [8] refer to this smallholder population as the "agrarian winners" of neoliberal reforms. And contrary to predictions, even within very small farmsteads of less than 5 ha, cropland areas remained constant throughout the period. Research conducted at the household level suggests that among non-ejido and ejido producers, mixed farming systems that couple maize production with cattle emerged as a widespread land use strategy to curb the effects of falling prices.

The purpose of this article is to provide a closer examination of adaptation strategies of peasant farmers to trade liberalization through mixed farming practices, growing maize primarily for home consumption and as animal feed [9]. At the present time, such systems prevail in rural México. They are mostly rainfed and encompass a wide agro-ecological range including semiarid, sub-humid and highland temperate and subtropical regions, covering 18, 8 and 7 percent, respectively, of México's total land area. We seek to: (1) ascertain how México's peasant farmers have adapted to the uncertain economic environment inherent in trade liberalization and (2), identify impacts of changes in production on household welfare for local farm communities. To address these issues we provide a case study of peasant farming in the Pátzcuaro Lake Watershed (PLW) of the State of Michoacán. We present results from a survey of 130 smallholder producers, eliciting temporal information that enables us to reconstruct the farm-level changes that have occurred in this region, which are reflective of broad-scale forces operative throughout México.

The paper is organized as follows. In the next section we address changes in Mexican agriculture, paying particular attention to the cattle sector and the emergence of a transnational beef supply chain. Following this, we consider our case study region, namely PLW in Michoacán State and describe the area's mixed farming systems based on crops and livestock. Next, we exploit our survey data to illustrate structural changes in household economies. A discussion of the impacts of trade liberalization follows, after which a brief conclusion ends the paper.

1.1. Emergence of the Maize-beef Complex

One explanation for the survival of a robust peasant farm sector is that maize has received preferential treatment in the provision of subsidies [7,8]. An example of this is the *Programa de Apoyos Directos al Campo* (Program for Direct Income Support for Farmers-PROCAMPO), which has helped buffer the effects of free trade through cash transfers to small producers [10]. The *Alianza para el Campo* (Rural Alliance Program) represents another important initiative, one providing capital liquidity and, therefore, stimulating both intensification and commercial agriculture [7,11]. Finally, the agency *Apoyos y Servicios a la Comercialización Agropecuaria* (Support and Services for Marketing and Market Development-ASERCA) has implemented a program similar to that of the US farm bill which provides subsidies for corn. Although agricultural support policies buffered the effects of market liberalization,

they do not fully explain why corn failed to displace maize and why maize production expanded and thrived in some regions. In order to understand current agricultural land use in México it is necessary to consider the expansion of the food processing sector in a post-NAFTA food regime with an emphasis on beef production [12].

1.2. Neoliberal Reforms

Although agriculture has been practiced in México for thousands of years, we focus attention on the past several decades which bracket gains in productivity, structural readjustment of the macro-economy and trade liberalization via the General Agreement on Trade and Tariffs (GATT), the North American Free Trade Agreement (NAFTA) and now the United States, México, Canada (USMCA). The overview story follows a well-known narrative of how price supports for maize farmers and subsidies for tortilla consumers maintained an inefficient production system that collapsed as the Mexican government opened its domestic markets to cheap American corn. Other commodities flooded the Mexican markets as well, including beef and the effect overall was one of economic stimulus and shock [13].

As the new institutional regime took hold, Mexican producers adapted to the new market conditions and radical changes began a process accentuated by rising prices on world markets between 2000 and 2017. This induced the emergence of the maize-beef complex and fattening operations, which organized production into a vertically integrated system of maize suppliers, feedlots and supermarkets. Much of this reconfiguration was concentrated near cereal production regions in temperate Central México, such as *El Bajío* (States of Guanajuato, Michoacán and Jalisco). In only one decade (2002–2012), México passed from being a net importer of meat from the USA to become one of its most important suppliers.

2. Methodology

2.1. Study Region and History

PLW is located in the Western part of the State of Michoacán, a region of temperate climate and mostly fertile soils (Figure 1). Like many other parts of rural México (e.g., the Mixteca, the Highlands of Chiapas, etc.), human settlement in PLW is ancient, stretching back more than 5000 years.

The importance of maize agriculture to PLW residents has been widely documented [14–16]. As in other indigenous regions, maize agriculture is linked to complex regional social dynamics, with multiple combinations, hybridizations, exclusions and coexistences typical of an evolving peasant culture [15,17]. However, less is known about the role played by livestock in mixed farming systems, particularly in light of neoliberal reforms and the emergence of the maize-beef complex.

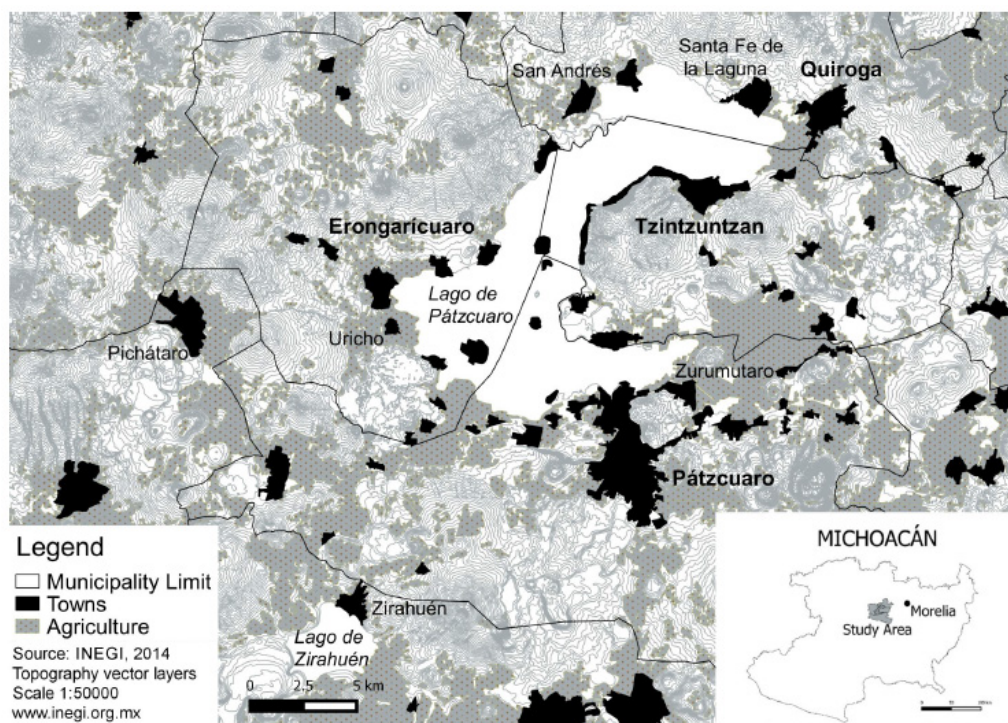


Figure 1. Map of the study area.

2.2. Sampling and Data Sources

The research presented here involved nine months of fieldwork conducted in 2018 and 2019 that consisted of: (1) key informant interviews with representatives from the Ranchers Council for the municipalities of Erongarícuaro, Pátzcuaro, Tzintzuntán and Quiroga; (2) household surveys (HH) with 130 families; and (3), the collection and assessment of maize and cattle production and prices data from Michoacán State.

The key informant interviews provided insight and context that informed our understanding of smallholder agriculture and the regional cattle economy. The household surveys were devised with the objective to elicit details on agricultural activities and changes that occurred in the wake of neoliberal reforms, therefore information was collected for two time periods (pre-GATT /NAFTA and current) on: (1) cattle production (i.e., type of animal, number of animals, head of cattle for meat, for milk, quantity sold, to whom sold, prices and costs); (2) cropping system (i.e., crop type, yield, area planted, quantity sold); and (3) the types of credit and technological extension provided for each activity.

The data collection for household surveys involved both random and systematic sampling methods. First, we randomly selected 10% of the 1303 registered ranchers from the Council of Ranchers Registry for four municipalities and visited 35 localities to ensure the sample was geographically representative (See Table 1). Next, we systematically selected households from each locality. If the landowner was not present or was unwilling to participate in the survey, we would visit the next house and so on until we had a sample of 8% in Erongarícuaro, 11% in Pátzcuaro, 20% in Tzintzuntán and 8% in Quiroga.

Table 1. Case Study Sample.

Municipality	Population of Ranchers	Sample Size	Percent
Pátzcuaro	284	31	11
Erongarícuaro	457	36	8
Tzintzuntzán	155	31	20
Quiroga	407	32	8
Total	1303	130	10

The sources for the agricultural data for Michoacán State derived from the agricultural censuses performed by the Agriculture, Food and Fishery Information System (SIAP), which depends on the Agriculture and Food Ministry [18]. The farmgate price for cattle and corn was obtained from Agrifood Information System (SIACON) and then adjusted to 2013 prices using the World Bank GDP deflator [19,20]. The prices in Mexican Pesos were converted to USD using the annual average exchange rate for 2013, which were next converted to 2018 USD values using 1.27 USD deflator.

2.3. Data Analyses

Given notable changes in the structure of Mexican agriculture and the institutional changes that have occurred over the past several decades, we now turn to our case study in order to assess farm system dynamics at household scale. Our analysis takes households as the economic unit of interest, which deploy family labor and land assets to produce farm goods in response to price signals. For the study period, we can reasonably assume that farm production has evolved from a purely Chayanovian structure based on family labor and producing only for household consumption [21]. We assume that households implement farm systems to maximize net revenue, which is tantamount to household welfare. The analytical strategy is to consider the structure of production for two time periods, ostensibly before and after the structural changes and institutional reforms associated with GATT and NAFTA. For each period, we provide data on production system and household structure. Before proceeding to the analysis, we provide economic context by describing changes in production magnitudes and prices, for both cattle and maize, in PLW, from the Pre-NAFTA period up until the present.

3. Results

3.1. Regional Production and Price Dynamics in the State of Michoacán

The maize-beef complex opened opportunities for both smallholders and more capitalized interests, given its expanding need for calves and feeders. Starting in the mid-1980s, production of both maize and beef grew in the State of Michoacán, as depicted in Figure 2, which shows that production of both maize and cattle has more than doubled during the period of record covering 38 years (1980–2018). Although the surge in maize output is dramatic for Michoacán as a whole, the trajectory has been mostly flat for the PLW study area over the past fifteen years (2003–2018). Planted area has trended down slightly, with a slight increase in production indicating some recent intensification in the past five years. Nevertheless, the overall production dynamics for Michoacán show two secular expansions that run largely in parallel for maize and beef. Statistical analysis (Kendall Correlation) indicates a positive and significant upward trend for the Michoacán herd, for the period 1990 and 2018 ($\tau = 0.79$, $p < 0.0001$).

The upward trend over the long-run is not evident for the prices paid to Michoacán producers, as shown in Figure 3. Here can be observed the effect of price supports to maize producers early in the period, which kept prices consistently higher than for beef up until the late 1980s. As the parastatal system is dismantled, maize prices begin falling after 1986, a trend that also manifests for beef. Both prices appear to stabilize in 2008, the final year of NAFTA implementation, when the tariff rate quotas were officially terminated. The producer price for maize in 2018 is ~0.30\$/kg, about one-third of its

maximum in 1984 (~0.90\$/kg). Beef prices do not show so precipitous a decline, falling from 8.00 to 5.00 \$/kg between 1980 and 2018.

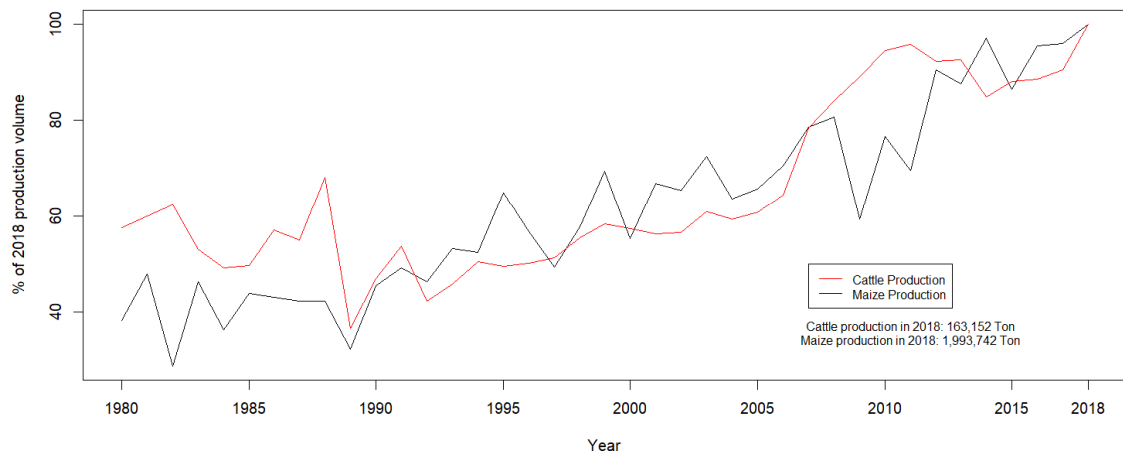


Figure 2. Cattle and Maize Production in Michoacán.

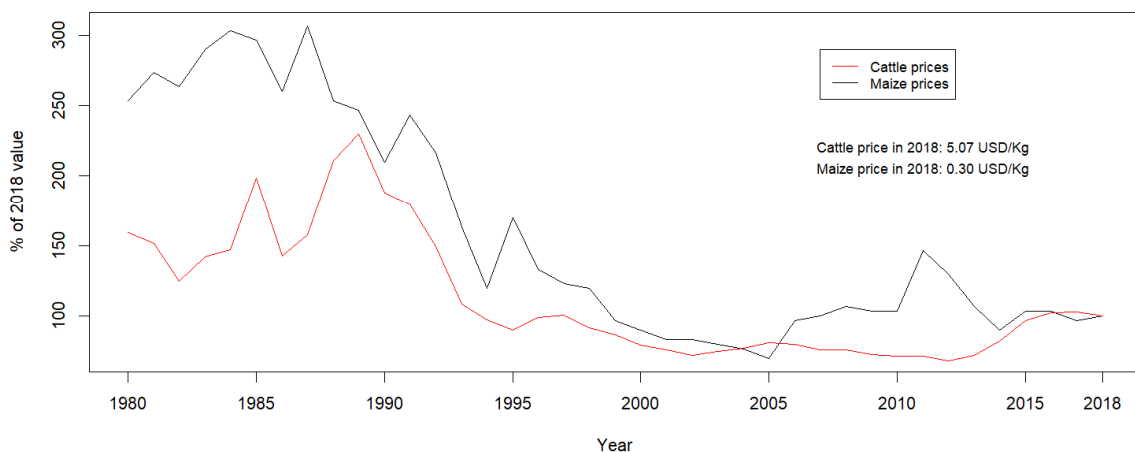


Figure 3. Cattle and Maize Prices paid to farmers in Michoacán (in 2018 US\$).

3.2. Farming systems and Sample Characteristics

Before proceeding to our analysis of changes in the structure of production at household scale, we present descriptive statistics for our sample of 130 smallholders in PTW (Table 2). Nine of the interviewed households do not have cattle because the head of the household is elderly and unable to take care of the animals or because their animals were stolen. The rest, 121 smallholders, are engaged in mixed farming activities. On average, five individuals live in each household and farm size averages four hectares, of which around half is planted with maize and the rest with forage crops. The average age of household head is 58 years. Most households own their land (75%), either in the *ejido* or as private property; many (80.7%) also rent, borrow or sharecrop additional plots.

Current farming systems combine crops, livestock and forestry. Cropping subsystems comprise both maize monoculture and highly diversified cropping subsystems such as the traditional *milpa* (a polyculture of maize, beans, squash and other crops). Production is mainly aimed at household consumption and to a lesser extent to local markets. Diversified crop management schemes include rotations with wheat or alfalfa, winter forage crops such as oats and vetch and fallow periods in which livestock, mainly cattle, are taken to graze. Livestock feed is based on crop residues, grazing in native grasslands, secondary forests and shrublands, as well as small amounts of purchased feed. Forests provide wood for cooking, building construction and furniture.

Table 2. General characteristics of the households (N = 130).

Variable	Average (SD)	Min	Max
Number of Male HH Heads	121		
Number of Female HH Heads	9		
Age of HH Head	57.7 (16.3)	20	88
# of HH Occupants	5.1 (5.1)	1	13
Area of HH Property (Ha)	4.2 (2.2)	0.12	24
Number of plots	3.4 (2.6)	1	17

All households report involvement in crop agriculture, with 42% selling produce to local markets, primarily maize but also alfalfa, fava beans, vetch, lentils and wheat (see Table 3). Maize is produced for self-consumption (80%), livestock feed (33%) and sale (55%), in which case the cropping component of the mixed system mainly serves household consumption by family members and their cattle. Many households (91%) work on plots dedicated strictly to forage crops such as oats, vetch and alfalfa. Rotation of maize, oats and maize crops is a regular practice.

Table 3. Cropping system characteristics for primary, secondary and tertiary crops in 2018 (N = 121).

Crop	# HH	Mean	Planted Area (ha)			# of HH Market Participation
			Median	Min	Max	
Alfalfa	7	0.56	0.63	0.03	1.00	0
Oats	59	2.47	1.50	0.25	20.00	7
Beans	2	0.19	0.19	0.13	0.25	0
Fava Beans	10	0.70	0.63	0.12	2.00	5
Vetch	54	1.73	1.00	0.25	13.00	5
Lentils	2	1.25	1.25	0.50	2.00	1
Maize	114	2.99	2.00	0.12	18.00	31
Cultivated Grass	3	0.67	0.50	0.50	1.00	0
Native Grass Land	3	4.00	4.00	4.00	4.00	0
Wheat	6	2.54	1.00	0.25	10.00	1
Total	121	6.43	3.50	0.16	171.00	

Maize from inherited seeds is the dominant crop, produced by 92% of the families in our sample. Nevertheless, hybrids have replaced traditional varieties in 8% of the sample households. White native varieties are the most commonly produced type (58%), although different colors are observed throughout PLW (yellow, blue and *pinto*-mixed). The average diversity of maize landraces is of 1.37 lots per household and 1.8 hectares is dedicated to maize production on average. Many use chemical fertilizers (76%) and agrochemicals (96%) to control weeds and pests. But, when they started farming, fewer than half used fertilizers (46%) or pesticides (24%). Almost all households (94%) own cattle and graze them in forest areas (56%), on croplands after harvest (49.5%) or along the lake's shoreline pastures (11.5%).

3.3. System Dynamics

As discussed, the key interest to our analysis are changes unfolding in the wake of structural reforms and trade liberalization, in particular those affecting peasant involvement in the maize-beef production complex. In fact, the mixed farming systems in PLW have long incorporated cattle as a key part of their production portfolio. That said, this component has grown in importance and has evolved structurally to serve different purposes than in decades past. The average number of animals owned by HHs in the early period ranged between 1.8 calves and 4 cows. At the present time the average herd size is 14.5 animals. In earlier times the majority of HHs owned small herds of less than 11 animals. Today, however, only half of HHs own less than 11 animals, while 44% (n=54) own 11–31 animals and 7% (n = 9) have 32–61 animals (Figure 4).

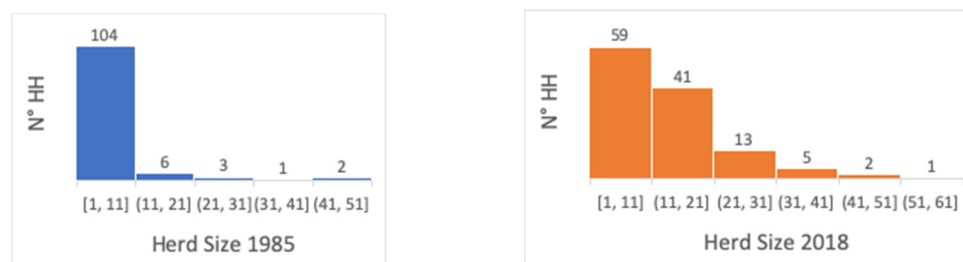


Figure 4. Herd Size 1985 and 2018.

Of the 116 HHs that responded to questions about cattle at the start of operations, most stated they began with cows ($n=89$) and possessed on average four of them (Table 4). Twenty-six of the respondents began operations with male calves, 25 with bulls, 24 with female calves, 7 with heifers and 6 with bullocks. Note that a large number possessed multiple animal types, with only 50 beginning exclusively with cows. As stated previously, the average number of animals owned by HHs in the early period ranged between 1.8 calves and 4 cows. At the present time, 121 HHs support an aggregate herd of 1760 animals, including 762 cows, 321 male calves, 221 female calves, 184 heifers, 155 bulls and 117 bullocks. Most possess cows (117) and calves (89) and on average herd size is 14.5 animals. By type of animal we have 3.4 female calves, 3.6 male calves, 3.3 bullocks, 2.5 bulls, 6.5 cows and 3.5 heifers. Only two HHs exclusively possess cows.

Table 4. Cattle Herd Evolution (N = 121).

Type	1985			2018			% Change
	# Farms	Mean	Sd	# Farms	Mean	Sd	
Calves, Female	24	1.8	1.9	66	3.4	3.1	64
Calves, Male	26	3	2.9	89	3.6	3	71
Bullocks	6	3.5	2.6	36	3.3	2.8	83
Bulls	25	2.8	2	62	2.5	2.3	60
Cows	89	4	6.4	117	6.5	5	24
Heifers	7	3.3	3.2	52	3.5	2.4	87

The structural change in the nature of the herd reflects a reorientation of the economic purposes served by the cattle component of the mixed farming system. In general, we observed a change from milk to beef production, given the relative decline in the number of cows and the emergent importance of young animals, presumably for sale to fattening operations [22]. Although the number of farms with cows increased by 24%, the most significant structural change is reflected in the three-fold growth in establishments with calves and bulls (See Table 4). These changes are depicted in Figures 5 and 6, which illustrate the evolving purpose and final destination of household livestock production. The use of oxen as a work animal disappears entirely by 2018, suggesting a shift to more capital-intensive production. Further, the importance of beef production grows, as do slaughterhouses as a final destination. Given the number of calves produced by 2018, both male and female, we assume that HHs sell feeders to brokers who deliver them to feedlots, as part of México's emergent maize-beef production complex [22].

Finally, modest but significant correlations were found between herd size and total crop and grassland area ($r^2 = 0.51$; $p < 0.01$) and between herd size and maize area ($r^2 = 0.42$; $p < 0.01$). This suggests that farmers seek to minimize their dependence on purchased feed and balance the risks and benefits of both crop and livestock production.

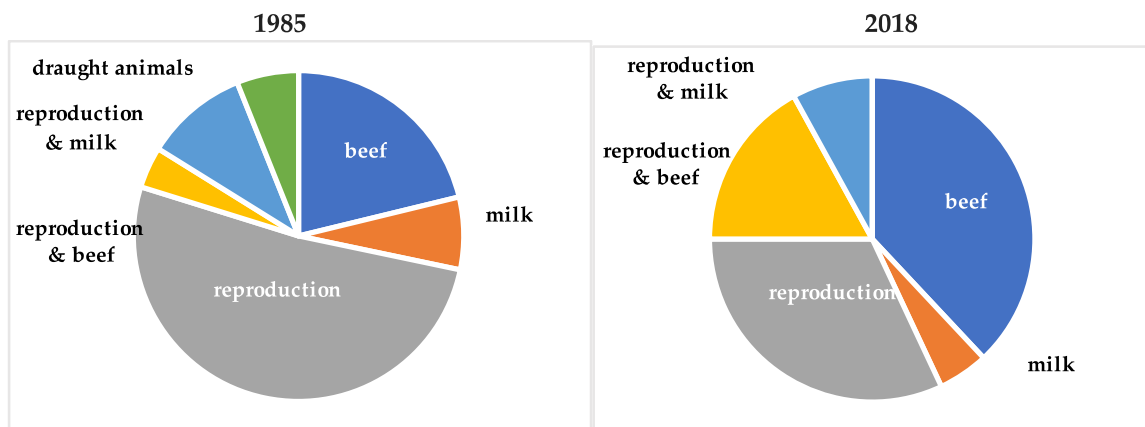


Figure 5. Purpose of household Cattle.

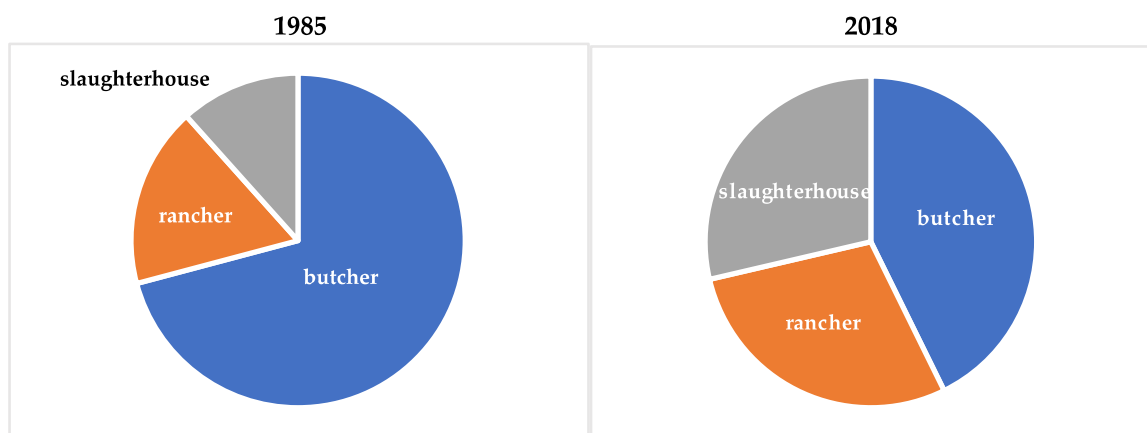


Figure 6. Destination of household Cattle.

4. Discussion and Conclusions

Many commentators have discussed the adverse impacts of neoliberal reform on México's rural poor but as our study demonstrates smallholder producers can be resilient in the face of change [23,24]. PLW provides an illustrative case. Although intense outmigration has occurred in certain communities over the past several decades, our analysis reveals adaptive responses in household production systems following structural changes in México's agricultural economy. The farmers we sampled are highly diversified and their production is mainly aimed at household consumption. Important interactions between the crop, livestock and forestry components enable farmers to reduce their reliance on external production inputs. Of these, the most relevant is the use of forage crops, maize residues and common grazing areas, which helps minimize the use of purchased feed.

Research has shown that maize hybrids and landraces have different but overlapping functions in the livelihood strategies of small-holder farmers [25]. Although some households plant hybrid maize instead of traditional varieties, especially for animal feed, local maize is still preferred for family consumption. Be that as it may, if reliance on cattle production continues to grow so too will the planting of hybrid corn, which farmers believe have higher yields than traditional maize, especially with chemical fertilizers and pesticides. Incentive to switch to hybrid maize and corn is further exacerbated by government seed subsidies.

Overall, the mixed farming systems of PLW reveal a diversification in production based on small cattle herds, with concomitant engagement in México's Post-NAFTA cattle supply chain. Survey respondents have lived in the PLW since the pre-NAFTA period. They reflect, presumably, that part of the Mexican peasantry that has been buffered from NAFTA shocks by its reliance on HH production and workforce [5].

The new agricultural economy of PLW has grown appreciably in the Post-NAFTA period, as the data from Figures 2 and 3 suggest. Specifically, total revenues from the sale of animals on the hoof by the region's producers was 36 million US\$ in 2000 (in 2018 US\$). By 2018, this had nearly tripled, to 90 million US\$, an outcome attributable to expanding production and rising prices. Although farm-gate prices for maize have remained stable, post-NAFTA at ~0.30\$ per kg (in 2018 US\$), production has doubled, with total revenues accruing to Michoacán maize production increasing from 200 to 400 million US\$.

From the aggregate perspective, the changing structure of PLW's mixed farming system demonstrates some degree of economic resilience in the post-NAFTA era [24]. By diversifying agriculture, small farmers persisted not in isolation but linked to dynamic global agri-food supply chains that benefited from de-regulation of agri-food markets. Their persistence was also linked to cultural rooted practices of rural communities [16,17]. In particular, one important finding is that local maize landraces have not been replaced and only a small fraction of households adopted hybrid varieties. The incorporation of cattle livestock in this context was one among several income strategies. Raising cattle allowed peasant families to use a devalued crop into the production of a higher value-added commodity. Some producers with better access to land specialized in cattle raising and shifted to hybrid maize varieties. However, for most producers local landraces offered another high value-added venue in regional food markets. Thus, our research shows that cattle did not induce a reduction in maize genetic diversity but on the contrary, by increasing the value of maize within the household portfolio of productive activities, it helped to preserve a pool of local landraces.

It is not surprising why extension programs aimed at increasing agricultural productivity are often at odds with the necessities of small farmers. Hybrid varieties have little sense for farmers with diversified strategies like the ones we found in our study [25]. In this sense, this study could serve to orient rural development programs and policies to strengthen regional agricultural value chains for local maize landraces as well as to improving the sustainability of livestock systems.

One limitation of our study is that it does not consider the social and environmental implications of post-NAFTA mixed farming systems. Future research will need to investigate whether post-NAFTA adaptations have helped to reduced poverty and improve value distribution in the agricultural sector, as well as to assess their contributions to regional emissions of GHG and land use change.

Author Contributions: M.A. conceived the paper; M.A., Y.G.-M., R.W. and C.S.S. conceptualized and designed the research; Q.O.-R. prepared and analyzed regional data; M.A., Q.O.-R., R.W. and C.G.-E. prepared and analysed farm data; M.A., R.W., C.S.S. wrote, reviewed and edited the paper; M.A. and R.W. administered the project and obtained funding; M.A. and C.S.S. finalized paper. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the National Science Foundation entitled *International Trade Agreements, Globalization, Land Change and Agricultural Food Networks*, 2016–2019 and also by UNAM-DGAPA-PAPIIT (No. IN-200319), Project titled *Análisis de la dinámica de sistemas mixtos agricultura-ganadería y sus impactos en la distribución de los recursos productivos, la diversidad de maíz y la configuración de los paisajes rurales en el Centro-Oeste de México*.

Conflicts of Interest: The authors declare no conflict of interest.

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