Chapter 6
Agriculture, Food Security and Livelihoods of the Mexican Population Under Market-Oriented Reforms

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6.1 Introduction

In the 1980s, the Mexican governments began to apply market-oriented policies. With respect to food, agriculture and the rural sector, the reforms ranged from constitutional changes to enhance private property rights in rural communal lands to the elimination of price supports granted to farmers producing staple crops. Policy changes included agricultural trade liberalisation: in 1985, Mexico joined the General Agreement on Trade and Tariffs (GATT), and in January 1994, the implementation of the North American Free Trade Agreement (NAFTA) began. Parallel to economic reforms a huge social programme to alleviate rural poverty began to be implemented.

The objectives of this chapter are threefold: (1) to evaluate the effect of reforms and NAFTA in agricultural production and food security on the rural economy and the livelihoods of the population of Mexico with special attention to maize (the major staple food of Mexico), (2) to reflect on the future of food security and the livelihoods of Mexicans, and (3) to draw lessons from the Mexican experience for other 'emerging economies'.[1]

This chapter is divided into six sections. In the next section, a summary of the main market-oriented reforms applied to agriculture is presented, pointing out their expected effects. Section 6.3 presents the tendencies of agricultural trade and production, with special attention to what are called in Mexico basic crops (major grains and oilseeds) produced in the country. In Sect. 6.4, we study the structure of crop production and its changes, assessing the role of agriculture by farm size in food security and the livelihoods of the Mexican population. The last two sections

[1] Due to data restrictions, the livestock sector is not treated systematically in the chapter; it is considered in Yunez-Naude (2010).

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are reflexive: in Sect. 6.5, hypotheses are proposed that explain why, contrary to expectations, the production of grains—non-competitive crops under NAFTA—has not collapsed. Based on our research, this chapter ends in Sect. 6.6, presenting policy options for the Mexican State and drawing lessons that the Mexican experience can provide to other emerging economies on food security and livelihoods.

6.2 Reforms and Expected Effects

As in other countries, market-oriented policy reforms in the Mexican economy began in the early 1980s. The Mexican agricultural sector was included in the late 1980s and its reforms deepened during the first half of the 1990s to prepare the sector for NAFTA. In the mid-1980s, government support prices to farmers producing what we call basic crops (barley, beans, maize, rice, sorghum, wheat, and oilseeds) were abolished, as well as subsidies for agricultural inputs and for credit. In addition, the banking system was re-privatised, public infrastructure to support the marketing of basic crops was sold or abolished and the Constitutional Article related to land property rights was reformed (Table 6.1; see also Yunez-Naude 2003).

The land or *ejidal* reform allowed individual property rights to *ejidatarios*; those peasants benefited from the process of rural land distribution and re-distribution implemented after the Mexican Revolution of 1910 during the application of the Agrarian Reform from the 1930s to1991. Before the reform, *ejidatarios* had to use the acquired land for production purposes, but were not allowed to sell or rent it, and not even to conduct business in association with the private sector. Individual beneficiaries of land distribution could and did pass their land to their children, who became *ejidatarios* themselves. With the land reform of 1992 the above restrictions could disappear if the Ejido Assembly approves it. The official expectation was that the Ejidal Reform would promote private property rights on land and ownership security in the rural sector of Mexico and, with it, the development of the land market, an increase in agricultural plot sizes and agricultural productivity, as well as greater access to private credit and investment.

In January 1994, NAFTA began with the following expectations. Based on the abolition of price supports to Mexican agricultural producers and the fact that the USA is Mexico's major trade partner, producing and exporting agricultural goods in which Mexico is non-competitive (basic crops, especially maize, the major staple in Mexico). NAFTA was expected to provoke price convergence in agricultural products, i.e. by liberalising domestic prices of basic crops and, with NAFTA, Mexico would follow closely US prices and, hence, its imports of these crops from its northern partner would rise. Neither the increase of food dependency caused by raising imports of grains and oilseeds, nor agricultural subsidies to US farmers worried Mexico's Government officials; their expectation was that lower basic crop prices and economic growth would enhance food security in Mexico and the livelihoods of its population. With respect to agricultural products in which Mexico is competitive (fruits and vegetables), US (and Canadian) liberalisation of import restrictions

Table 6.1 Liberalisation process of Mexico's food sector. (Source: Own)

Policy	Main policy changes	Year(s)
Mexico joins GATT and food imports restrictions began to be reduced	Substitution of import licensing for tariffication of agricultural goods (tariffs ranging from 0 to 20%)	1986–1994
Sale of food state enterprises	Privatization of state food storage facilities and state enterprises selling seeds and fertilisers at subsidised prices	1988/1989
	Abolition of state enterprises selling coffee, sugar and tobacco	
'Ejidal' reform (land property rights reform)	Ending of agricultural land distribution to peasants	1992
	Liberalisation of agricultural land property rights	
Elimination of price supports to farmers producing food staples (in 1999 the state trading enterprise providing this subsidy was abolished)	Domestic prices of staples determined taking into account international prices	1989 to date
	Creation of Support Services for Agricultural Marketing (ASERCA) in 1991, a marketing support agency granting subsidies to commercial staple crops' producers and buyers	
	Creation of PROCAMPO in 1994, a direct income transfer program to all producers of staples	
North American free trade agreement (NAFTA)	Prohibits the use of import licenses and applies tariffication principles	Jan. 1994–2008
	'Free' trade in 15 years. Sensitive agricultural products were subject to tariff rate quotas for a transitional period of up to 15 years	
	Interventions are allowed in the three countries for agricultural subsidies, import restrictions on phytosanitary grounds and rules of origin and for packing	
Alliance for the countryside	Group of programs to promote agricultural and rural productivity, including small farmers	1995–2007

under NAFTA would increase Mexico's export of these goods. Added to the Ejidal Reform, trade liberalisation would hence improve resource allocation, efficiency and agricultural productivity in Mexico.

These changes would imply the transformation of Mexican agriculture, leading in the short to medium run to an increase in rural migration to the USA. However, in the longer run, this tendency would tend to disappear with the expected rapid growth of the Mexican economy.

Parallel to economic liberalisation, domestic 'transitional' policies were implemented with the creation of Support Services for Agricultural Marketing (ASERCA is its Spanish acronym), a government institution that has being providing subsidies to commercial producers and buyers of basic crops, and, through *Procampo*'s direct

income transfers to all farmers producing these crops before NAFTA began to be implemented. 'Alliance for the Countryside' was the third major programme the Mexican government implemented from 1995 to 2007. It consisted of government supports to enhance rural productivity (Table 6.1).

Specific public policies and institutions aimed at reducing rural poverty—and, implicitly, food access to the poor—were created in parallel with the above reforms. In the early 1990s, the Ministry for Social Development was created and in 1997 a programme for Rural Education, Health and Nutrition (now called *Oportunidades*) began to be implemented. *Oportunidades* is a conditional cash-transfer programme aimed at reducing poverty in the short run while promoting human capital formation in the medium to long run.

Politically, the process of agricultural reform and liberalisation went smoothly until the beginning of the present century, when the political party that had ruled Mexico for 70 years lost power and when massive protests against the agricultural components of NAFTA emerged. The basic concern in these protests was the increasing imports of maize from the USA and the argument that with them Mexico was losing food security and sovereignty. The way to solve the conflict was by the creation of the Law for the Sustainable Development of the Rural Sector (LDRS, Spanish acronym; see Dyer and Dyer 2003) in 2002. Amongst other purposes, this Law includes the promotion of food security in Mexico, translated in practice by increasing public expenditure in the rural sector. However, it was not until 2005/2006 that food security purposes began to be implemented in a more concrete manner by the strategy called Special Programme for Food Security (PESA).

6.3 Tendencies: Agricultural Prices, Trade and Production, Food Dependency, Migration, Land Property Rights, Poverty and the Economy of Rural Households

Contrary to expectations, agricultural growth in Mexico has been poor and per capita agricultural GDP rates of growth have been negative before and after the reforms (the exception is the period of 2005–2008; Table 6.2). However, and as we will discuss, these trends do not necessarily mean that food security in major staples has sharply decreased.

As expected, since the deepening of reforms to agriculture, farm-gate prices of major grains declined until around 2006; the exception was the period of the macroeconomic crisis of Mexico in 1995/1996 (Fig. 6.1). Since the tendency is similar to that for international prices of these crops, the trend in Mexico suggests the presence of the 'law of one price' during reforms. We tested this hypothesis empirically and the results show that, indeed, domestic Mexican producers' prices of basic crops increased their convergence with US prices (see World Bank 2005; Yunez-Naude and Barceinas 2003; Yunez-Naude and Serrano 2009).

Table 6.2 Total and agricultural GDP, and per capita agricultural and processed foods (GDP/2002 pesos). (Sources: Own estimations. GDP based on Bank of Economic Information Website (Banco de Información Económica or BIE) and Population based on INEGI's data)

	Production				Per capita	
	GDP (%)	Field crops and pastures (%)	Livestock (%)	Processed foods and beverages (%)	Agriculture (%)	Processed foods and beverages (%)
1980–1988	−0.41	0.92	−2.77	1.97	−1.93	0.11
1989–1993	4.06	2.28	−1.40	5.41	−0.92	3.13
1994–1998	1.60	−2.48	0.53	1.59	−3.21	0.00
1999–2004	4.60	−0.66	2.86	4.02	−0.80	2.79
2005–2008	4.38	8.11	0.78	3.21	3.87	2.03

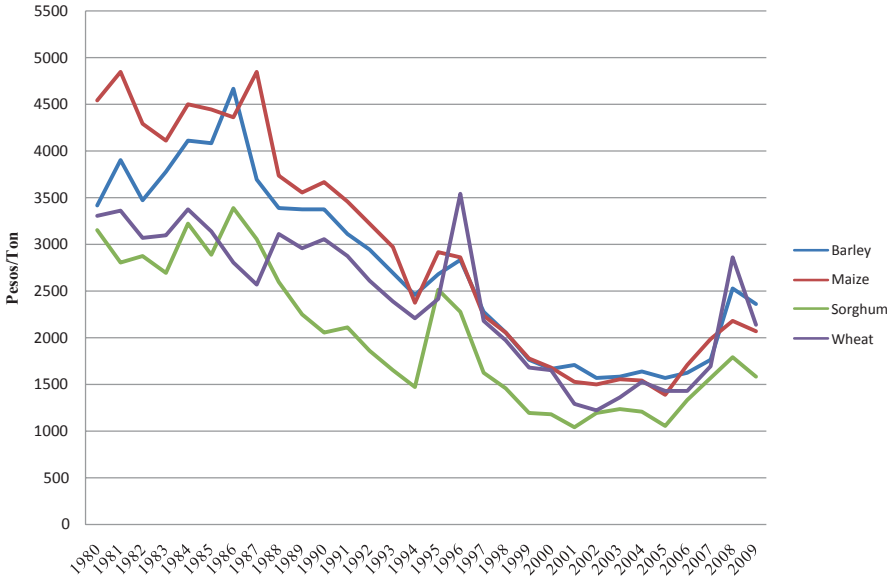

Fig. 6.1 Mexico. Producer price of selected grains (base 2002 = 100). (Source: SAGARPA-SIACON website, deflacted using Bank of Mexico consumer price index)

Before and after NAFTA, the weight of the USA in Mexico's total and agricultural trade has been greater than 80%. During NAFTA, both food exports to and imports from the USA increased (Fig. 6.2).[2] Of particular interest in this chapter are imports of field crops and of maize in particular, because maize has been the major crop and staple food of Mexico produced by commercial and family farmers.

[2] For example, in 1990, Mexico was the sixth largest importer of US agricultural products, while in 2008 Mexico reached the second place, just behind Canada. A detailed presentation of the effects of NAFTA in the agriculture of Mexico is in Yunez-Naude (2011).

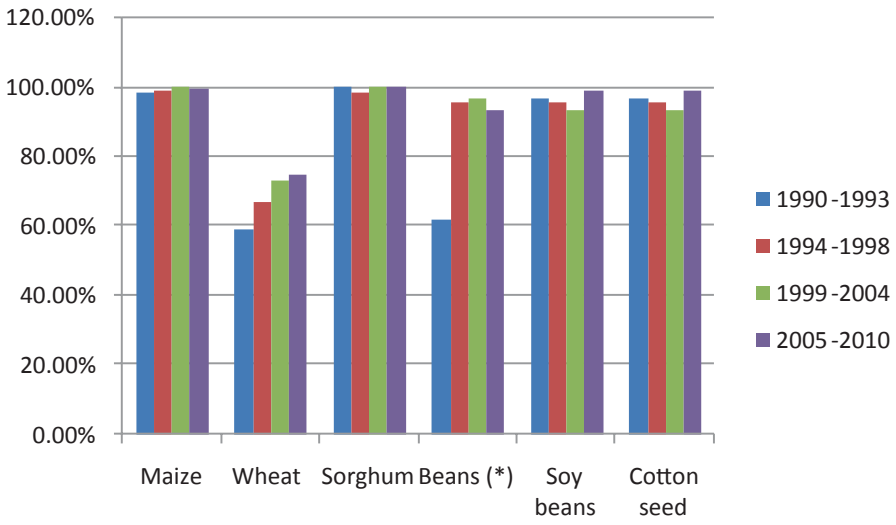

Fig. 6.2 Weight of USA in Mexico's value of imports (constant dollars). (*) Includes kidney beans and white pea beans. (Source: http://www.comtrade.un.org and http://www.imf.org/)

As expected, during the NAFTA era, production of Mexico's competitive crops (fruits and vegetables) has grown, whereas production of basic/non-competitive crops declined (oilseeds, rice and wheat) or grew (barley, beans, maize and sorghum; Table 6.3). Growth of domestic production of these four non-competitive crops was unexpected, especially the sharp increase in maize production; the reasons for this unexpected trend are discussed in Sect. 6.5 below.

Food dependency caused by increasing imports of basic grains from the USA has been a concern as well as an argument for state intervention by critics of liberalisation. We venture an answer to this question by calculating the ratios of non-competitive field crop imports to domestic production. Table 6.4 shows that 'food dependency' has clearly increased for major oilseeds (particularly soy beans), and this is not the case for all grains. The ratio of imports to domestic production remained practically unchanged for maize and sorghum, and it declined for beans and increased a little for barley.

Rural labour out-migration has increased continuously, both to urban Mexico and to the USA. During NAFTA, the rate of rural international migration has been higher with respect to domestic migration (Fig. 6.3).

In relation to the Land/Ejidal Reform, official information shows that expected effects have not been quite realised. After 17 years of its implementation land fragmentation increased, i.e. *minifundia* has grown and private property rights of former *ejidal* lands for agricultural production have not grown (Panel 1 of Table 6.5).

Measured in terms of access to a basket of basic foods, poverty indices of Mexicans increased in the first half of the 1990s, and increased sharply during the mid-nineties when Mexico suffered a severe macroeconomic crisis. Food poverty decreased from

Table 6.3 Domestic production of major crops: 1980–2008 (thousands of metric tons). (Sources: Mexico Ministry of Agriculture's website: 1980–2005 SIACON; 2006 onwards SIAP)

		1980–1988	1989–1993	1994–1998	1999–2004	2005–2009
Grains and beans	Rice	553.2	390.0	412.5	280.6	282.1
	Beans	1038.4	1053.1	1242.0	1189.5	1071.8
	Maize	12,296.8	14,978.9	18,145.1	19,513.8	21,859.6
	Wheat	4044.7	3913.9	3577.2	3010.5	3647.7
	Barley	524.2	519.5	452.2	779.7	716.6
	Sorghum	5449.3	4644.5	5373.4	6183.1	5989.4
Oilseeds	Sesame seed	68.4	37.7	26.1	33.2	26.6
	Cotton seed	749.1	345.4	613.6	274.9	374.3
	Saflower	257.5	98.9	138.7	159.2	90.8
	Soy beans	638.1	676.8	220.7	117.1	126.1
Fruits[a]		8.4	9.7	11.7	14.1	15.5
Vegetables[b]		3.4	4.6	5.2	6.7	7.2

[a] Fruits include avocado, peach, strawberry, guava, citrus, mango, apples, melon, papaya, pineapple, banana and water melon

[b] Vegetables include tomato, carrot, garlic, broccoli, pumpkin, onion, chayote, peas, chili, coriander, brussel sprouts, cauliflower, asparagus, cucumber and peppers

Table 6.4 Weight of imported volume on total domestic production: 1985–2006. (Source: Ministry of Agriculture http://www.siap.sagarpa.gob.mx/AnxInfo/)

	1985	1990	1995	2000	2001–2006
Grains[a]	027	0.30	0.22	0.48	0.48
Oilseeds	1.05	0.57	3.36	11.21	11.23
Rice	0.37	0.58	1.03	1.85	2.68
Beans	0.20	0.26	0.02	0.07	0.08
Maize	0.22	0.28	0.14	0.30	0.29
Wheat	0.11	0.09	0.31	0.69	1.01
Barley	0.07	0.23	0.14	0.22	0.25
Sorghum	0.52	0.48	0.50	0.88	0.60
Sesame seed	0.00	0.22	0.11	0.26	0.50
Cotton seed	0.00	0.00	0.00	0.00	0.00
Saflower	0.20	0.15	0.23	2.09	1.69
Soy beans	1.61	0.88	11.12	38.27	32.54

[a] Includes beans

1997 to 2006 and is rising again, mainly due to the rise in international food prices. In addition, the gap between rural and urban poverty has not decreased (Fig. 6.4).[3]

[3] Income inequality prevails and remains high in Mexico: the Gini coefficient was 0.53 in 1992 and 0.51 in 2005; see the website of the National Council for the Evaluation of Social Policy

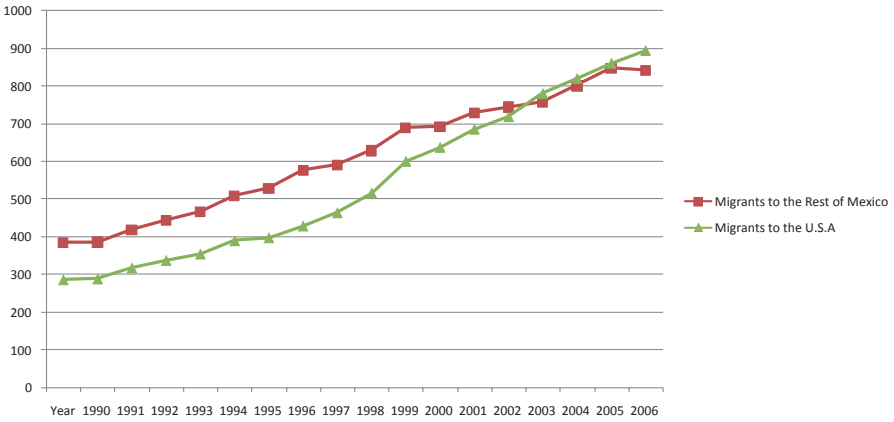

Fig. 6.3 Number of rural migrants: 1990–2007 (No expansion factors were applied to the survey results). (Sources: National Survey of Rural Households (ENHRUM, Sapnish acronym). PREC-ESAM website)

Table 6.5 Structure of property rights, size and weights of rural agricultural units of production (AUP): 1991 and 2007. (Source: Agricultural Censuses: 1990 and 2007, provided by the National Institute of Statistics, Geography and Informatics (INEGI, Spanish acronym)

(*1*) *Land property rights*	*Millions of hectares* (*ha*)		*Distribution in total land* (*%*)			
	1991	2007	1991	2007		
Ejidal	30.03	37.01	28.28	33.35		
Communal	4.34	3.78	4.09	3.41		
Private	70.49	69.67	66.39	62.79		
Public	1.32	0.49	1.24	0.44		
(*2*) *Size of AUP*	*Average size* (*ha*)		*Distribution in total AUP* (*%*)		*Distribution in total ha* (*%*)	
	1991	2007	1991	2007	1991	2007
Up to 2 ha	1.12	1.09	34.56	44.47	4.71	6.10
From 2 to 5 ha	3.41	3.46	25.35	24.21	10.55	10.51
From 5 to 20 ha	8.78	9.23	31.25	23.16	33.52	26.84
From 20 to 50 ha	20.51	25.26	5.27	5.10	13.22	16.16
From 50 to 100 ha	42.64	51.68	1.77	1.74	9.24	11.32
From 100 to 1000 ha	104.11	130.58	1.67	1.25	21.22	20.45
From 1000 to 2500 ha	351.45	517.82	0.09	0.05	3.70	3.06
More than 2500 ha	710.86	1724.79	0.04	0.03	3.84	5.55

(CONEVAL, Spanish acronym). The results of our research on changes in poverty and inequality from 1990 to 2005 are consistent with the above (see Yunez et al. 2010).

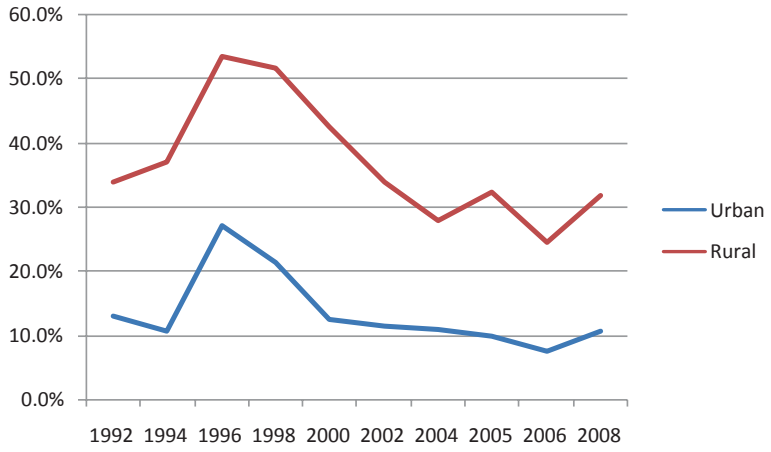

Fig. 6.4 Changes in food poverty (weights in total rural and urban populations). (Source: Coneval website. http://www.coneval.gob.mx)

That some of the expected effects of the reforms have not happened does not mean that Mexico's agricultural sector and rural economy are not changing; in fact, both are undergoing transformations. Today Mexico produces more agricultural GDP with a similar quantity of workers than in the early 1990s. For example, from 1993 to 2008, the annual average rate of growth of 'primary production' (agriculture, plus fisheries and hunting) measured in 2002 pesos was 1.2%, whereas the number of persons employed in the sector declined by 0.9% during the same period.[4] The agricultural supply chain is being transformed by an increasing concentration of food trade in the hands of a few large retailers, intermediaries and basic foods processors. Meanwhile, the economy of Mexican rural households is changing. For example, the share of independent farming income in total rural households' income decreased from more than 31% in 1992 to 10% in 2004, whereas that of waged non-farm labour increased from 20% to almost 35% during the same period (Table 6.6).

Table 6.6 Changes in the composition of income sources of rural households: 1992–2004. (Source: CONEVAL website)

	Non-farm waged labour	Independent farming	Private transfers	Public transfers
1992	20.0	31.2	11.0	1.3
1994	23.9	24.0	12.3	2.5
1996	24.9	24.3	9.9	4.0
1998	26.0	20.8	12.5	4.1
2000	27.3	17.5	14.3	5.0
2002	26.7	15.9	15.1	7.5
2004	34.2	10.0	9.9	9.1

[4] Based on own estimations using data on GDP from the same source as Table 6.3, and data on employment from FAO's website and from the Statistical Annex of the President of Mexico's 2011 Address to the Congress.

6.4 Structure of Crop Production and Changes: 1991–2007

The livelihoods of Mexico's rural poorest population highly depend on agricultural staple production, which was and is still done by highly heterogeneous farmers in Mexico. At one extreme are a considerable number of subsistence rural households producing maize, beans and rearing small animals for their families' own consumption on small plots of land, while at the other extreme, there are market-oriented large farmers; in the middle, there are farmers producing agricultural goods for both their families' own consumption and for the market. This heterogeneity must be considered in any study of food security and on the livelihoods of the Mexican population. This approach is also fundamental to reflect on the future of agriculture of Mexico and to propose lessons that the Mexican experience can provide to other emerging and less-developed countries.

6.4.1 Structure and Evolution of Mexican Agricultural Production

Data from the Mexican Agricultural Censuses of 1991 and 2007 (AGC in what follows) provide information to describe the structure and evolution of agriculture by farm size ('units of agricultural production' or AUP in AGC terms).[5]

From 1991 to 2007, the average size of Mexico's AUP declined from 8.18 to 7.96 hectares (ha in what follows) and average farm size slightly decreased for plots of less than 2 ha, remained practically unchanged for plots between 2 and 5 ha, and increased for the remaining plots (Panel 2 of Table 6.5). This table also indicates the prevailing high heterogeneity in Mexico's agrarian structure. For example, the number of small AUP (up to 5 ha of land) accounted for almost 60 % of total AUP in 1991 and for 68 % in 2007, but had just around 16 % of total area in both years. By contrast, big AUPs (more than 50 ha) constitute just over 3 % of total AUP, but cover around 40 % of total ha.

The AGC provides additional information about the persistence of agricultural heterogeneity in Mexico. Indeed, as AUP size decreases, more family, non-waged labour is used for agricultural production and more crops are used for family consumption. For example, production of crops for own consumption in 2007 was as high as 61 % in farms with up to 2 ha, and this weight sharply decreases as farm size increases (details in Taylor et al. 2011). With respect to property rights in agricultural lands, the average size of *ejidal* plots decreased by 1 ha, from 8.5 to 7.5 (Robles 2010).

Thus, contrary to expectations about the effects of economic liberalisation and the Land/ *Ejidal* Reform, fragmentation has increased. In addition to the prevalence of *minifundia*, formal credit access has decreased. As the AGC data shows, the number of farms with access to credit declined by almost 77 % from 1991 to 2007.

[5] The AGC for 2007 does not cover all major crops, such as rice, soy beans and other oilseeds.

6.4.2 Crop Production by Farm Size

Based on the heterogeneity of agricultural production, it is relevant to study the evolution of food production by farm size in order to examine the role played by agriculture during NAFTA and the reforms on food security and the livelihoods of Mexicans. For this, we use again the AGC data of 1991 and 2007, focusing on the most important crops cultivated in the country in terms of area planted by AUP. We stress here and in Sect. 4.3 below on production by small and medium-sized farming because we consider that production on these farms of some of the selected crops has been fundamental in the livelihoods of Mexicans, especially for the country's rural households that are the poorest segments of Mexico's population. In addition, production under small and medium-sized farms could be important in the future for improving the role of agriculture in Mexico's economic development.

Notwithstanding the prevailing high heterogeneity in the structure of land distribution by AUP per size (Table 6.5, Panel 2) and differentiation on inputs used (Taylor et al. 2011), volume of production of major basic crops has increased in all farm sizes (the exceptions are beans and wheat, whose production declined in all AUP but in the biggest AUP; Panel 1 of Table 6.7). In addition, yields between farms of different sizes have not been highly different in major basic grains and beans production, and neither has their growth from 1991 to 2007 (Panel 2 of Table 6.7).[6]

Consistent with the figures presented in Table 6.3, the AGC data shows that the volume of maize production sharply increased during the past years; it increased by 2.9 times between 1991 and 2007. This sharp growth was experienced by all farm sizes, but much more in the largest ones (Panel 1 of Table 6.7). In addition to increasing yields (Panel 2 of Table 6.7), the growth of maize production in AUP with more than 20 ha has been based on the extension of harvested area with the grain. This is reflected by the sharp rise from 1991 to 2007 in the participation of these AUP in both maize production and in harvested area: from 35 to 50 % (Panel 3.1 of Table 6.7) and from 37 to 39 % (Panel 3.2 of Table 6.7), respectively. Notwithstanding that maize production and yields also increased in the remaining AUP, their participation in total production and total harvested area decreased from 1991 to 2007 (hypotheses about the reasons for the evolution of maize production are discussed in Sect. 6.5 below).

Total production of beans in small and medium-sized AUP decreased slightly during 1991–2007. However, the weight of AUPs with less than 5 ha of land on total AUP participation and harvested area has remained, indicating that, as for maize, small farmers still grow beans for their own consumption (Table 6.7).

Cultivation of grains other than maize is for the market. The AGC data show that physical production of sorghum increased sharply from 1991 to 2007 in all farm sizes. However, most of this cash crop is grown by medium-sized and big farmers. During the same period, the volume of production of barley almost doubled, and this increase is explained by the rise of its production amongst all farm sizes.

[6] The exception is yields in maize as in 2007 they were much higher in the bigger farms. However, from 1991 to 2007 yields have grown sharply in all farm sizes.

Table 6.7 Structure of production by farm size of major basic crops. (Source: Agricultural Censuses: 1990 and 2007)

AUP	Barley		Beans		Maize		Sorghum		Wheat	
	1991	2007	1991	2007	1991	2007	1991	2007	1991	2007
Volume of production (*thousands of metric tons*)										
Up to 2 ha	8.2	20.8	62.9	53.7	1071.4	2396.2	33.3	167.9	30.8	44.6
From 2 to 5 ha	40.6	88.7	158.8	115.8	1705.8	3853.0	295.5	766.8	271.3	193.1
From 5 to 20 ha	116.6	237.6	573.4	383.2	3887.2	8796.9	1356.8	2930.1	1258.9	683.5
From 20 ha	229.0	378.2	484.5	580.3	3563.8	15,102.6	2005.0	9085.4	1914.7	2693.0
Total	*394.3*	*725.3*	*1279.6*	*1133.0*	*10,228.3*	*30,148.8*	*3690.6*	*12,950.2*	*3475.7*	*3614.3*
Yields (*volume of production per cropped area*)										
Up to 2 ha	1.05	2.37	0.31	0.45	1.04	2.09	3.32	6.91	2.24	4.53
From 2 to 5 ha	1.08	2.59	0.34	0.48	0.96	2.39	3.21	5.73	3.27	5.44
From 5 to 20 ha	1.24	2.72	0.44	0.56	1.11	3.21	2.36	5.84	3.47	5.63
From 20 ha	1.41	2.80	0.56	0.65	1.56	4.52	2.02	6.50	3.58	5.62
Distribution of AUP by size in total production and harvested area										
Production										
Up to 2 ha	2.08%	2.86%	4.92%	4.74%	10.48%	7.95%	0.90%	1.30%	0.89%	1.23%
From 2 to 5 ha	10.30%	12.23%	12.41%	10.22%	16.68%	12.78%	8.01%	5.92%	7.81%	5.34%
From 5 to 20 ha	29.56%	32.76%	44.81%	33.82%	38.00%	29.18%	36.76%	22.63%	36.22%	18.91%
From 20 ha	58.07%	52.15%	37.86%	51.22%	34.84%	50.09%	54.33%	70.16%	55.09%	74.51%
Harvested area										
Up to 2 ha	2.50%	3.15%	7.00%	5.74%	12.29%	12.54%	0.57%	1.19%	1.37%	1.43%
From 2 to 5 ha	12.46%	12.77%	15.71%	11.94%	20.59%	17.73%	5.41%	5.47%	8.36%	5.37%
From 5 to 20 ha	31.81%	32.83%	46.07%	35.68%	40.67%	31.23%	34.38%	24.72%	36.64%	18.65%
From 20 ha	53.22%	51.25%	31.23%	46.64%	26.45%	38.50%	59.63%	68.62%	53.63%	74.55%

Finally, the AGC data indicates that production of wheat slightly increased from 1991 to 2007, and that almost all of its production comes from medium and bigger farmers. However, the weight on total volume of wheat production of medium-sized farms (5–20 ha) declined during the period, whereas the contribution of bigger farms increased (Table 6.7).

Sugarcane and oranges are two of the major perennials produced for the market in Mexico in all farm sizes in the lowlands and tropical regions of Mexico. The study of the evolution of these two types of plantations from 1991 to 2007 is helpful to illustrate the structure, productivity, and tendencies in the production of cash agricultural products relevant for small and medium farmers and for the livelihoods of Mexico's population.[7]

The AGC data show that the volume of sugarcane productionincreased by more than 32% from 1991 to 2007. Most of the sugarcane is produced in medium-size farms: for both years, more than 92% of AUPs cultivating this crop had less than 20 ha of land, producing between 75% in 1991 and 71% in 2007 of the total sugarcane produced in Mexico (Taylor et al. 2011).

From 1991 to 2007, the volume of production of oranges increased almost 2.4 times. As in the case of sugarcane, most oranges are produced in small and medium-size farms: for both 1991 and 2007, more than 86% of AUPs cultivating this crop had less than 20 ha of the land, producing 67% in 1991 and 62% in 2007 of the total volume of oranges produced in Mexico. Yields in orange production have sharply increased similarly in all farm sizes (Taylor et al. 2011).

The tendencies described above on production and yields allow us to propose that notwithstanding the economic reforms and trade liberalisation, not only production of basic corps has prevailed in Mexico but also the production by small farms of maize, barley and other cash agricultural goods—such as sugarcane and oranges—has remained and supported crop production and the livelihoodsof Mexico's population. If we add that medium-sized farmers have also played a role in this respect, we can argue that small and medium-size farming have survived NAFTA and reforms, and practically without government supports as discussed in Sect. 6.5 below.

6.4.3 Productivity and Efficiency in Agricultural Production of Rural Households

As discussed in the previous section, yields in the production of major basic grains and cash crops have grown during the period of reforms in all farm sizes, and therefore, agriculture has helped to support the livelihoods of Mexicans and food availability in the country. Based on panel data for 2002 and 2007 from the National Rural Households Survey for Mexico (ENHRUM, Spanish acronym), the results of

[7] Coffee is another major cash crop of small and medium-sized farmers. Coffee has been excluded here because data provided by the AGC are insufficient to study its evolution during the period under consideration.

on-going econometric research on productivity and efficiency in agricultural production of Mexican rural households by farm size allow us to extend the study on the role and changes of agriculture in food production and livelihoods in Mexico to the case of rural farmers (agricultural households located in communities of less than 2500 inhabitants; see DAS website).

Our results support the hypothesis proposed in the literature that there is an inverse relationship between farm size and productivity (the ENHURM sample splits evenly at a farm size of 3.0 ha, with the average size of small farms being 1.3 ha and that of bigger farms 8.1 ha). According to our results, other things being equal, a 1 % increase in farm size is associated with a 0.49 % reduction in output value per hectare and a 0.58 % reduction in labour-days per hectare.

In addition, we are studying empirically if the inverse relationship between farm size and productivity implies that small farms are more efficient than large farms. By defining the production efficiency frontier in terms of per-hectare output, we directly link productivityand efficiency and test for the existence of an inverse relationship between farm size and efficiency and for changes in this relationship over time using a pooled fixed effects stochastic frontier regression. The results of the stochastic frontier analysis when we allow for differences in technology between large and small farms (i.e. when the farm-size dummy variable is interacted with all inputs in the model: land, labour and purchased inputs) show that the marginal returns to labour are significantly lower on large farms. This is the only statistically significant difference in the efficiency frontiers between small and large farms (details in Taylor et al. 2011).

In summary, our results indicate that there is an evidence of an inverse relationship with respect to both productivity and efficiency on Mexican farms of rural households. Small farms enjoy a productivity advantage with respect to labour and large farms are significantly more inefficient than small farms. We find no evidence that the efficiency frontier is changing over time.

Overall, our findings suggest that despite the increasing importance of off-farm income of rural households members (Table 6.6) and far-reaching transformations of the agricultural policy and the supply chain, small farmers in rural Mexico continue to enjoy both a productivity and efficiency advantage with respect to larger farmers in rural Mexico, and so remain a relevant component in food production and in the livelihoods of the population of Mexico.

6.5 Towards an Interpretation of the Changes in the Rural Economy of Mexico with Special Reference to Maize Production

It is evident that during the period of economic liberalisation the rural sector of Mexico has experienced considerable transformations in some respects and no significant changes in others. With respect to the latter, after more than 20 years of

reforms and more than 15 years of NAFTA implementation, production of non-competitive crops remains (this is especially so in the case of maize).

So, notwithstanding the high increase in maize imports from the USA during the reforms and up to 2006 the reduction of producer maize prices during NAFTA, production in Mexico of this grain has increased. To study the reasons explaining these events is relevant because, being the major staple in Mexico produced by all farmers, maize is closely related to questions of food security and livelihood in emerging economies.

We propose that in order to enquire about the factors explaining the evolution of the maize sector of Mexico one has to consider heterogeneity in its production and use, as well as the characteristics of public agricultural and rural policies that have accompanied the market-oriented reforms.

Maize in Mexico has been produced by all farmers, independent of their farm size and market orientation. These farms, including rural households, produce maize for their own consumption while engage in other family activities to diversify their income sources: production of cash crops, livestock, migration and remittances, local non-farm as well as farm wage work, etc. Whereas commercial producers of maize respond directly to price changes, family farmers may not, i.e. subsistence maize producers are price inelastic, either because of the presence of high transaction costs, or because they react in apparently unexpected ways to changes in maize output market prices. For the first hypothesis, see de Janvry et al. (1995). With respect to the second hypothesis, using a microeconomic computable general equilibrium model (MCGE), Dyer et al. (2006) found for a typical Mexican village that a maize market price shock is indirectly transmitted to subsistence producers through interactions in factor markets. They concluded that a drop in the market price of maize reduces local wages and land rents, stimulating maize production by subsistence households. (They also found that the real income of subsistence households falls.)

For the case of commercial medium and large maize farmers, we propose the following three hypotheses to explain its increasing production during NAFTA and the reforms: some of these farmers have reacted to price reductions by increasing productivity per yields (e.g. medium-sized farmers); others have changed their land use for other purposes; and the remaining have been isolated from US competition through government supports. No time series are available to test these three hypotheses. However, the AGC data presented in Table 6.7 do not contradict them.

With respect to government supports, income subsidies for marketing from ASERCA (target income, or *Ingreso Objetivo*) have been channelled to commercial maize farmers, mostly in the northwest of Mexico and those with access to irrigation. Excluding *Procampo*, around 70% of ASERCA's budget has been used to support the income of farmers with surplus basic crops (between 430 and 600 million USD per year). 50% of this subsidy goes to this type of maize producer, of which 70% is for farmers in a single north-western state, Sinaloa. There is empirical evidence showing that the target income programme has promoted maize production by its beneficiaries. Hence, the programme is coupled and has isolated some maize surplus producers from US competition. The same applies to farmers in the

north of Mexico receiving target income to market their sorghum and wheat production (see Sumner and Balgatas 2007).

In addition to target income, *Procampo's* direct income and decoupled transfers to producers of basic crops may also help explain why Mexico's domestic supply of maize (and other basic crops) has not collapsed. Winters and Davis (2009) reviewed the empirical literature supporting the hypothesis. In their review, these authors included the effects of the conditional income transfers of *Oportunidades* on agricultural production of its beneficiaries. The empirical results indicate that both programmes have positively influenced the agricultural production of rural households. This, in addition to rural small farms' productivity and efficiency, has helped to maintain the role of small rural farming in contributing to food production and in the livelihoods of Mexico's rural population. Finally, by increasing the income of rural households, *Oportunidades* has provided access to food for the poorest population of Mexico.

6.6 Final Remarks

The increase or maintenance in some major grains' production in Mexico during the period of agricultural reforms and trade liberalisation may be taken as a success story by those who worry about endogenous food security in emerging as well as less-developed countries. However, these tendencies have been mainly based on the endurance of maize production of small and subsistence farmers and the target income transfers to big commercial farmers in the north of Mexico, as well as by subsidising transnational grain marketing enterprises and domestic processors with monopoly power to get them to buy domestically produced grains instead of importing them.

By isolating some large commercial Mexican farmers from competition, this type of policy conflicts with the efficiency goals of trade liberalisation, and hence is inefficient and expensive. At the other extreme, small-scale agricultural households have not benefited from government supports, with the exception of *Procampo's* transfers. For maize, small farmers producing this crop for the markets were negatively affected by declining maize prices following the reforms. Meanwhile, production in subsistence households remained or even increased.

Agricultural programmes in contemporary Mexico are not only expensive and inefficient, but they have been regressive, high, and have increased during the present century. For example, the United Nations' Food and Agricultural Organization (FAO) estimates that for Mexico, the relationship between agricultural subsidies/ total subsidies and Gross Domestic Agricultural Product/ total GDP is much higher with respect to the other 19 Latin American countries considered in the estimation; for example, in 2001 the ratio for Mexico was 1.4, whereas for Brazil it was less than 0.8, for Chile 0.5, for Peru 0.4, and for Colombia less than 0.05 (Scott 2010).

The regressive character of Mexico's agricultural policies has additional consequences: to reduce the effects of rural poverty alleviation policies and to create interest groups amongst big farmers with political power to press the government for the continuation of the subsidies channelled to them.

Table 6.8 Policy changes from 2001. (Source: Own)

Policy change	Main characteristics	Years of implementation
Law for sustainable rural development (LDRS)	Adds to agricultural government supports all rural activities and use of natural resources in a decentralised manner	From 2002
Special concurrent program (PEC, acronym in Spanish)	Instrumentation in public budget terms of the LDRS with the participation of all ministries involved in supports to the rural sector	From 2003
Special program for food security (PESA, acronym in Spanish)	Supports low income farmers to increase food production (follows FAO-type programs established in 1994 for countries with food deficits)	From 2005
Food Supports/'Vivir Mejor'	Special Program to protect the poor from food price surge	From 2008
The programmes in of the ministry of agriculture are rearranged	SAGARPA's more than 50 Programmes are regrouped into eight. PROCAMPO remains as a single programme, marketing supports become part of the 'Programme to Attend Structural Problems' and alliance for the countryside disappears as such and its components became part of two of the eight new programmes	2008–2010
The programmes in of the ministry of agriculture are rearranged	SAGARPA's eight programmes are regrouped again into five. PROCAMPO remains as a single programme, marketing supports become part of the 'Programme to Prevent and Manage Risks'[a]	From 2011

[a] The target population/attended farmers and the instruments of PROCAMPO and marketing supports suffer no major changes

The experience of Mexico shows that one condition for the expected effects of market-oriented policies to realise is the existence and/or functioning of markets, and this has not been the case for some relevant markets for the rural sector and rural households' economy. In addition, instead of using public resources for the provision of public goods to enhance technical change and markets (e.g. in research and development and investing in infrastructure), most government expenditure to the rural sector has been for the provision of private goods (e.g. income transfers for rural households and big farmers). To the above, one has to add that the transfer of public enterprises to the private sector without the application of laws for competition could have promoted monopoly power in some areas of the Mexican food chain, reducing the positive effects of liberalisation on final consumers (Economic Commission for Latin America 2006).

Public concerns in emerging countries about poverty reduction, equity, livelihoods and securing a food supply based partially on domestic production have to focus on their rural households. For this, Mexico has its LDRS (Table 6.8).

Unfortunately, this Law has not meant a change in the structure of public expenditure to the rural sector. However, there is a recent successful concrete experience based on the application of the special federal programme of food security (PESA) mentioned earlier. The experience is for rural areas of Guerrero, one of the poorest states of Mexico. The programme adds to the beneficiaries of *Oportunidades* supports for productive purposes and access to financial services. A recent rigorous evaluation of the effects of the programme shows that the programme has reduced poverty and increased the nutrition levels and food production of its beneficiaries (Yunez-Naude et al. 2009).

We are convinced that increasing food prices in the contemporary global economy offers an opportunity in Mexico to reform the agricultural reforms, by eliminating distorting subsidies to powerful basic crops farmers, by putting into practice competition laws, by adding to poverty-alleviating measures in rural productive programmes, and by putting into practice the LDRS (details in Taylor et al. 2007).

Based on the experience of Mexico, we propose that some of the challenges faced by governments in emerging countries to attend to poverty, inequality, and food security are the following: to know which rural households have the productive potential to make the transition to an increasingly globalised economy while designing effective policies to solve the problems of small-scale production and commercialisation (assisting the creation of co-operatives and/or associations, contract farming, etc.); to enhance rural financial and land markets; and to invest in public goods.

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