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Longitudinal analysis of household types and livelihood trajectories in Oaxaca, Mexico

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ABSTRACT

In Mexico, a political shift to fit into neoliberal directives since the 80s has brought several consequences to rural households and their trajectories. This study focused on the relation between drivers of change and household trajectory. The study was carried out in Santa Catarina Tayata, in the state of Oaxaca, Mexico. 44 household heads were interviewed to recall their production system and economic activities at significant moments. The results were summarized as variables describing the socio-economic and agronomic situation of households over three decades: 1988-1997, 1998-2007, and 2008-2017. Household types were identified for each decade. Three household types were distinguishable in the first two decades, and five in the last decade. Drivers of change such as international markets, land tenure, government support, and migration were connected to household trajectories. Results showed that household type diversity increased, while half of the households changed types at one point according to different strategies. Changes in land tenure in the study area in the early 2000s were attributable to the PROCEDE national program, which acted to lift restrictions on land tenure, facilitating the buying and selling of land. The implementation of PROCEDE resulted in fewer households relying on borrowed or rented land while allowing others to expand their land and form a new household type. A migration process enabled some households to invest in land or animal production as a "step up" strategy. The majority of households that received agriculture-related subsidies tended to engage solely in agricultural activities. Half of the households that did not benefit from subsidies engaged in off-farm to diversify their income, suggesting that the type of governmental support can have an impact on farming activities. Household types that had more animal production or larger areas did not tend to engage in off-farm activities because of high demands for labor in their production systems. This type of study can be used to monitor policy impact and households' strategic responses, to arrive at better articulation of policy objectives and policy impact while considering household type diversity.

1. Introduction

In Mexico, small-scale agriculture in poor areas is challenged by a lack of natural, economic, and social resources (Speelman et al., 2014).

Furthermore, a series of changes towards neoliberal policies contributed to the decline of the agricultural contribution to the Mexican GDP, and to widespread abandonment of agricultural activities (UN 2014). A shift to neoliberal directives in the 80s, culminating in the General

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Agreement on Tariffs and Trade (GATT) in 1986 and the North American Free Trade Agreement (NAFTA) in 1994, had several effects on poor rural areas (González and Alferes, 2010; Klepeis and Vance, 2003; Sweeney et al., 2013). The GATT and NAFTA impacted households directly or indirectly by triggering shifts in government support to farmers (Winters and Davis, 2009), facilitating the commercialization of land (Echanove Huacuja, 2016), reducing prices of agricultural product (Barnes, 2009; Nicita, 2004), increasing migration (Taylor et al., 1999), and leading farmers to diversify their income through off-farm activities (Avalos and Graillet, 2013; Patel and Henriques, 2003). Considering the diversity in agricultural systems and socio-ecological contexts in Mexico (Appendini et al., 2008; Speelman et al., 2014), it is safe to expect that a particular driver of change will not have the same impact on each household. Yet little is known about the relations between drivers of change and household trajectories, hampering feedback on the efficacy of policy measures.

Households react and adapt to global (e.g. out-migration, market liberalization, global trade) and local (e.g. municipal regulations) drivers of change (Fabricius et al., 2007; Novotny et al., 2021; Speelman et al., 2014; Tittonell, 2014; Zimmerer, 2007). Households can react to these drivers by accumulation or selling assets, diversifying income, and changing cropping systems. This dynamic process is often referred to as livelihood trajectories (Bagchi et al., 1998) or household trajectories (Camfield and Roelen, 2013; Sallu et al., 2010). Analysis of household trajectories can bring out the role of political, demographic, economic, and environmental drivers of change (Carney, 1998; Reidsma et al., 2010) on households' income sources, social relations, and material assets (Mushongah and Scoones, 2012). In contrast with static household studies, household trajectories can also reveal temporary and chronic problems such as poverty (Camfield and Roelen, 2013). By contextualizing these trajectories, insights are gleaned from how households respond or adapt to shocks (Sallu et al., 2010), which may be used to assess the efficacy of policies, develop interventions, and elaborate research agendas for improving livelihoods in rural areas.

One way to assess the degree to which drivers impact differentially on households is by categorizing households into types (Iraizoz et al., 2007). Typology studies are used to categorize households according to their production systems or their decision-making process, or a combination of both (Tittonell et al., 2020). However, given the difficulty to include a temporal perspective, household typologies often provide a single snapshot in time, failing to capture the household trajectories. Studies by Falconnier et al. (2015) and Chopin et al. (2015) addressed this issue by assuming that only households were dynamic, but household types remained unchanged, thereby ignoring changes in the pattern of household types. In other words, households could transition between types, but these types remained the same. By assuming stationarity of household types, these studies run the risk of not capturing important emergent patterns such as out-migration, abandonment of agriculture, and the increasing importance of other economic activities (agriculturally related or not).

Therefore, this study aimed at assessing the influence of drivers of change on the trajectory of households. We hypothesized that drivers of change (e.g. land tenure change, subsidies, and migration) sway both household trajectories and the set of household types. Based on this hypothesis, the following research questions were asked: what are the main drivers of change, and how do they influence household typology and household trajectory? This study assesses the pattern of household trajectories in a case study municipality in Oaxaca, one of the poorest states in Mexico (Juárez and Pfitze, 2015). This case study municipality, like others in the state (Juárez and Margarita, 2008), experienced high migration and a declining population (INEGI 2010a). We decided on the case study approach for its advantages over other methods (e.g. narrative research, ethnography, and phenomenology) in explaining how drivers affected households (Creswell and Poth, 2018; Yin, 2018). Quantitative and qualitative information was gathered from the literature and household interviews, which were used to identify drivers of

change related to international trade, migration, land reforms, and government support (e.g. subsidies). The interviews used a recall method to reconstruct household histories for up to 30 years. The resulting information was used to build household typologies for every decade through a multivariate analysis. Answers provided by the interviewees in combination with a literature review allowed us to relate household trajectories with drivers of change.

2. Case study description and research methods

2.1. Case study area

The municipality of Santa Catarina Tayata (SCT) (37.22 km²) is located in the state of Oaxaca, Mexico, at an elevation of 2000–2500 m above sea level. The climate is temperate sub-humid, with average temperatures ranging from 16 to 18 °C and annual rainfall between 1000 and 1200 mm. Land use in SCT can be divided into three major categories; settlement areas, privately-owned plots, and communal land (Fig. 1). Settlement areas are agglomerations of houses and contain the local administration facilities. Privately-owned plots are predominantly used for crop production. Communal plots mostly comprise forests, but farmers use areas without trees as pasture for their animals. The main economic activity in the area is rainfed agriculture, although small irrigation systems can be found. The area of arable land per household ranges from 0.5 to 12.5 ha. The agroecosystems are diverse, with a predominance of maize (*Zea mays* L.) for human and animal consumption and beans (*Phaseolus vulgaris* L., *Vicia faba* L.) exclusively for human consumption. Maize and beans are grown either as a monoculture or in mixed crop stands such as the milpa system that also includes squash (*Cucurbita* spp.) (Ebel et al., 2017; Hernández and Bello, 1995). Every household is involved in animal production. On average households have 7 chickens and 10 sheep. Households usually do not sell their production due to physically difficult access to larger towns. Instead, production is used for consumption within the household. Income is mainly generated by providing labor for sowing, weeding, and harvesting on the land of other local farmers. Other sources of income come from remittances, off-farm activities, and government support.

2.2. Policies affecting change

A total of 51 households were surveyed in the area before this study. The survey included questions about agricultural production and the socio-economic conditions of households. The survey and a literature review of rural policies and dynamics revealed four domains in which policies potentially affected livelihood trajectories in the case study area. These domains comprise land tenure, international trade, government support, and migration (Fig. 2).

Land tenure – The Mexican constitution of 1917 stipulated the creation of the *Ejido* system of communal land tenure as part of the agrarian reform (Assennato and León, 2007), which enabled the distribution of land to formerly landless people. This land could not be sold and was to be worked by the owner (Núñez, 2000). The *Ejido* system was changed in 1992 as one of the consequences of the NAFTA (Barnes, 2009), giving farmers the right to sell their land (Klepeis and Vance, 2003). The federal Program for the Certification of *Ejido* and Land Ownership Titles (PROCEDE by its Spanish acronym) was introduced to implement the privatization process and provide clarity on land tenure. While the land tenure regulation process implemented through PROCEDE started in 1992, the local authority of Santa Catarina Tayata only permitted the process to take place in 2000, after approval by the local assembly. Within 5 years tenure of the land in the municipality was regulated.

International trade - The General Agreement on Tariffs and Trade (GATT) had an impact on the Mexican agrarian sector by reducing state influence and increasing the role of markets in agriculture by 1990 (Núñez, 2000; Pérez-Soto et al., 2016; Sweeney et al., 2013). As a consequence of the GATT, tariffs on imports of agricultural products and

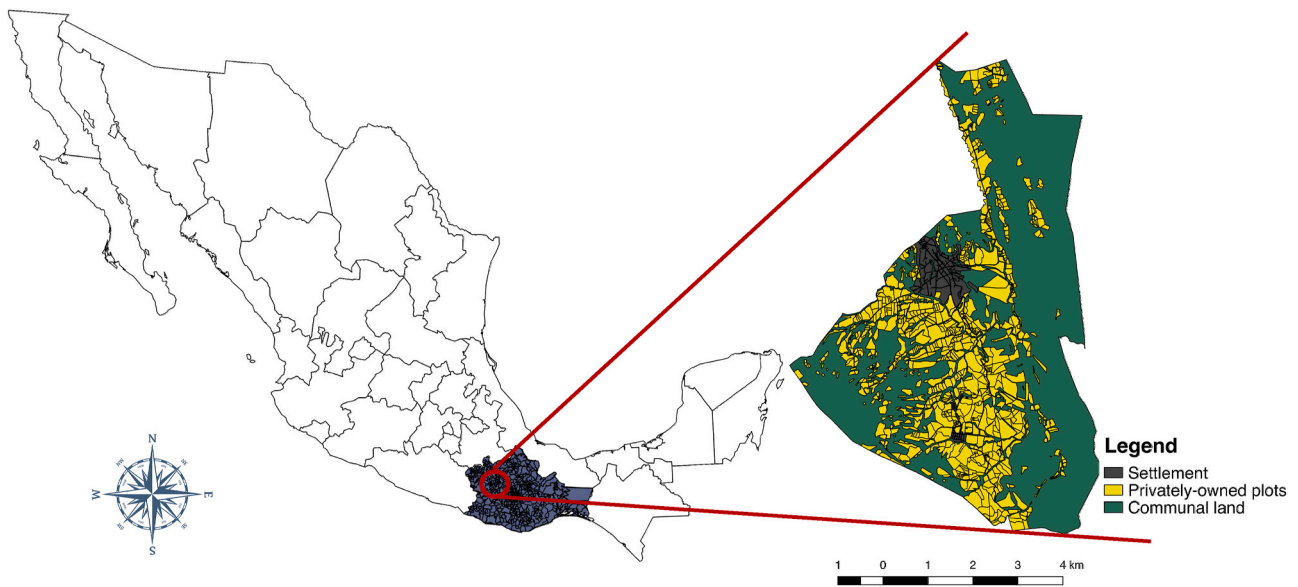


Fig. 1. Geographical situation of Santa Catarina Tayata in the state of Oaxaca, Mexico. Colors on the map represent land uses: settlement area (gray), agriculture (yellow), communal land (green). Figure elaborated from the National Agrarian Registry (RAN, 2019). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

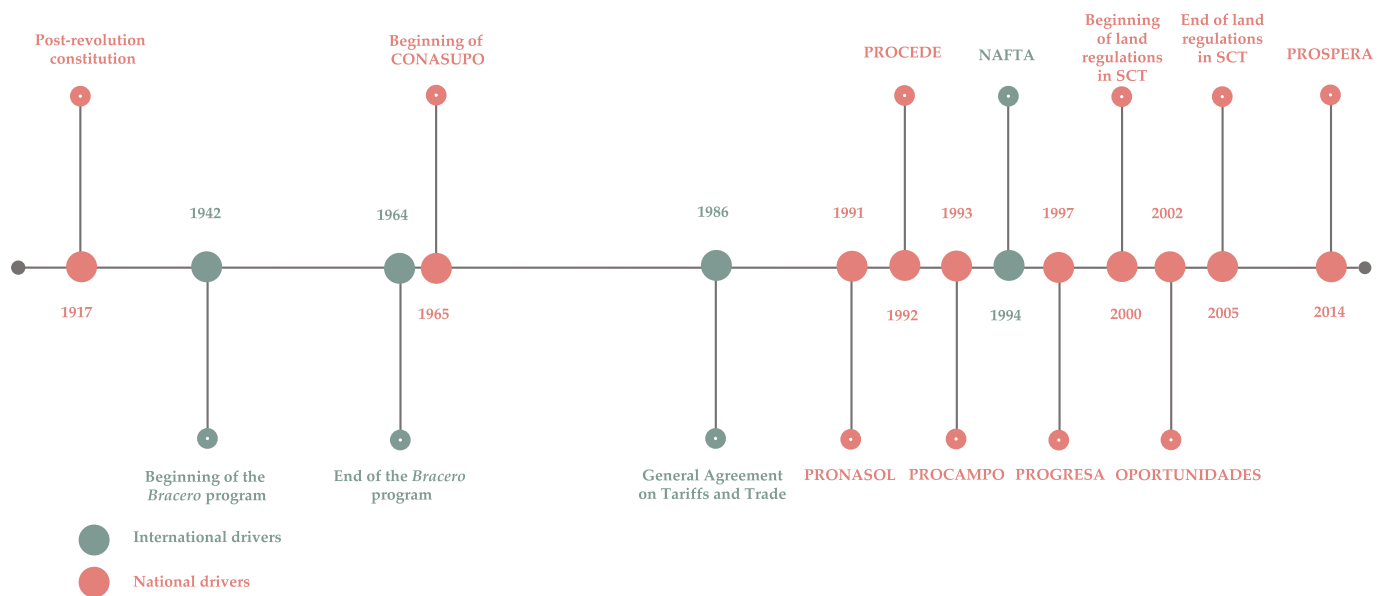


Fig. 2. Timeline of the major policies and agreements impacting farm livelihoods in Oaxaca, Mexico.

subsidies on inputs were either removed or reduced (Foley, 1995; Klepeis and Vance, 2003). Furthermore, government intervention in crop prices, established to guarantee a minimum price, was abolished for all crops except maize and beans (Foley, 1995). The North American Free Trade Agreement (NAFTA) consolidated the reforms that started during the GATT period.

Government support - The National Solidarity Program (PRONASOL by its Spanish acronym) was created in 1991 to mitigate poverty in rural areas (Yúnez and Barceinas, 2000). Considering that two-thirds of the Mexican population lived in extreme poverty (World Bank, 2005), the PRONASOL provided monetary loans for subsistence production and development of sustainable agricultural activities. It supported activities such as forestry, agroindustry, and extractive industries, and stimulated regional development through better infrastructure, such as road access (FAO 2003). Since the creation of PRONASOL, the program has changed

with each new president, changing its name to PROGRESA (1997–2002), OPORTUNIDADES (2002–2014), and its current title PROSPERA (2014–today). From PROGRESA onwards, governmental support mainly consisted of providing family allowances for poor households.

In 1993, the PROCAMPO program was created to support farmers and mitigate potential hardship ensuing from the agricultural section of NAFTA (Shwedel, 1994). The main objectives of PROCAMPO were to improve domestic and international competitiveness in the private and social sector, improve the livelihood of rural families and modernize the marketing system by providing financial resources to stimulate the production of crops more profitable than maize (Pérez-Soto et al., 2016; Zarazúa-Escobar et al., 2011). In practice, the program gave financial support to farmers in proportion to the acreage of particular crops (Avalos and Graillet, 2013; Klepeis and Vance, 2003; Sweeney et al.,

Table 1
Main variables used to describe 5 household types in 3 distinct decades: 1988–1997, 1998–2007, and 2008–2017. Different lower-case letters indicate statistically significant differences across decades for the same household type ($p < 0.05$). n.a. Indicates that the given household type was not present.

Variables	Overall average			Mid-scale household type			Livestock household type			Land tenant household type			Labor migrant household type			Large-scale household type		
	1988–1997 (n = 24)	1998–2007 (n = 34)	2008–2017 (n = 44)	1988–1997 (n = 15)	1998–2007 (n = 16)	2008–2017 (n = 21)	1988–1997 (n = 3)	1998–2007 (n = 3)	2008–2017 (n = 3)	1988–1997 (n = 6)	1998–2007 (n = 8)	2008–2017 (n = 4)	1988–1997 (n = 7)	1998–2007 (n = 8)	2008–2017 (n = 8)	1988–1997 (n = 8)	1998–2007 (n = 8)	2008–2017 (n = 8)
Owned land (ha)	4.0 ± 6.6	2.4 ± 2.7	2.6 ± 2.5	2.9 ± 2.5	2.4 ± 2.4	1.2 ± 1.1	11.4 ± 11.9	3.3 ± 1.5	3.3 ± 1.5	0.0 ± 0.0	0.4 ± 0.7	2.7 ± 2.5	n.a.	5.5 ± 3.9	1.6 ± 2.3	n.a.	n.a.	6.7 ± 0.8
Borrowed/rented (ha)	0.9 ± 1.5	0.8 ± 1.3	0.3 ± 0.9	0.1 ± 0.2	0.2 ± 0.3	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	4.5 ± 0.6	2.5 ± 1.0	3.0 ± 1.5	n.a.	0.0 ± 0.2	0.1 ± 0.0	n.a.	n.a.	0.0 ± 0.2
Crops (#)	4.0 ± 1.4	3.7 ± 1.5	3.9 ± 1.7	3.7 ± 1.3	4.1 ± 1.2	4.8 ± 1.4	5.7 ± 1.1	6.0 ± 1.0	6.0 ± 1.0	4.2 ± 1.2	3.6 ± 1.6	3.4 ± 1.1	n.a.	2.1 ± 1.0	3.0 ± 0.8	n.a.	n.a.	2.5 ± 1.6
TLU (#)	6.7 ± 8.3	5.7 ± 5.7	4.3 ± 3.54	3.6 ± 3.1	6.0 ± 3.9	4.0 ± 2.1	24.7 ± 9.0	14.2 ± 2.9	20.2 ± 1.9	5.7 ± 5.4	4.0 ± 4.2	5.3 ± 1.5	n.a.	2.6 ± 3.9	1.6 ± 3.9	n.a.	n.a.	4.0 ± 1.6
Migration (persons/household)	0.2 ± 0.8	0.2 ± 0.4	1.0 ± 1.8	0.3 ± 1.0	0.0 ± 0.0	0.2 ± 0.5	0.0 ± 0.0	0.3 ± 0.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	n.a.	0.7 ± 0.3	3.6 ± 1.4	n.a.	n.a.	1.0 ± 2.1

2013). PROCAMPO changed its name in 2014 to PROAGRO (SAGARPA 2016), but we only refer to PROCAMPO in this article. PROCAMPO together with the PROGRESA-PROSPERA programs aimed to reduce poverty in rural areas (Naude et al., 2015).

Migration - An important phase in managing migration between Mexico and the USA was the Bracero program, which was a bilateral agreement on temporary migration between the countries. The program started in 1942 and ended in 1964. After the Bracero program ended, migration became characterized by the illegal flow of Mexicans to the USA. This flow of migrants was stimulated by the perception of better prospects in the USA and facilitated by emigrants themselves, who provided financial assistance to their family members still living in Mexico (Santos, 2017).

The state of Oaxaca has around 4 million inhabitants and ranks 9th in terms of state-wide migration (INEGI, 2010b). While migration from Oaxaca to the USA is important, domestic migration is also common. For instance, between 1995 and 1999 0.5% of inhabitants of Oaxaca left for another state on an annual basis. In 2010, migration numbers dropped to 0.12% (CONAPO 2016). Migration resulted in negative population growth in many municipalities of Oaxaca, especially during the 1990s (Juárez and Margarita, 2008).

2.3. Data collection and analysis

Household trajectories were constructed through in-depth interviews. In mid-2017, local authorities in SCT were consulted on candidate households, well-spread across the geographic extent of the municipality. This resulted in 44 households that were available and willing to participate in the study out of around 160 households in the municipality. The interviews followed a semi-structured format to enable exploring topics that would have been overlooked in a structured interview (Mapedza et al., 2003). The interviews included questions regarding past animal and crop production, migration, and different sources of income, as is common in studies on livelihoods (Mushongah and Scoones, 2012; Scoones, 2009; Tiltonell, 2014). Farmers recalled their past by referring to important events in their lives and connecting these to changes in their households. For instance, they were asked to recall the time at which they became responsible for their first plot, marking thus the beginning of their farm household. To track major changes in their production system, farmers were first asked about the size of the current herd. They were subsequently inquired if they used to have more or fewer animals in the past. This process was repeated until we could no longer identify changes. During the interviews, farmers were asked to explain why a certain change occurred. In the case of migration, interviewees were questioned when a family member had left, where they had gone and whether they had returned. When finishing talking about a specific topic, the answers provided would be repeated to the farmers so they could corroborate or correct them. The results of the interviews were discussed with the local authorities in September 2018 to triangulate the trends in the data.

The interview data were organized into three periods of ten years each, i.e. 1988–1997, 1998–2007, and 2008–2017. The year 1988 was selected as the starting year because more than 20 of the 44 household heads were farming at that time. Besides, 1988 was several years before the NAFTA, allowing to see changes in household trajectories caused by this driver. The number of households analyzed per decade increased over the three decades as a consequence of farmers establishing their households. The number of households per period were 24, 34, and 44 for 1988–1997, 1998–2007, and 2008–2017, respectively. Organizing the data in 5-year periods did not yield new insights and proved to be harder to interpret.

For each period, household types were identified based on a principal component analysis (PCA) followed by hierarchical cluster analysis (HCA) (Alvarez et al., 2014; Chopin et al., 2015; Tiltonell et al., 2010). The analysis was performed on the following quantitative variables: land area (owned, borrowed or rented), tropical livestock units

(TLU), number of crops, and number of household members who migrated. Animals owned were converted to TLU based on 1 TLU being equivalent to a cow of 250 kg (Jahnke, 1982). TLU for other animals were derived from the base value of 250 kg, resulting in a TLU of 0.1 and 0.01 for sheep and chicken, respectively. To address intra-period variation (i.e. change in a variable from one year to another within the decade), the weighted averages of the variables for each decade were calculated. For instance, if a certain farmer had a TLU of 1 for 6 years and a TLU of 2 for 4 years over 10 years, the weighted average for the decade was 1.4 TLU. Values across periods were compared using the non-parametric Kruskal-Wallis test. After performing the HCA, household types were distinguished by assessing cut-off values for each quantitative variable (Falconnier et al., 2015). The cut-off value is obtained by comparing the data dispersion between household types and assessing if they overlap. When no overlap is found, the cut-off value is established as the minimum observed value for the household type with the greatest median (see A 1 for illustration). These cut-off values were used to classify household trajectories. For instance, for a household to shift to a type characterized by a high TLU, it would have to surpass the cut-off value defining that type.

The analysis in this study was performed in R v. 3.5.1 for Mac using the package *ade4* for the PCA and the packages *stats* and *factoextra* for hierarchical clustering analysis. Household types were compared across decades using the non-parametric Kruskal-Wallis test, obtained through the *pgirmess* package. When a household type differed significantly from every other type from the previous decade, it was considered an emergent household type.

The household trajectories (i.e. the progress of each household through time) were linked to their livelihood strategy. According to Dorward (2009) and Mushongah (2009), livelihood strategies can be classified as: “Hanging in”, “Stepping up”, “Dropping out” and “Stepping down”. “Hanging in” households are the ones that sustain their level of wealth and well-being while coping with threats, stresses, and shocks. This study considered those households that did not change type over time as “Hanging in” households. “Stepping up” households invest in assets to improve their crop production through land acquisition or to expand their sheep herd. Households in the process of migration were classified as “Dropping out”. Trajectories that involved the decrease of resources such as land or animals were labeled as “Stepping down”.

The household types were evaluated in terms of the role of off-farm activities and the importance of government support through agricultural subsidies (e.g. PROCAMPO) and family allowances (e.g. PRONASOL and PROSPERA). The off-farm activity was not considered when migration occurred, and no remittance money was provided to family. A Cochran-Mantel-Haenszel test was performed with the data nested in decade to test the association between household types, off-farm activities, and government support. This test identifies partial associations between factors within a stratum (Wittes and Wallenstein, 1987). To complement the evaluation of income sources, the 44 households were asked to calculate the current share of income from crop production, animal production, local off-farm income, governmental support, and remittances. This was only done for the year 2017, as recalls for earlier years turned out to be inaccurate.

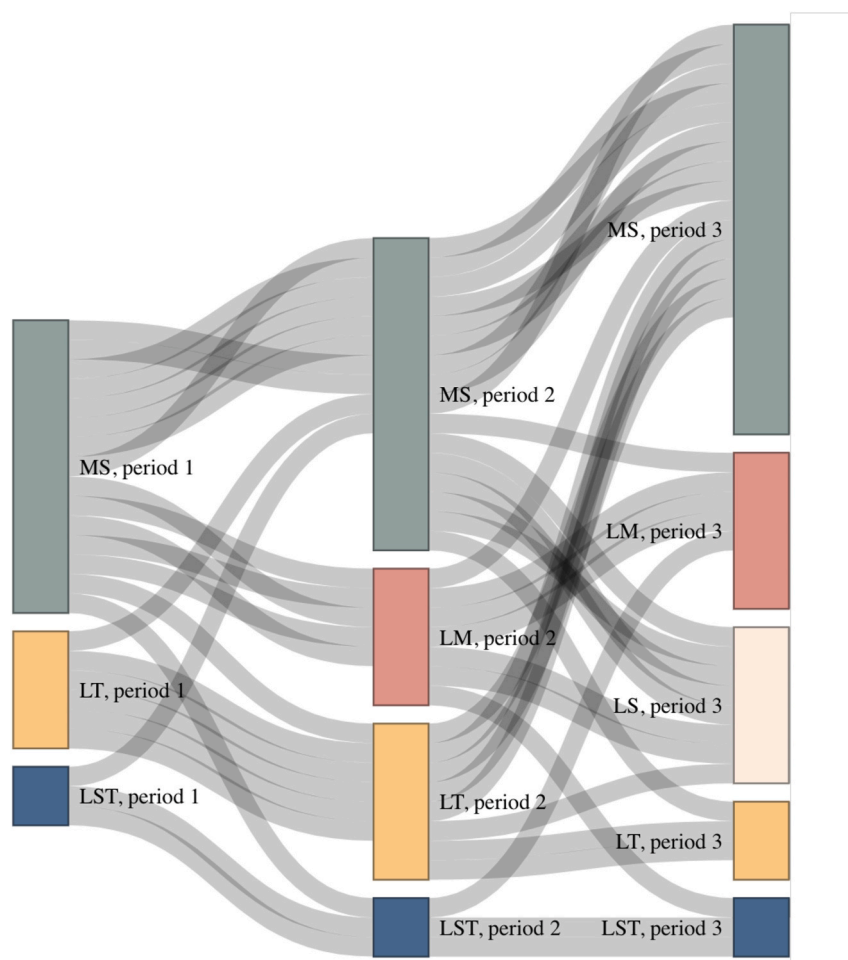


Fig. 3. Sankey diagram showing the fluxes of households into and out of farm types between decades. MS = Mid-scale; LT = Land tenants; LST = Livestock; LM = Labor migrants; LS = Large scale.

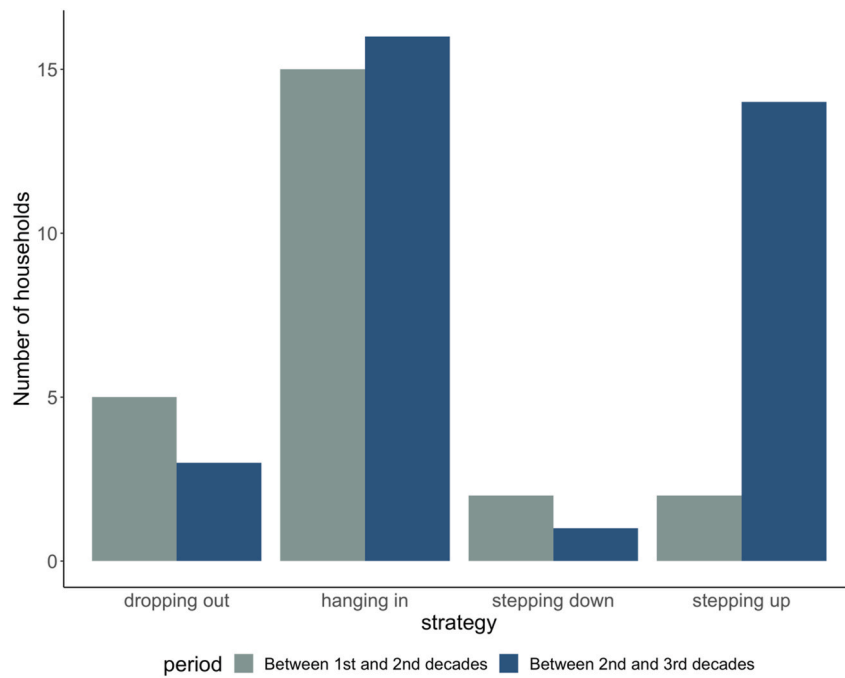


Fig. 4. Number of households and their livelihood strategies between the 1st and 2nd decades and between the 2nd and 3rd decades.

3. Results

3.1. Household type description and changes over time

Three household types were identified for the first decade (1988–1997), which were labeled “Mid-scale”, “Livestock”, and “Land tenant” household types. Migration was only found in two households in

the first period. For the second decade (1998–2007), a fourth household type was identified and labeled “Labor migrants”. For the last period, another household type appeared, labeled “Large-scale” (Table 1). Details on PCA and HCA are provided in A 2 and A 3.

The Mid-Scale household type was found throughout the last 30 years. Households from the Mid-scale type overlapped partially with one or more of the other groups. No statistical differences were detected in

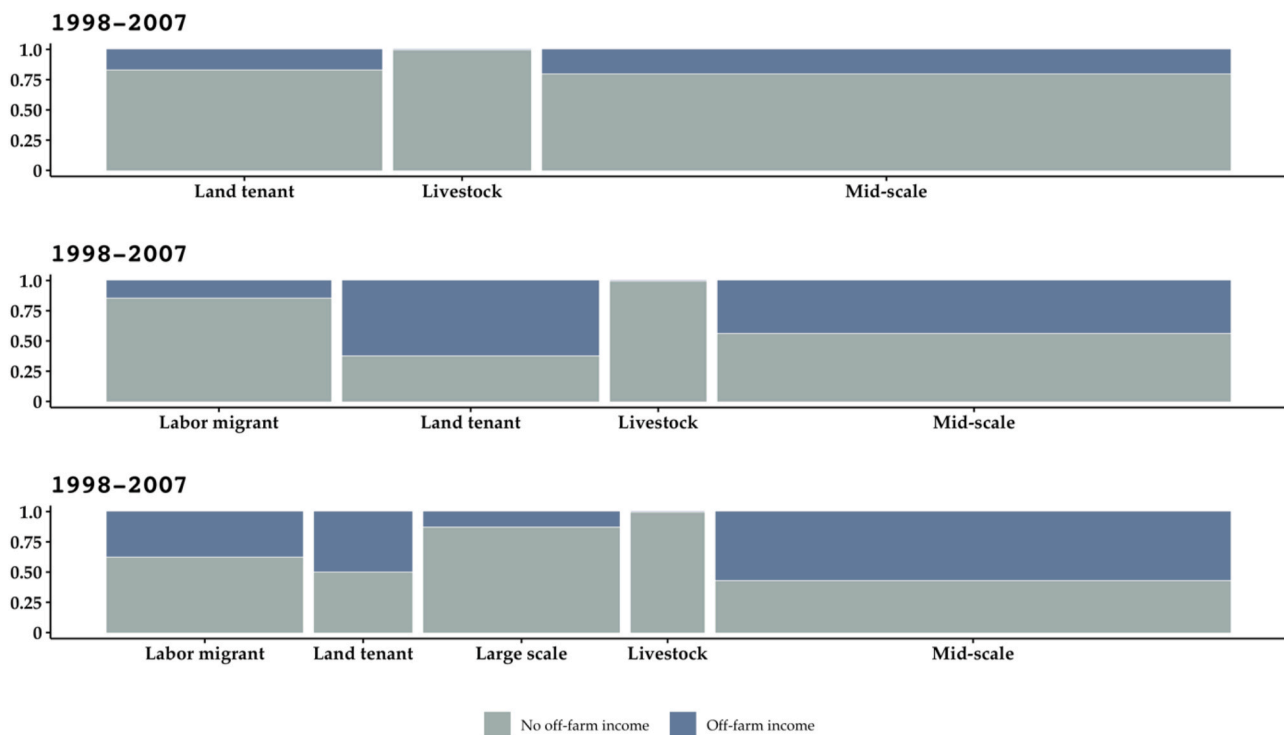


Fig. 5. Proportion of household heads with or without off-farm according to household type in three decades: 1988–1997, 1998–2007, and 2008–2017. Bar width represents the relative proportion of a given household type of the total number of households. Stacked bars represent the relative proportion of households engaged or not in off-farm activities for a given household type.

variables between the first and second decades, while the area of owned land was significantly lower in the third decade compared to the second ($p < 0.05$).

The main focus of the Livestock household type was sheep production. The Livestock type was found in each period and consistently harbored only a few farm households. No statistically significant differences were found between the variables characterizing this type across the three decades.

The Land tenant household type was characterized by comparatively large areas of land borrowed or rented from other households. This type was found in every decade. Households from this type did not have family members who migrated and had average numbers of TLU and cultivated crops. The Land tenant households significantly increased the area of owned land during the last decade compared to the previous decade, while the other variables did not change significantly over time.

The Labor migrant household type appeared in the second decade (1998–2007) and was characterized by relatively large numbers of migrants per household. The average TLU and number of cultivated species in this type were the lowest of all the groups. No significant differences were found between the second and third decades for any variable.

The Large-scale household type only appeared in the last period and was characterized by households owning greater land areas than other types. This was usually achieved by purchasing land. While migration occurred, the number of persons per household that migrated was lower than for the Labor migrant type. The few households in this type had an average number of TLU, but a below-average number of cultivated crops.

3.2. Livelihood trajectories and strategies

On average, household heads started their agricultural activities at age 34, with a minimum observed age of 15 and a maximum of 84 years. Out of the 44 households, 20 had members who temporally migrated within Mexico and started their farming activities later. Across the three decades, 23 out of the 44 households changed from one household type

to another. Of the 24 households present in 1988–1997, 17 had changed type by 2017. Six out of ten households that were established during the second decade also changed type. Half of the new households started as the Mid-scale type, with the other half distributed among other groups (Fig. 3). Most of the households that formed the two new household types (Labor migrant and Large-scale) in the second and third decades originated from the Mid-scale type. During the first and second decades, the Land tenant type comprised about 25% of households, but only 10% during the third decade. Most households that left the Land tenant type changed to the Mid-scale type. The Livestock type was represented by three households in each period (although not the same households).

The classification of the livelihood trajectories in terms of the four livelihood strategies distinguished in this study revealed “hanging in” as the most frequent strategy, followed in descending order by “stepping up”, “dropping out” and “stepping down” (Fig. 4). More than half of the households that adopted a “hanging in” strategy belonged to the Mid-scale type. In total, we recorded three households that “stepped down”, while 8 “dropped out” as a consequence of migration. A strong increase in the number of households “stepping up” between the 2nd and 3rd decade was observed.

Households that “dropped out” were associated with the migration of family members. During the first decade, we found 5 cases of domestic migration and none of the interviewees reported a case of international migration. In the second period, 6 persons had migrated nationally, and 5 persons went to the USA. This increase in the number of migration cases resulted in the emergence of the labor migrant type. A greater number of people migrated during the 2008–2017 decade, with 34 persons having migrated nationally and 20 persons to the USA. This increase in migration is also reflected in the demography of SCT, which decreased from 864 to 663 between 1980 and 2017 (INEGI, 2015, 1980).

Seven households were observed to “step up” from the land tenant type. Five of these seven households changed types by reducing the rented/borrowed cropping area while inheriting land during the implementation of PROCEDA. The remaining two households purchased

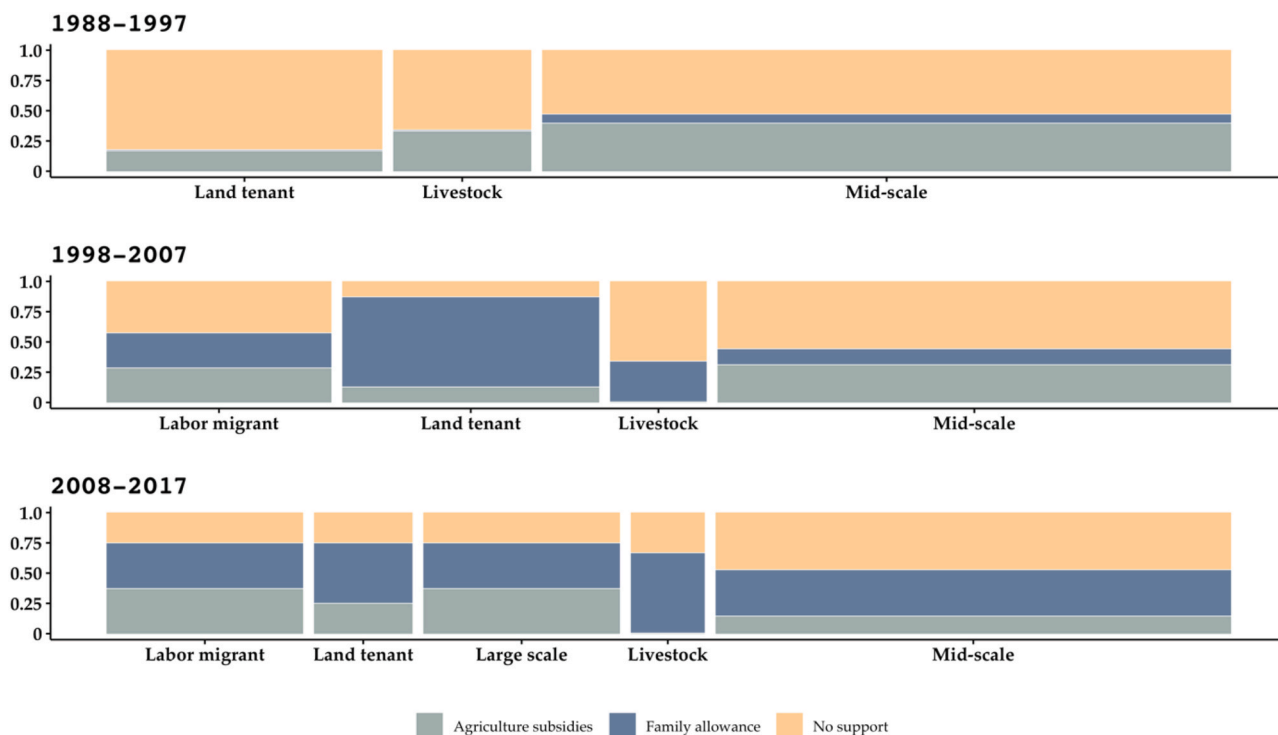


Fig. 6. Proportion of households receiving agricultural subsidies through PROCAMPO, family allowance through PROGRESA-PROSPERA, or no support according to household type in three decades: 1988–1997, 1998–2007, and 2008–2017. Bar width represents the relative proportion of a given household type to the total number of households. Stacked bars represent the relative proportion of households according to the government support received for a given household type.

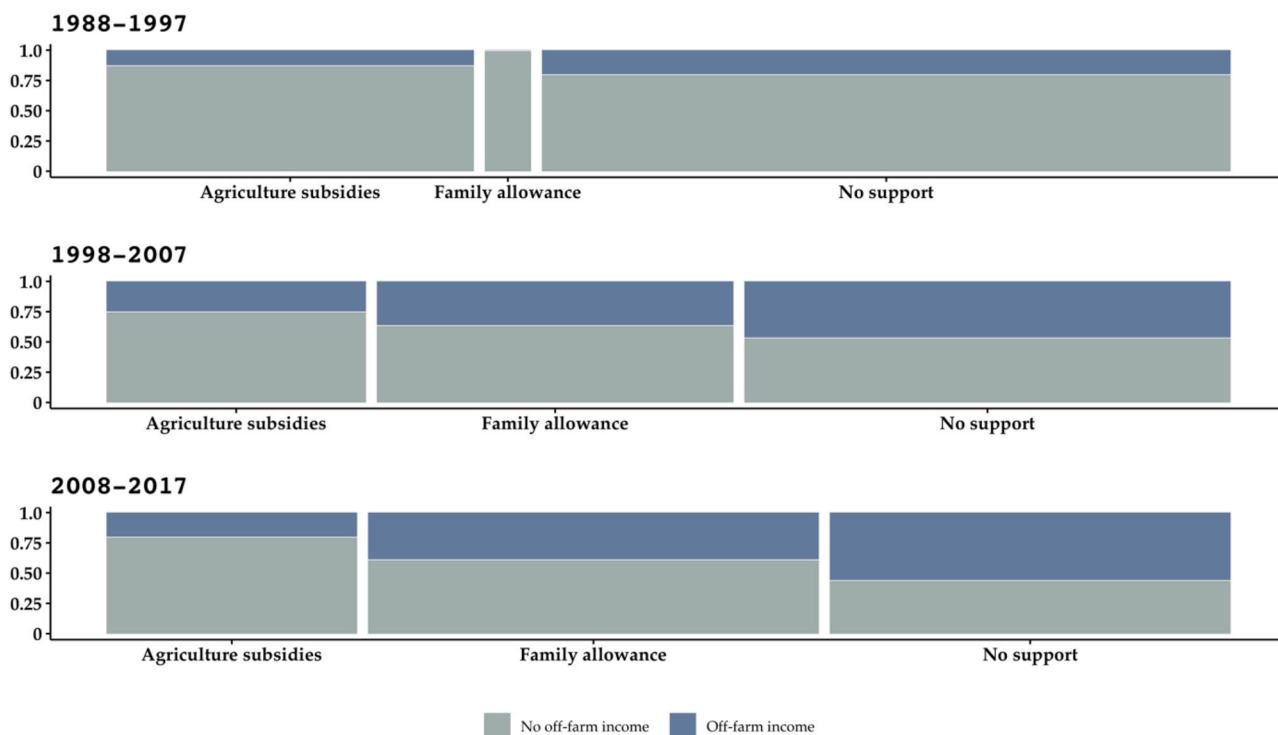


Fig. 7. Proportion of households with or without off-farm income according to the type of government support in three decades.: 1988–1997, 1998–2007 and 2008–2017. Bar width represents the relative proportion of households receiving a given government support. Stacked bars represent the relative proportion of households with off-farm income for a given government support.

land with their savings when the PROCEDE program facilitated the process of purchasing land. The PROCEDE program also permitted eight households to purchase or inherit larger areas of land, enabling them to “step up” to the Large scale type.

The proportion of households engaging in off-farm activities increased from 15 to 40% between the first and last decade. The Cochran-Mantel-Haenszel test showed a significant association between the household type and the income source ($p < 0.0001$). We observed an increasing proportion of households having an off-farm income source in the Mid-scale and Land tenant household type (Fig. 5). Households from the Livestock and Large scale types generally did not have off-farm income. Households from the Livestock type stated that animal husbandry activities were incompatible with off-farm income, while those from the Large scale type mentioned that labor in their plots did not allow them to work elsewhere.

The association between household type and the type of government support was significant (Cochran-Mantel-Haenszel test, $p < 0.0001$). During the first decade of 1988–1997, 33% of households had agriculture-related subsidies (i.e. PROCAMPO), mostly households in the Mid-scale type (Fig. 6). This proportion, however, was reduced to 22% in 2008–2017, with a larger share of households receiving PROCAMPO coming from the Large scale and Labor migrant types.

Family allowances through PROGRESA-PROSPERA were not commonly found among households in 1988–1997 (Fig. 6), whereas in 1998–2007 34% of the households received family allowances, mainly in the Land tenant type. By 2008–2017, around 40% of the households were receiving family allowances. The Mid-scale type had an increasing share of households receiving family allowances over the decades. This increased share was because households that moved from the Land tenant to the Mid-scale type between 1998–2007 and 2008–2017 were already receiving family allowances. When combining the households that either received agriculture subsidies or family allowances, government support rose from 35 to 65% between the first and last decade, showing a clear increase in financial support in rural areas.

A significant association between government support and off-farm

income was found ($p = 0.029$, Cochran-Mantel-Haenszel test). The proportion of households receiving the subsidy PROCAMPO decreased over time, while the ones receiving family allowance increased (Fig. 7). Furthermore, the proportion of households without any type of government support decreased in the last 30 years. In the 1988–1997 period, 17% of the households engaged in off-farm activities. This proportion increased to 50% by 2017. From 1998 onwards, off-farm income was more predominant for households with no government support. No significant effect of government support on crop diversity was observed.

In 2017, 7% of the household income came from crop production, 20% from animal production, 39% from local off-farm income, 25% from governmental support, and 9% from remittances. Maize production was primarily destined for household consumption (human consumption first, animal consumption second), rather than for selling. The high diversification of income we found is reflected by the population censuses, which shows that 75% of the economically active population of SCT worked in the agricultural sector in 1990, while by 2010 the proportion was 45% (INEGI 2010a, 1990).

4. Discussion

Mexico houses a large variety of socio-ecological contexts and a political scenario that has been shaping rural households. Yet, studies usually do not focus on assessing how individual trajectories are affected by drivers of change. Through a longitudinal analysis of the last 30 years, this study revealed that drivers of change do not have the same impact across every household. Furthermore, new household types emerged as a consequence of migration and changes in land tenure policies. As migration rose in the area and shifts in land tenure policy affected land market dynamics, two household types emerged. The household trajectory patterns point to a rising disinterest in agriculture, which is expressed by an increase in out-migration process and participation in off-farm activities.

Migration and changes in land tenure policies influenced the household trajectory and household typology in this study. Major land

tenure shifts were implemented through the PROCEDE program. PROCEDE was expected to guarantee property rights to land users, giving them more flexibility to rent, sell, and buy land (Ita, 2006). Before PROCEDE, land could only be inherited by the first-born child and could not be divided and distributed to other children. PROCEDE allowed farmers to register ownership at the plot level. During this process, many farmers decided to pass their land on to their children, thus leading to a boost in land inheritance. During the second decade (1998–2007) and coinciding with the period that PROCEDE was implemented in the region, the number of households inheriting land in SCT increased. This was associated with Land tenant households moving to the Mid-scale type and in the emergence of the Large scale household type (Fig. 3). One of the concerns caused by the implementation of PROCEDE was that the program would facilitate the accumulation of land by a few land-owners. Literature reports contrasting results. Rodríguez-Gutiérrez (1998) argued that the agrarian law does not allow PROCEDE to trigger this process. On the contrary, Echanove (2016) reported that a community in Campeche state had two-thirds of the land was in the hands of outsiders after the implementation of PROCEDE. This caused a shift in cropping systems in the area, favoring more profitable species such as soybean. In a community in Zacatecas state, Hernández-Santos (2006) Found neither land ownership nor cropping systems changed markedly after PROCEDE. Torres-Mazuera (2015) described how migration increased after PROCEDE in Yucatán state, as farmers started selling their land to explore other economic activities. In our study, migration increased before PROCEDE. According to Osorio (1999), the PROCEDE had a slow progress when registering land ownership in Oaxaca. de Ita (2019) states that around 40% of the land in Oaxaca has not been registered by PROCEDE due to rejection by the communities, as they perceive they would lose land governance. While this study revealed several households acquiring more land, it was not observed that outsiders started buying land in Santa Catarina Tayata. These contrasting results highlight how a policy can lead to a diversity of outcomes, reinforcing the need to understand the diversity in household types and their trajectories.

In our case study, migration increased following the implementation of the NAFTA, as a consequence of reduced rural employment (Taylor et al., 1999). People migrated either within Mexico or to the USA, as also found by Sadoulet et al. (2001). The increase in migration in SCT coincided with the Labor migrant type, marked by households that were “dropping out” of agriculture. Although a number of people migrated permanently, some returned; 20 out of the 44 interviewed households had started their agricultural activities after having migrated for a given time. All household members returned voluntarily because of family-related reasons, similar to the results found by Mestries (2013) for the state of Veracruz. He also found other reasons for returning, such as fear of deportation from the USA and opportunities to invest in agricultural systems. While his study focused on migrants returning from the USA, in our study all returnees had previously migrated within Mexico. Although the present study could not track down households that abandoned completely their agricultural activity, a different study performed in Santa Catarina Tayata showed a forest expansion pattern driven by land abandonment (Novotny et al., 2021).

According to Eakin et al. (2014), Mexican policies presented a dichotomy in their approach to agriculture. On the one hand, programs focused on benefiting mid to large-scale farmers by strengthening the agribusiness supply chain, modernizing production, and providing income support to farmers who would engage in market activities (e.g. PROCAMPO). On the other hand, small-holder farmers were targeted by social assistance programs (e.g. PROSPERA), which aimed at either steering farmers towards non-agricultural activities or at stimulating the production of profitable crops. Results from this study showed that recent drivers did not contribute to the abandonment maize production in favor of other crops. Furthermore, results showed that the proportion of PROCAMPO beneficiaries decreased over time, similar to reports by López et al. (2019) for the Chiapas state. Other studies also reported on

the persistence of maize production in different states in Mexico (Avalos and Graillet, 2013; Eakin et al., 2014). Although there was no decrease in the number of cultivated crops in the case study, farmers stated they decreased the area under intercropping to favor monocropping systems of maize and beans. They attributed the decrease in intercropping systems to the lack of available labor, similar to what was found in other studies (Gutiérrez Carbajal and Magaña Magaña, 2017; Otero Prevost et al., 2018; Kontoleon et al., 2009).

The lack of available labor in Santa Catarina Tayata mainly stemmed from an increasing participation in off-farm activities. Off-farm activity, in turn, was correlated with social assistance programs (e.g. PROSPERA) or the absence of government support, which drove farmers to diversify their income. A study using the Rural Household National Survey showed that around 80% of households diversified their income for survival reasons, while only 20% diversified for accumulating assets (Mora Rivera and Cerón Monroy, 2015). Contrastingly, households receiving agricultural subsidies through PROCAMPO did not engage in off-farm activities. This can be explained by the rules associated with each government support. PROCAMPO obliges recipients to grow crops, which reduces the time available to engage in off-farm activities. Thus, this type of coupled payment may encourage households to keep farming activities. Carrera-Chávez and Carrillo-Carrera (2016) found that households in a community in Chihuahua state relying on agricultural production for subsistence engaged more in off-farm activities, while others receiving more payments from PROCAMPO tended to focus solely on agriculture. In a study in Campeche, households with little income from PROCAMPO and crop production were also the ones that engaged more in off-farm activities. These results contrast with the findings of Ahearn et al. (2006) for the USA who concluded that the type of government support, either coupled or not to certain rules, had no effect on on-farm labor. In their study they described off-farm income as an ongoing trend, and that government support was not enough to revert this. Unlike PROCAMPO, PROSPERA is a type of direct payment that is not coupled to agricultural production. The decoupled payments may have stimulated households to work off-farm as was shown for Ireland by Hennessy and Rehman (2008).

The proportion of households receiving PROCAMPO was the largest during the first decade. Over time, PROSPERA became the most common type of government support, while the proportion of households with no subsidy decreased. López et al. (2019) also reported that fewer households were receiving PROCAMPO in the state of Chiapas. In addition to the decrease in relative beneficiaries of PROCAMPO, Ortiz-Pech (2019) demonstrated that PROSPERA contributed to eliminating 25% of the extreme poverty in Yucatán, while PROCAMPO only contributed to eliminating 4%. We observed the Large scale and Labor migrant types were the groups that most commonly received PROCAMPO, while the other groups benefitted more from PROSPERA. Similarly, Carrera-Chávez and Carrillo-Carrera (2016) found PROCAMPO's relevance to be different between household type, favoring less those households geared towards subsistence and more those who commercialized their production. The contribution of government support varies greatly in Mexico, with reports showing contributions of 7, 15, and 40% to households' total income (Grajeda-Estrada and Francisco-Cruz, 2016; Mora Rivera and Cerón Monroy, 2015; Ortiz-Pech et al., 2019).

The strategies adopted by households of this study were connected to drivers of change. In defining the “stepping up” strategy Dorward (2009) considered that, to step up, a household would have to invest and expand their current activities to improve their livelihood (e.g. expand land to increase crop production, or increase animal production). In our case study, asset accumulation mostly resulted from changes in ownership rights facilitated by PROCEDE, rather than investments or changes in activities. For instance, households from the land tenant “stepped up” to mid-scale type because land rights were bestowed to them by their parents. While agriculture-related policies are common in Mexico and other Latin American countries like Haiti, Nicaragua, Brazil, Uruguay,

and Peru (Egas and De Salvo, 2018), this is not the case in most countries in Africa, where the strategy concepts were coined (Scoones et al., 2005). Thus, stepping up needs to be interpreted within the context with more influence from the government. Therefore, we propose the usage of “step up” when households invest in assets with the aim of increasing their production.

Mushongah (2009) says “dropping out” strategy is marked by households in the process of migrating away. However, households from the Labor migrant continued farming activities even after family members migrated, suggesting that they are not really “dropping out”. Furthermore, some of them even had the opportunity to “step up” as a consequence of remittances sent by the household members who migrated. In their case migration leveraged the “step up” process. The notion of “dropping out” should probably be readjusted to fit these situations where migration is used to invest in agriculture. The effect of accumulating resources by off-farm activity to invest on-farm is also discussed by Pfeiffer et al. (2009).

This household trajectory analysis and the contribution of agriculture to the households’ income indicated that government plans to modernize and commoditize agriculture through PROCAMPO were not successful SCT. The decrease in the proportion of PROCAMPO beneficiaries and the increase in PROSPERA beneficiaries highlights the disinterest in agricultural activities. The increasing share of off-farm income among households receiving PROSPERA shows that the program partially reached its goal of stimulating income diversification through non-related agricultural activities. Nevertheless, 40% of the households are still not receiving any type of government support, and half of these households engaged in off-farm activity. These findings and the literature suggests that, first, small-holder farming is not the target group of Mexican policies and, second, rural households still maintain their farming activities in spite of also participating in off-farm activities. Isakson (2009) describes the importance of agriculture going beyond economic gains, underlining factors like food security, culture, and life style as reasons for why households keep farming activities. The lack of economic gains from agricultural activities and increasing income diversification in Mexico is a phenomenon of the past decades largely described in the literature (Appendini et al., 2008; Delgado Campos, 1999; López Moreno, 2017). The consequences of the last century’s policy to the national rural panorama are reflected in how Mexico shifted from food exporter to food importer (Eakin, 2006). From a food production perspective, the reduced interest in farming activities might seem grim for Mexico. However, a study by Lerner et al. (2013) showed cases of a strong bond between rural and urban areas in a metropolitan area of Toluca. They described how agriculture acts as a cushion for the unstable job market. Meanwhile, the urban population benefited from high-quality and locally produced goods. Unfortunately, this was not the case for marginalized areas of Oaxaca and similar states like Chiapas and Guerrero. Comparing the results from this study with others from the literature (Echanove Huacuja, 2016; Hernández-Santos et al., 2006; Rodríguez-Gutiérrez, 1998; Torres-Mazuera, 2015) show that political drivers not only have different impacts depending on the region but also within a single municipality. Such finding demonstrates the importance of taking diversity into account when defining programs. The lack of consideration of diversity and trajectories might lead to ineffective policies, or worse, to transformations that deepen chronic problems (Shackleton et al., 2019).

The methodology used for this study had some limitations. We used recall based on interviews and other techniques to improve accuracy. The interviewees usually consulted other household members when they could not provide an answer. We always repeated answers to confirm whether the data was captured correctly or not. We crossed the information provided with local authorities and NGO members to corroborate our findings. Quantitative information provided during the interviews on the size of the owned land is likely to be accurate as households drew on official ownership papers that farmers could check for the exact plot size. Information on the migration of household

members was likely also accurate. Information on rented/borrowed areas, numbers of animals, and numbers of cultivated crops is expected to be less accurate. Albeit the limitations of this methodology, this type of study allows a historical reconstruction for places with little to no prior available data, such as the case with many places in Latin America, Africa, and Asia.

5. Conclusions

Household type diversity was shown to evolve over time as affected by drivers of change. Half of the rural households in our study adjusted to policy-based and socio-economic drivers, including changes in land tenure laws and regulations, public financial support, migration opportunities, income diversification, and changed their livelihood strategy as a result. Over the last 30 years, this led to 1) 20% of the households increasing the area they owned and resulted in the Large scale group, 2) the proportion of households receiving government support to increase from 35 to 65%, 3) a proportion of household heads engaged in off-farm activities increased from 15 to 40% and 4) the emergence of the Labor migrant type to reflect an increasing number of household members migrating.

Changes in land tenure policies did not negatively impact households in Santa Catarina Tayata, as was found elsewhere in Mexico. The PROCEDE program enabled several households to become less dependent on borrowed or rented land. No indication was found that changes in land tenure and government support stimulated the commoditization of agriculture in the region. The impact of drivers of change over the last 30 years led to an increase in subsidy beneficiaries, especially from PROSPERA, and an increase in households engaging in off-farm activities. The presence of off-farm activities coincided with those households that did not receive any type of government support. This scenario shows an increasing reduction in agriculture as the main activity. Despite this unfavorable scenario, households continue to farm, even when agricultural activities consisted of around 25% of the current total income, on average. These results show the persistence of farming activities, opening a window of opportunity to stimulate agricultural production instead of insisting on political agendas that only stimulate the abandonment of agricultural activities and stimulate migration processes.

This type of study shows how drivers of change have different impacts depending on the household type. To understand the impact of government programs and assess their efficacy, this diversity in potential beneficiaries needs to be taken into account. The decrease in PROCAMPO beneficiaries shows how this program does not offer a compelling reason to households to accept all the rules demanded by the program. As such, the program could be reviewed to first make acceptance more readily and second give freedom to farmers to decide whether to invest in production for subsistence or economic gain.

CRedit authorship contribution statement

Ivan P. Novotny: Conceptualization, Methodology, Software, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing. **Mariela H. Fuentes-Ponce:** Conceptualization, Writing - review & editing, Project administration. **Santiago Lopez-Ridaura:** Writing - review & editing. **Pablo Tittonell:** Writing - review & editing, Funding acquisition. **Walter A.H. Rossing:** Conceptualization, Writing - review & editing, Project administration.

Declaration of competing interest

None.

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Appendix A. Supplementary data

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References

- Ahearn, M.C., El-Osta, H., Dewbre, J., 2006. The impact of coupled and decoupled government subsidies on off-farm labor participation of U.S. Farm operators. *Am. J. Agric. Econ.* 88, 393–408. <https://doi.org/10.1111/j.1467-8276.2006.00866.x>.
- Alvarez, S., Paas, W., Descheemaeker, K., Titttonell, P., 2014. Constructing typologies, a way to deal with farm diversity: general guidelines for the Humidtropics. Report for the CGIAR Research Program on Integrated Systems for the Humid Tropics. Plant Sciences Group, Wageningen University, the Netherlands.
- Appendini, K.A., Torres-Mazuera, de, Colegio de México, G., 2008. ¿Ruralidad sin agricultura?. In: *perspectivas multidisciplinares de una realidad fragmentada*, 1a ed. ed. Colegio de México, México, D.F.
- Assennato, B., León, P., 2007. La democracia interna en el ejido. *Procuraduría Agraria* 16.
- Avalos, A., Graillet, E., 2013. Corn and Mexican agriculture: what went wrong? *Am. J. Econ. Sociol.* 72, 145–178. <https://doi.org/10.1111/j.1536-7150.2012.00873.x>.
- Bagchi, D.K., Blaikie, P., Cameron, J., Chattopadhyay, M., Gyawali, N., Seddon, D., 1998. Conceptual and methodological challenges in the study of livelihood trajectories: case-studies in Eastern India and Western Nepal. *J. Int. Dev.* 10, 453–468. [https://doi.org/10.1002/\(SICI\)1099-1328\(199806\)10:4<453::AID-JID538>3.0.CO;2-Q](https://doi.org/10.1002/(SICI)1099-1328(199806)10:4<453::AID-JID538>3.0.CO;2-Q).
- Barnes, G., 2009. The evolution and resilience of community-based land tenure in rural Mexico. *Land Use Pol.* 26, 393–400. <https://doi.org/10.1016/j.landusepol.2008.05.007>.
- Camfield, L., Roelen, K., 2013. Household trajectories in rural Ethiopia: what can a mixed method approach tell us about the impact of poverty on children? *Soc. Indic. Res.* 113, 729–749. <https://doi.org/10.1007/s11205-013-0298-7>.
- Carney, D. (Ed.), 1998. *Sustainable Rural Livelihoods: what Contribution Can We Make?* Dept. for International Development, London.
- Carrera-Chávez, B., Carrillo-Carrera, J., 2016. Pobreza rural y PROCAMPO: un análisis comparativo de dos municipios de Chihuahua. *Cienc. Ergo Sum.: revista científica multidisciplinaria de la Universidad Autónoma del Estado de México* 23, 134–144.
- Chopin, P., Blazy, J.M., Doré, T., 2015. A new method to assess farming system evolution at the landscape scale. *Agron. Sustain. Dev.* 35, 325–337. <https://doi.org/10.1007/s13593-014-0250-5>.
- Consejo Nacional de Población, 2016. *Dinámica demográfica 1990-2010 y proyecciones de población 2010-2030*. Consejo Nacional de Población, Mexico.
- Creswell, J.W., Poth, C.N., 2018. *Qualitative inquiry & research design: choosing among five approaches*. In: SAGE (Ed.), fourth ed. (Los Angeles).
- de Ita, A., 2019. Las reformas agrarias neoliberales en México. In: *en: Revista El Cotidiano*, No. 214, México, UAM Azcapotzalco, marzo-abril 2019, vol. 214, pp. 95–108, 95–108.
- Delgado Campos, J., 1999. La nueva ruralidad en México. *Investigaciones geográficas* 82–93.
- Dorward, A., 2009. Integrating contested aspirations, processes and policy: development as hanging in, stepping up and stepping out. *Dev. Pol. Rev.* 27, 131–146. <https://doi.org/10.1111/j.1467-7679.2009.00439.x>.
- Eakin, H., Perales, H., Appendini, K., Sweeney, S., 2014. Selling maize in Mexico: the persistence of peasant farming in an era of global markets: selling maize in Mexico. *Dev. Change* 45, 133–155. <https://doi.org/10.1111/dech.12074>.
- Eakin, H.C., 2006. *Weathering Risk in Rural Mexico: Climatic, Institutional, and Economic Change*. University of Arizona Press, Tucson.
- Ebel, R., Pozas, J.G.C., Soria, F.M., Cruz, J.G., 2017. Manejo orgánico de la milpa: rendimiento de maíz, frijol y calabaza en monocultivo y policultivo. *Terra Latinoamericana* 35, 149–160.
- Echanove Huacuja, F., 2016. La expansión del cultivo de la soja en Campeche, México: Problemática y perspectivas. *An. Geogr.* vol. 36. Univ. Complut, pp. 49–69. https://doi.org/10.5209/rev_AGUC.2016.v36.n1.52713.
- Egas, J.J., De Salvo, C.P., 2018. Agricultural support policies in Latin America and the Caribbean: 2018 review. *Inter-American development bank*. <https://doi.org/10.18235/0001191>.
- Fabricius, C., Folke, C., Cundill, G., Schultz, L., 2007. Powerless spectators, coping actors, and adaptive co-managers: a synthesis of the role of communities in ecosystem management. *Ecology and Society* 12.
- Falconnier, G.N., Descheemaeker, K., Mourik, T.A.V., Sanogo, O.M., Giller, K.E., 2015. Understanding farm trajectories and development pathways: two decades of change in southern Mali. *Agric. Syst.* 139, 210–222. <https://doi.org/10.1016/j.agsy.2015.07.005>.
- Foley, M.W., 1995. Privatizing the countryside: the Mexican peasant movement and neoliberal reform. *Lat. Am. Perspect.* 22, 59–76. <https://doi.org/10.1177/0094582x9502200105>.
- Food and Agriculture Organization, 2003. *La pobreza rural en América Latina: lecciones para una reorientación de las políticas*. In: CEPAL (Ed.), Presented at the Encuentro de altos directivos sobre la mitigación de la pobreza rural, FAO, p. 248.
- González, A.E., Alferes, M.V., 2010. Competitividad y ventajas comparativas de la producción de maíz en México. *Revista mexicana de ciencias agrícolas* 1, 381–396.
- Grajeda-Estrada, J.S., Francisco-Cruz, C.A., 2016. Desigualdad y fuentes de ingresos de los hogares rurales de México Período de 1992 a 2014 (MSc thesis). FLACSO México, Mexico.
- Gutierrez Carbajal, M.G., Magaña Magaña, M.A., 2017. Migration and urban influence in food consumption in two Mayan communities of Yucatan. *Estud. Soc.* 27 (50) <https://doi.org/10.24836/es.v27i50.429>.
- Hennessy, T.C., Rehman, T., 2008. Assessing the impact of the 'decoupling' reform of the common agricultural policy on Irish farmers' off-farm labour participation decisions. *J. Agric. Econ.* 59, 41–56. <https://doi.org/10.1111/j.1477-9552.2007.00140.x>.
- Hernández, E.X., Bello, E.B., 1995. La milpa en Yucatán: un sistema de producción agrícola tradicional.
- Hernández-Santos, M.I., Mora-Flores, J.S., Martínez-Saldaña, T., Vaquera-Huerta, H., Cruz-León, A., García-Salazar, J.A., 2006. El Programa de Certificación de Derechos Ejidales y Titulación de Solares Urbanos (PROCEDE): su impacto en Fresnillo, Zacatecas, México. *Agrociencia* 40, 249–256.
- Inegi, 2010a. *Censo de Población y Vivienda 2010 (Census)*. Instituto Nacional de Estadística y Geografía, Mexico.
- Inegi, 2010b. *Censos y Conteos de Población y Vivienda (Mexico)*.
- Inegi, 1990. *Censo de Población y Vivienda 1990 (Census)*. Instituto Nacional de Estadística y Geografía, Mexico.
- Iraizoz, B., Gorton, M., Davidova, S., 2007. Segmenting farms for analysing agricultural trajectories: a case study of the Navarra region in Spain. *Agric. Syst.* 93, 143–169. <https://doi.org/10.1016/j.agsy.2006.05.002>.
- Isakson, S.R., 2009. No hay ganancia en la milpa: the agrarian question, food sovereignty, and the on-farm conservation of agrobiodiversity in the Guatemalan highlands. *J. Peasant Stud.* 36, 725–759. <https://doi.org/10.1080/03066150903353876>.
- Ita, A. de, 2006. Land concentration in Mexico after PROCEDE. In: *Promised Land: Competing Visions of Agrarian Reform*. Food First Books; Distributed by CDS, Oakland, California.
- Jahnke, H.E., 1982. *Livestock Production Systems and Livestock Development in Tropical Africa*. Wiss. Verl. Vauk, Kiel.
- Juárez, A., Margarita, A., 2008. *Migración y pobreza en Oaxaca. El cotidiano* 23.
- Juárez, L., Pfitze, T., 2015. The effects of a noncontributory pension program on labor force participation: the case of 70 y más in Mexico. *Econ. Dev. Cult. Change* 63, 685–713. <https://doi.org/10.1086/681668>.
- Klepeis, P., Vance, C., 2003. Neoliberal policy and deforestation in southeastern Mexico: an assessment of the PROCAMPO program. *Econ. Geogr.* 79, 221–240. <https://doi.org/10.1111/j.1944-8287.2003.tb00210.x>.
- Kontoleon, A., 2009. *Agrobiodiversity Conservation and Economic Development*, London. Routledge, New York.
- Lerner, A.M., Eakin, H., Sweeney, S., 2013. Understanding peri-urban maize production through an examination of household livelihoods in the Toluca Metropolitan Area, Mexico. *J. Rural Stud.* 30, 52–63. <https://doi.org/10.1016/j.jrurstud.2012.11.001>.
- López, M.C.M., Gordillo, G., del, C.A., Gálvez, M., del, C.A., García, A.A.E., 2019. Percepciones sobre las transformaciones alimentarias y su relación con los programas Procampo y Prospera en dos localidades rurales de Chiapas, in: *estudios rurales en México*. CLACSO 270–294.
- López Moreno, I., 2017. La nueva ruralidad y la nueva gobernanza en México: una propuesta de categorización territorial operativa para los nuevos territorios rurales. *Sociológico*. Mexico 32, 217–239.
- Mapedza, E., Wright, J., Fawcett, R., 2003. An investigation of land cover change in Mafungautsi Forest, Zimbabwe, using [GIS] and participatory mapping. *Appl. Geogr.* 23, 1–21. [https://doi.org/10.1016/S0143-6228\(02\)00070-X](https://doi.org/10.1016/S0143-6228(02)00070-X).
- Mestries, F., 2013. Los migrantes de retorno ante un futuro incierto. *Sociológica*. Mexico 28, 171–212.
- Mora Rivera, J.J., Cerón Monroy, H., 2015. Diversificación de ingresos en el sector rural y su impacto en la eficiencia: evidencia para México. *Cuad. Desarro. Rural* 12 (57). <https://doi.org/10.11114/Javeriana.cdr12-76.disr>.
- Mushongah, J., 2009. *Rethinking Vulnerability: Livelihood Change in Southern Zimbabwe, 1986-2006 (PhD dissertation)*. University of Sussex.
- Mushongah, J., Scoones, I., 2012. Livelihood change in rural Zimbabwe over 20 years. *J. Dev. Stud.* 48, 1241–1257. <https://doi.org/10.1080/00220388.2012.671474>.
- Naude, A.Y., Leal, G.D., Ramírez, F.R., Arana, O.S., 2015. Evaluación del impacto conjunto de programas de transferencia condicionadas y de apoyo a la producción agrícola sobre la pobreza y la producción de alimentos: el caso de PROSPERA y PROCAMPO en México. *Sobre México. Rev. Econ.* 3, 14–33.
- Nicita, A., 2004. Who Benefited from Trade Liberalization in Mexico? Measuring the Effects on Household Welfare. Policy Research Working Papers. The World Bank. <https://doi.org/10.1596/1813-9450-3265>.
- Novotny, I.P., Fuentes-Ponce, M.H., Titttonell, P., Lopez-Ridaura, S., Rossing, W.A.H., 2021. Back to the people: the role of community-based responses in shaping landscape trajectories in Oaxaca, Mexico. *Land Use Pol.* 100 (104912) <https://doi.org/10.1016/j.landusepol.2020.104912>.
- Núñez, M.C.M., 2000. *Estudios Agrarios*, Revista de la Procuraduría Agraria, Estudios Agrarios. Procuraduría Agraria, Mexico City, Mexico.

- Ortiz-Pech, R., Álvarez-Marchan, G.P., Albornoz-Mendoza, L., 2019. Pobreza objetiva y subjetiva de los hogares en Timul, Yucatán y su dependencia a programas sociales. *Estudios Sociales* 29. <https://doi.org/10.24836/es.v29i54.817>.
- Otero Prevost, D.E., Delfin Gurri, F., Guizar Vazquez, F., 2017. The inclusion and increase of the industrialized foods supply in the diets of households and their relationship with the abandonment of the self-subsistence system in the rural mayan communities of Yucatan, Mexico. *Cuad. Desarro. Rural*. 14 (80), 1–16. <https://doi.org/10.11144/javeriana.cdr14-80.iaoa>.
- Osorio, Ó.F., 1999. El conflicto agrario en Oaxaca. *Estudios Agrarios* 5.
- Patel, R., Henriques, G., 2003. Agricultural Trade Liberalization and Mexico. *Food First Policy Brief*.
- Pérez-Soto, F., Figueroa-Hernández, E., Godínez-Montoya, L., 2016. Efectos de PROCAMPO en la producción e importación de maíz y sorgo en México (1990-2015). *Desarro. Econ.* 3, 1–14.
- Pfeiffer, L., López-Feldman, A., Taylor, E.J., 2009. Is off-farm income reforming the farm? Evidence from Mexico. *Agric. Econ.* 40, 125–138. <https://doi.org/10.1111/j.1574-0862.2009.00365.x>.
- Ran, 2019. Zonas de tierras parceladas. *Registro Agrario Nacional, Mexico*.
- Reidsma, P., Ewert, F., Lansink, A.O., Leemans, R., 2010. Adaptation to climate change and climate variability in European agriculture: the importance of farm level responses. *Eur. J. Agron.* 32, 91–102. <https://doi.org/10.1016/j.eja.2009.06.003>.
- Rodríguez-Gutiérrez, 1998. *Procede: conceptos básicos y un perfil sobre sus avances. Estudios Agrarios* 9–37.
- Sadoulet, E., de Janvry, A., Davis, B., 2001. Cash transfer programs with income multipliers: PROCAMPO in Mexico. *World Dev.* 29, 1043–1056. [https://doi.org/10.1016/S0305-750X\(01\)00018-3](https://doi.org/10.1016/S0305-750X(01)00018-3).
- Sallu, S.M., Twyman, C., Stringer, L.C., 2010. Resilient or vulnerable livelihoods? Assessing livelihood dynamics and trajectories in rural Botswana. *Ecology and Society* 15.
- Scoones, I., 2009. Livelihoods perspectives and rural development. *J. Peasant Stud.* 36, 171–196. <https://doi.org/10.1080/03066150902820503>.
- Scoones, I., Devereux, S., Haddad, L., 2005. Introduction: new directions for african agriculture. *IDS Bull.* 36, 1–12. <https://doi.org/10.1111/j.1759-5436.2005.tb00188.x>.
- Secretaría de Agricultura, 2016. Ganadería desarrollo rural, pesca y alimentación. In: Programa de Fomento a la Agricultura Componente PROAGRO Productivo (No. 1st), Informe Trimestral de Resultados. SAGARPA, Mexico.
- Shackleton, S., Masterson, V., Hebinck, P., Speranza, C.I., Spear, D., Tengö, M., 2019. Editorial for special issue: “livelihood and landscape change in Africa: future trajectories for improved well-being under a changing climate. *Land* 8 (114). <https://doi.org/10.3390/land8080114>.
- Shwedel, S.K., 1994. The future of agro-subsidies. *Bus. Mex.* 4, 16–18.
- Speelman, E.N., Groot, J.C.J., García-Barrios, L.E., Kok, K., van Keulen, H., Tittonell, P., 2014. From coping to adaptation to economic and institutional change—trajectories of change in land-use management and social organization in a Biosphere Reserve community, Mexico. *Land Use Pol.* 41, 31–44.
- Sweeney, S., Steigerwald, D.G., Davenport, F., Eakin, H., 2013. Mexican maize production: evolving organizational and spatial structures since 1980. *Appl. Geogr.* 39, 78–92. <https://doi.org/10.1016/j.apgeog.2012.12.005>.
- Taylor, J.E., Yunez-Naude, A., Dyer, G., 1999. Agricultural price policy, employment, and migration in a diversified rural economy: a village-town CGE analysis from Mexico. *Am. J. Agric. Econ.* 81, 653–662. <https://doi.org/10.2307/1244030>.
- Tittonell, P., 2014. Livelihood strategies, resilience and transformability in African agroecosystems. *Agric. Syst.* 126, 3–14. <https://doi.org/10.1016/j.agsy.2013.10.010>.
- Tittonell, P., Muriuki, A., Shepherd, K.D., Mugendi, D., Kaizzi, K.C., Okeyo, J., Verchot, L., Coe, R., Vanlauwe, B., 2010. The diversity of rural livelihoods and their influence on soil fertility in agricultural systems of East Africa. A typology of smallholder farms. *Agric. Syst.* 103 (2), 83–97. <https://doi.org/10.1016/j.agsy.2009.10.001>.
- Tittonell, P., Bruzzone, O., Solano-Hernández, A., López-Ridaura, S., Easdale, M.H., 2020. Functional farm household typologies through archetypal responses to disturbances. *Agric. Syst.* 178 (102714) <https://doi.org/10.1016/j.agsy.2019.102714>.
- Torres-Mazuera, G., 2015. Las consecuencias ocultas de la enajenación de tierras ejidales: proliferación de disonancias normativas. *Desacatos* 150–167.
- United Nations, 2014. Mexico’s Agricultural Development: Perspectives and Outlook (Conference). United Nations, Switzerland.
- Winters, P., Davis, B., 2009. Designing a programme to support smallholder agriculture in Mexico: lessons from PROCAMPO and oportunidades. *Dev. Pol. Rev.* 27, 617–642. <https://doi.org/10.1111/j.1467-7679.2009.00462.x>.
- Wittes, J., Wallenstein, S., 1987. The power of the mantel—haenszel test. *J. Am. Stat. Assoc.* 82, 1104–1109. <https://doi.org/10.1080/01621459.1987.10478546>.
- World Bank, 2005. *generacion de ingresos y proteccion social para los pobres (Executive report No. 36853)*. World Bank, Mexico.
- Yin, R.K., 2018. *Case Study Research and Applications: Design and Methods*, sixth ed. SAGE, Los Angeles.
- Yúnez, A.N., Barceinas, F., 2000. Efectos de la desaparición de la Conasupo en el comercio y en los precios de los cultivos básicos. *Estud. Económicos* 15, 189–227.
- Zarazúa-Escobar, J.A., Almaguer-Vargas, G., Ocampo-Ledesma, J.G., 2011. El programa de apoyos directos al campo (PROCAMPO) y su impacto sobre la gestión del conocimiento productivo y comercial de la agricultura del Estado de México. *Agricultura, sociedad y desarrollo* 8, 89–105.
- Zimmerer, K., 2007. Agriculture, livelihoods, and globalization: the analysis of new trajectories (and avoidance of just-so stories) of human-environment change and conservation. *Agric. Hum. Val.* 24, 9–16. <https://doi.org/10.1007/s10460-006-9028-y>.