Agricultura, Sociedad y Desarrollo

PROPOSED TYPOLOGY FOR CITRUS FARMING SOCIOECONOMIC UNITS IN GUTIÉRREZ ZAMORA, VERACRUZ, MEXICO

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Citation: Pérez-López O, Nava-Tablada ME, Graillet-Juárez EM. 2025. Proposed typology for citrus farming socioeconomic units in Gutiérrez Zamora, Veracruz, Mexico.
Agricultura, Sociedad y Desarrollo
https://doi.org/10.22231/asyd.v22i3.1705

ASyD(22): 376-396

Editor in Chief:
Dr. Benito Ramírez Valverde

Received: June 20, 2024.
Approved: November 13, 2024.

Estimated publication date:
June 18, 2025.

ABSTRACT

Citrus farming is a productive activity of economic and social importance in Mexico, sustained mainly by small-scale peasant socioeconomic units (PSUs). Therefore, it is necessary to understand the way these units function, in order to propose improvement methods in this sector. In this context, the objective was to analyze the internal and external conditions of citrus PSUs in Gutiérrez Zamora, Veracruz, to provide information that would contribute to understanding the current operation of PSUs in the Mexican citrus sector. The variables considered to characterize them and create a typology were demographic, socioeconomic, and productive. Statistical tests such as Student's t test, Mann-Whitney test, one-way ANOVA, Kruskal-Wallis test, and Multiple Correspondence Analysis (MCA) were used to identify differences between groups. Results show a greater number of men as landowners and PSU owners. Orange is the main citrus fruit in 90.7% of the units, followed by grapefruit (9.3%); 81.4% only have one type of citrus, 14% have two and 4.7% have three. The variables referring to type of tenure, production system, main occupation, hiring of day laborers and education explain PSU operation and allow these to be characterized into five types: agrarian ejido, specialized ejido, pluriactive ejido, pluriactive private and non-peasant private. We conclude that PSU operation is influenced by the demographic, socioeconomic and productive profile of the citrus growers, as well as the sociostructural transformations in these areas that define the possibility of employment outside agriculture.

Key words: citrus fruits, land tenure, pluriactivity, production system, smallholder agriculture.

INTRODUCTION

Citrus farming in Mexico is specialized and geographically concentrated in terms of the types of citrus produced; the most important nationally are limes and oranges (SIAP, 2024b). This concentration results in strong seasonality in production (Vargas-Canales *et al*., 2022).

Although seasonality contributes to low prices, these are primarily affected by excessive intermediation (Martínez-Jiménez and García-Salazar, 2020). Under these conditions, citrus growers are not the main beneficiaries of their

activity and only receive approximately a quarter of the final value of limes and oranges (Arias and Suarez, 2016; Rivera-López *et al*., 2020).

Mexican citrus farming is sustained by small and medium-sized producers. Of the 75,435 citrus growers reported in Mexico, 93.9% own an average area of less than 5.5 hectares (Lara and Cervantes, 2014). Together, these producers position Mexico among the five countries with the greatest citrus production worldwide (FAO, 2024).

Given the economic and social importance of citrus farming, it is necessary to design strategies that contribute to fortify this. To this end, the design of typologies is an important tool, as they serve two complementary purposes: understanding agricultural systems through their heterogeneity, and designing and implementing public policies for agriculture (Huber *et al*., 2024).

The design of typologies related to agricultural or peasant producers has been developed from different theoretical approaches and purposes (FAO and IDB, 2007; Mançano, 2014). For example, the Family Farming typology exists to promote competitiveness, market integration, and technological innovation through public policies, divided into three categories: subsistence, transition, and consolidation (SAGARPA and FAO, 2012b, 2012a). For the same purpose, others include levels of innovation, productivity, and economic investment (Cadena *et al*., 2016; Miranda-Salas *et al*., 2019). Meanwhile, typologies that prioritize analytical purposes, such as that of Schneider and Escher (2014), recognize four types of agriculture: peasant (divided into peasant, commercial and entrepreneurial) and entrepreneurial (capitalist) agriculture.

Family labor is an important variable in family and peasant agriculture. However, in most typologies, the demographic aspect of the domestic development cycle is excluded from the analysis, although this category allows us to understand family growth over time, as well as consumption needs and labor availability (Chayanov, 1974).

The domestic development cycle has been addressed by Solís *et al*. (2022), Hernández Flores (2021), and Arias (2013, 2020). These contributions are local in character, and take a qualitative approach, with a sociodemographic and anthropological focus. Implicitly or explicitly, these works take rural transformations from the new rurality approach as a reference. Our discussion focuses on the survival and social reproduction strategies of peasants.

Based on the above, this paper includes the variable of the domestic development cycle in its analysis of peasant agriculture. It also offers a cross-sectional quantitative analysis. To address the methodological and empirical gap, we discuss the case of the municipality of Gutiérrez Zamora, Veracruz, where, as at the national level, smallholder citrus production units predominate (Pérez-López and Nava-Tablada, 2021).

We aimed to analyze the internal and external conditions of the citrus PSUs in Gutiérrez Zamora, Veracruz, Mexico, in order to identify factors that contribute to the understanding of the current operation of PSUs in the Mexican citrus sector. However, our hypothesis suggests that to understand the current situation of the citrus PSUs, it is necessary to identify the internal and external variables, so they can be characterized and categorized in their context.

THEORETICAL FRAMEWORK

Environmental and economic factors define the conditions of peasant production; however, it is the family that controls its capacity for work and internal organization (Chayanov, 1974). For this reason, Bartra (2020) recognizes the need to analyze the rationality of the peasant economy in relation to its external context.

A peasant economy refers to the set of production units related to agricultural activities, where the family is involved in production tasks and whose purpose is to achieve the reproduction of their living and working conditions (González-Santos, 2015). This does not limit the exploitation of the possibilities of accumulation and protection of family assets (Van der Ploeg, 2021).

Bartra (2006) opines that the peasant economy does not constitute a mode of production distinct from the capitalist one; its specificity lies in its rationality or internal logic; in this sense, subjective evaluations, self-exploitation and the work-consumption balance are only coherent at the level of the basic cell that constitutes the PSU; that is, at the microeconomic level.

Key elements comprising the logic of the peasant economy include: "size of farm, type of crops, family size and composition by sex and age, consumption patterns, handicraft production, (…) number of consumers and workers, etc" (Chayanov, 1974, pp. 8-9). Of these, family size and how this varies over time stand out. Changes in size, accompany the variations in the following contexts: consumption needs, number of workers, level of self-exploitation at work, the size of the production unit, and level of economic activity (Rincón, 2018).

Family size is derived from the family's biological development or domestic development cycle (Hocsman, 2014). The cycle consists of three phases. It begins with the "expansion" phase with the founding of the household, and ends with the birth of the last descendant. This continues with the "dispersal" phase when children cease to depend economically on their parents and ends when the last descendant founds their own household. Finally, there is the "replacement" phase, where one of the descendants remains or returns to the household to care for their parents until their death and to inherit the land (Cuellar and Sánchez, 2017).

A household may consist of numerous individuals for three reasons: one, because it is in a stage of expansion. Two, because parents share the home

with a descendant, who has formed a new family (Arias, 2013; López and Rojas, 2017). Three, the home is shared with other people, who may or may not be related (INEGI, 2020b). According to Robichaux (2007), these residential patterns are summarized in the form of nuclear and extended households, where the nuclear household may be in either the expansion or dispersal phase and likewise, the extended household may be in the dispersal or replacement phase.

Chayanov's theory of peasant economics only analyzes the internal organization of the production unit. Consequently, it does not address the factors that determine the labor productivity of the PSU. These factors are: "Soil fertility, an advantageous location of the farm relative to the market, the market situation, local social relations of production, organizational forms of the local market, and the type of penetration of commercial and financial capitalism" (Chayanov, 1974, 73).

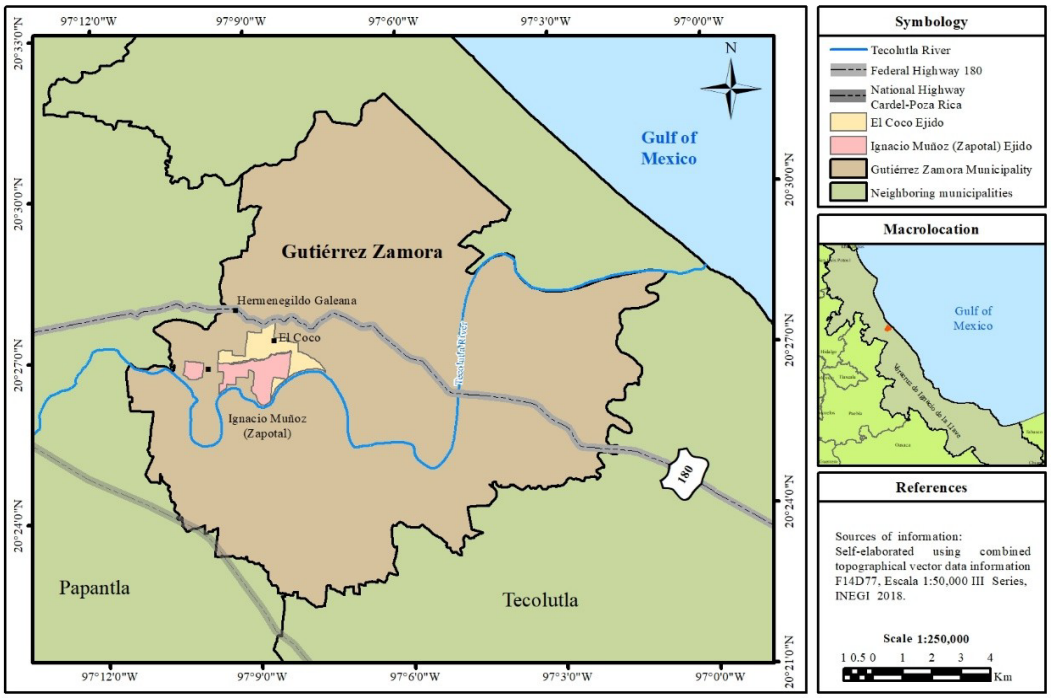
A complementary way of approaching labor productivity is implicit in the volume of economic activity at the PSU, which consists of all the economic activities carried out within it to satisfy consumption needs (Arias, 2020). From the perspective of historical materialism, these activities reflect the proletarianization of the peasantry (Bernstein, 2020). However, these concepts do not explain the dynamics of work outside the PSU as the result of transformations in rural societies (Morette, 2015).

We propose constructing categories of pluriactivity and deagrarianization to expand the explanatory capacity of the volume of economic activity and proletarianization; these are included in the new rurality approach that generally indicates that a clear boundary between rural and urban contexts no longer exists (Sánchez, 2016). This approach is justified for two reasons. Firstly, in a methodological sense, it recognizes the relationship between pluriactivity and deagrarianization, with the external factors that influence labor productivity at the PSU. Pluriactivity is understood as the set of productive activities outside the PSU, and deagrarianization as the decline in agricultural activity, as well as any related income (Van Den Bosch, 2020).

Secondly, this new rurality includes a spatial approach, which is why it offers an opportunity to characterize the transformations of the immediate environment of the PSU and not only its internal functioning, disconnected from the external context (Gaudin, 2019; Vargas-Espíndola *et al*., 2020).

METHODOLOGY

The research took a quantitative, cross-sectional approach, with a descriptive and correlational outlook. The study area was the municipality of Gutiérrez Zamora, located in the north of the State of Veracruz (Figure 1); at an altitude range between 10 and 200 meters above sea level, with 76.2% of its surface



Source: self-elaborated based on INEGI (2015) and RAN (2023).
Figure1. Geographical location of the municipality of Gutiérrez Zamora, Veracruz Mexico.

area consisting of hilly plains and the remainder consisting of coastal plains. Temperature and precipitation range from 24 to 26°C and 1,400 to 1,600 mm, respectively (INEGI, 2009).

In 2020, the municipal population was 24,085 inhabitants, of which 42% were located in rural communities with fewer than 2,500 inhabitants (INEGI, 2020a); this rural population decreased by 28.1% compared to the 1990 census (INEGI, 1990). During the same period (2010-2020), the percentage of the population employed in the tertiary sector grew (52.2 to 59%), whereas in the secondary and primary sectors it decreased (13.4 to 10.9% and 32.8 to 29.2%, respectively) (CEIEG, 2022; SEFIPLAN, 2015).

In 2022, of the 11.5 thousand hectares of harvested agricultural land, 78% corresponded to citrus fruits, with oranges being the most important fruit, accounting for 70.6% of this area (SIAP, 2024a).

Sampling and data collection were carried out in three locations: Hermenegildo Galeana, El Coco, and Ignacio Muñoz (Figure 1); the latter two belong to ejidos (communal land). The selection was based on the proximity and identification of three citrus production systems, defined by the topographic characteristics of the soil, which, in turn determine its fertility and productive yield (Table 1). The CONCITEVER citrus grower register (2005) did not provide an adequate

Table 1. Characteristics of orange production systems, according to study locations.

Production System	Soil type	Yield t ha^{-1}	Location
Hillside	Regosol, Phaeozem	3- 8	HG, CC
Clay plain (gently sloping)	Phaeozem, Vertisol	8- 25	HG, CC
Sandy plain (river valley)	Cambisol	10- 20	CC, IM

HG: Hermenegildo Galeana; CC: El Coco; IM: Ignacio Muñoz.
Source: self-elaborated based on INEGI (2024) and Gómez and Schwentesius (1997).

sampling framework, as it is outdated and only shows names by locality. Because of this, the non-probabilistic snowball sampling technique was used. Furthermore, the sample sought to include PSUs from all three types of production systems, following the logic of a maximum variation sample (Hernández-Sampieri *et al*., 2014).

Data collection took place from December 2019 to February 2020. A total of 43 questionnaires were applied. This survey addressed demographic, socioeconomic, and productive aspects through 16 quantitative and 11 qualitative variables. To deepen understanding of the data, five complementary open-ended questions were included. These were only included in the PSU sample with a surface area of up to 15 ha, which is under the reference limit of family farming (SAGARPA and FAO, 2012b).

Data were analyzed using SPPS-26 software. Firstly, descriptive statistics were provided; then, means were compared according to land tenure type and production system. Means were only compared for PSUs with orange orchards. For this purpose, both parametric and nonparametric statistical techniques were applied: student's t test and one-way ANOVA (parametric), as well as Mann-Whitney and Kruskal-Wallis (nonparametric). These tests were selected based on their compliance with normality, which was verified by applying the Shapiro-Wilk test. If data complied with this assumption, parametric tests were applied; otherwise, nonparametric tests were used (Mayorga *et al*., 2022).

Finally, the multivariate Multiple Correspondence Analysis (MCA) technique was used, enabling recognition of associations between the levels of categorical variables (Kamalja and Khangar, 2017). Notably, the Principal Component Analysis (PCA) technique was tested initially; however, variables did not manifest clear linear relationships. Therefore, the quantitative variables were categorized. MCA thus made it possible to recognize relationships between the variables used. To define the typology of PSUs, using MCA, a model with the highest proportion of variance explained in two dimensions was chosen (Table 2).

Table 2. Variables used in multiple correspondence analysis.

Variable	Levels
3. Education	No education; Primary; Secondary; High school; Professional
4. Main occupation	Agriculture; Agriculture and daily workers; Agriculture and business; Services; Other
5. Number of people in the homestead	1-2; 3-4; 5-6; 7-8; 9-Mayor
6. Number of people who contribute income	One; two; three
7. Number of financial dependents	None; one; two; three; four; five
8. Domestic development cycle	Expansion; Dispersal; Replacement
9. Number of people with access to health services	None; 1-2; 3-4; 5-6; 7-more
10. Proportion of income spent on food purchases	31-40; 41-50; 51-60; 61-70; 71-80; 81-90; 91-100
11. Type of land tenure	Private; Ejido
13. Planted area (ha)	0.2-1.9; 2-3.7; 3.8-5.5; 5.6-7.3; 7.4-9.1; 9.2-10.9; 11-12.7
14. Area used (14=[(13/12, Available area)*100])	30-39; 40-49; 50-59; 60-69; 70-79; 80-89; 90-100
15. Total production t	0-17.9; 18-35.9; 36-53.9; 54-71.9; 72-89.9; 90-107.9; 108-125.9
16. Yield t ha^{-1} (16=15/13)	0-4; 4.1-8.1; 8.2-12.2; 12.3-16.3; 16.4-20.4; 20.5-24.5; 24.6-.6
19. Usual harvest month	Aug.; Sep.; Oct.; Nov.; Dec.; Jan.; Feb.; Mar.; Apr.
20. Years as a citrus grower	1-11; 12-22; 23-33; 34-44; 45-55; 56-66; 67-77
21. Number of workers in the plantation	Zero; one; two; three; four; five; six
22. Hiring of daily workers	Family labor; hires out some work; hires out all work
23. Type of work carried out during the year	Two; three; four; five; six
24. Production system	Sandy plane

Source: self-elaborated.

RESULTS

Demographic, socioeconomic and productive aspects

In relative terms, the sample recorded a greater participation of men as landowners and holders of land rights. In ejido land tenure, the proportion of women owners is lower than that of men. This proportion is the lowest, when compared to private land tenure and the sample as a whole. Most PSUs are in the replacement phase. Expansion and dispersal phases are similar. In ejido land tenure, the proportion of PSUs in the replacement phase is higher than the sample, as well as higher than that recorded for private land tenure (Table 3).

Depending on the type of ownership (private or communal), the variables of age (2), available surface (12) or property size, planted surface (13) and yield (t ha^{-1}) (16) were statistically different (Table 4).

The statistical differences mentioned above indicate better economic results in ejido citrus farming, so greater socioeconomic and productive differentiation would be expected between private and ejido PSUs. However, they did not

Table 3. Percentage distribution of the sample: type of tenure versus variables of owner gender and domestic development cycle**.**

Variable	Type of Ownership		Sample
	Private	Ejido	
Number	25	18	43
Percentage:	58.1	41.9	100
1. Gender of owner	100	100	100
Woman	52	27.8	41.9
Man	48	72.2	58.1
8. Domestic development cycle	100	100	100
Expansion	32	5.6	20.9
Dispersal	28	16.7	23.3
Replacement	40	77.8	55.8

Source: self-elaborated by the authors based on survey data, 2019-2020.

reveal statistical differences in terms of the following variables: number of people in housing (5); number of people providing income (6); number of dependents (7); proportion of income spent on food (10); surface area used (14); number of orchard workers (21); and age of trees (27) (Table 4).

The values in Table 3 do not disaggregate information by type of citrus fruit and production system. At the sample level, orange is the primary citrus fruit for 90.7% of PSUs, followed by grapefruit (9.3%). However, 81.4% of PSUs only have one type of citrus fruit, 14% have two, and 4.7% have three.

In the comparison of means by production system, only the yield variable showed a significant difference. The contrast lies between the sandy plain system and the hillside and clay plain system. Between the latter two, no differences were observed for any of the variables analyzed (Table 4).

Depending on the production system, production volume is not a key variable for two reasons. Firstly, production is a result of planted area and yield. Secondly, there is no statistically significant difference in available or planted area between production systems. Under these conditions, the level of income from citrus sales is also not a relevant variable for demonstrating differences between PSUs. The price per ton did not reveal any statistically significant differences (Table 4).

Yield, for its part, is an external factor related to soil fertility and the production system. This is significant considering that only 27% of citrus growers surveyed practice foliar or soil fertilization. Additionally, the most common cultivation tasks are manual weed control (100%), herbicide control (53.5%), and pruning (95.3%). Although 86.4% observe pests and diseases, only 46.5% undertake prevention, management or control measures.

Table 4. Statistical comparison of socioeconomic and productive aspects.

Statistical	Variables analyzed by type of tenure											
	2	5	6	7	10	12	13	14	16	17	21	27
Average												
Private, n=25	58.1	3.9	1.3	2.2	68.6	2.8	2.4	91.2	4.7	622.4	1.9	29.7
Ejido, n=18	65.0	4.2	1.4	2.2	69.7	5.1	4.0	86.6	12.4	905.5	1.7	33.2
Probability values: Shapiro-Wilk normality test, variables analyzed by type of tenure												
Private	0.090	0.004	0.000	0.012	0.423	0.000	0.000	0.000	0.489	0.098	0.000	0.262
Ejido	0.218	0.521	0.000	0.162	0.000	0.000	0.009	0.000	0.242	0.002	0.009	0.094
Stat test.	t	M	M	M	M	M	M	M	t	M	M	t
P value	0.046*	0.617	0.811	0.940	0.748	0.002*	0.034*	0.852	0.001*	0.106	0.775	0.560
Variables analyzed by production system (Only PSU with orange orchard)												
Average												
Hillside n=22	-	4.2	1.4	2.5	67.3	3.5	2.9	88.1	4.0	694.5	2.0	32.8
Flat Clay n=4	-	3.2	1.0	2.0	75.0	2.3	2.3	100.0	4.4	600.0	1.2	31.5
Flat Sandy n=13	-	4.0	1.4	1.9	68.4	5.2	3.8	84.6	12.9	892.3	1.9	31.3
Probability values: Shapiro-Wilk normality test, variables analyzed by production system												
Hillside	-	0.051	0.000	0.078	0.028	0.000	0.000	0.000	0.189	0.190	0.000	0.253
Flat Clay	-	0.086	-	0.577	0.001	0.220	0.220	-	0.129	0.577	0.001	0.016
Flat Sandy	-	0.345	0.000	0.332	0.000	0.000	0.006	0.000	0.736	0.091	0.121	0.151
Stat test.	-	A	K	A	K	K	K	K	A	A	K	K
P Value	-	0.586	0.334	0.452	0.597	0.142	0.242	0.435	0.013*	0.216	0.514	0.987

Statistical test: t: t-Student; M: Mann-Whitney; A: One-way ANOVA; K: Kruskal-Wallis.
*Significance value, 0.05.

Alternative typology for citrus PSU

In constructing the typology, we decided that it should include both internal and external variables. From the reduction of variables, 17 models were identified; however, in most cases, internal or external variables predominated. Notably, the domestic development cycle variable was adequate for characterizing the internal conditions of the PSUs. However, when this variable is combined with other external variables, its explanatory power is considerably reduced.

Of the 17 resulting models, the one that explained the greatest variance in two dimensions was chosen. The first dimension accounts for 57.8% of the variance, suggesting that it accounts for the most significant differences in the associations between categories. The second dimension accounts for 41.6%, capturing additional relevant patterns. Both dimensions explain 98.9% of the total variance in the data (Table 5).

The identified model is closely related to the concepts of pluriactivity and de-agriculturalization (main occupation, daily wages). External factors such as land tenure type and fertility (reflected in yields) are also included.

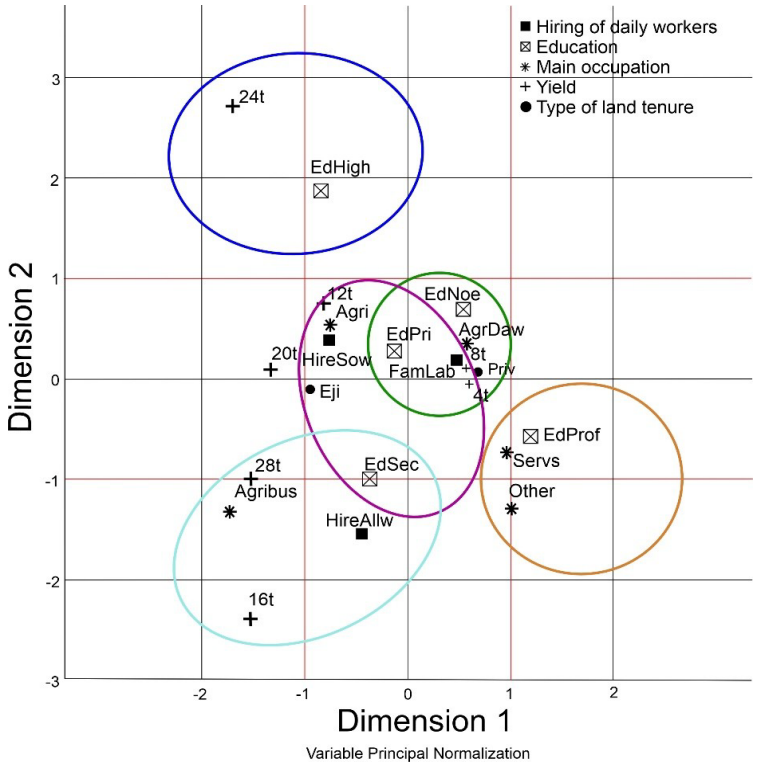
In the MCA, variables of yield, main occupation, and education show significant differences in categorizing citrus PSUs. In total, three types of citrus PSUs were identified: two communally owned and one privately owned. The former were referred to as specialized communal PSUs and pluriactive communal PSUs. The latter were referred to as non-peasant production units (PUs) (Figure 2).

According to the MCA, the sample identified PSUs that do not reflect differences between them. However, analyzing these PSUs with information from the open-ended questions made it possible to identify internal processes

Table 5. Model resulting from multiple correspondence analysis.

Concept	Value
Iteration number	36
% Variance	
Dimension 1	57.811
Dimension 2	41.104
Mean	49.458
Discriminatory measures	Mean
Main occupation	0.641
Education	0.443
Hiring of daily workers	0.388
Yield	0.662
Type of land tenure	0.338
Total assets	2.473

Source: self-elaborated using data from the survey, 2019-2020.



FamLab (Family labor); HireSow (hires out some work); HireAllw (hires out all work); EdNoe (No education); EdPri (Primary); EdSec (Secondary); EdHigh (High school); EdProf (Professional); Agri (Agriculture); AgrDaw (Agriculture and daily workers); Agribus (Agriculture and business); Servs (Services); Other (Other Occupation); t (Ton). Priv (Private); Eji (Ejido).
Source: self-elaborated using data from the survey, 2019-2020.
Figure 2. Main associations of the model.

within the PSUs that are not described by the MCA. Based on the type of landholding, the types defined as agrarian ejido PSUs and pluriactive private PSUs were combined.

Therefore, although pluriactivity is observed in the agrarian PSU ejido, the activities carried out outside the PSU are predominantly located in the primary sector or are in the process of agricultural recovery. For example, the owner is a migrant and sends money to recover or maintain the citrus industry. A family member may be taking responsibility for the PSU.

In the communal land unit (PSU) that specializes in agriculture, the owner works only on his or her plot. These units may specialize in citrus or have complementary crops such as corn (maize), beans, and pipián. Likewise, in the multi-active communal land unit (PSU), in addition to agricultural work, activities are also carried out outside the unit, whether or not they form part of

the primary sector. In other words, agriculture and other activities, primarily commerce, are complementary.

Private pluriactive PSUs are distinguished from agrarian PSU ejidos because their activities may or may not be in the primary sector. Descendants or co-residents tend to engage in activities other than agriculture. Meanwhile, in the private PU category, agriculture plays a secondary role as the primary occupation. In this type, PSUs retain descendants, even when they achieve vocational training. The results suggest that professional qualifications displace agriculture because of access to better-paid jobs. Notably, no ejido PSU holders reported having vocational education (Table 6).

To strengthen the typology, the following variables were used to characterize the PSUs: age, domestic development cycle, production system, and daily wages. These results show that the work structure within the PSU is a combination of yields per hectare, production system, and the main occupation of the PSU owner (Table 6).

DISCUSSION

In statistical terms, sample size represents a limitation to the reliability of results. However, for Huber *et al*. (2024), in the development of agricultural typologies, sensitivity to the context, as well as theoretical and conceptual support, are more important than the amount of data and the methods

Table 6. Typology and characterization of citrus PSUs.

Variable	PSU Agrarian ejido	PSU Specialized ejido	PSU Pluriactive ejido	PSU Pluriactive private	non-peasant PU
n=43	7	5	4	20	7
Age	46 - 87	53 - 87	60 - 73	39 - 87	39 - 73
Education	NE, Prim., or Sec.	Prim. or Sec.	Prim., Sec. or HIgh.	NE., Prim., Sec., or High.	Professional
Main occupation	Agriculture and day workers	Agriculture	Agriculture; Agriculture and business	Agriculture and day workers (includes various jobs)	Provision of professional services or employee
Domestic development cycle	D. 28.6% R. 71.4%	D. 20% R. 80%	E. 25% R.75%	E. 25% D. 30% R. 45%	E. 42.9% D. 14.2% R. 42.9%
Production system	PA. 71.4% L. 28.6%	PA. 100%	PA. 100%	L. 76.9% PAR. 23.1%	L. 85.7% PAR. 14.3%
Yield t ha^{-1}	8.2 - 12.2	8.2 - 24.5	12.3-28.6	0 - 8.1	0 - 8.1
Hiring of daily workers	MF. 42.9% AL. 42.9% TL. 14.2%	MF. 60% AL. 40%	MF. 50% AL. 25% TL. 25%	MF. 82.3% AL. 11.8% TL. 5.9%	MF. 57.7% AL. 28.6% TL. 14.3% (retired)

E: Expansion; D: Dispersal; R: Replacement; H: Hillside; Cl P: Clay plain; SP: Sandy plain; FL: Family labor; S Ch: Some chores; A Ch: All chores; NE: No education; Prim.: Primary; Sec.: Secondary; High: High School.
Source: self-elaborated using data from the survey, 2019-2020.

used. In these circumstances, the resulting typology is characterized as one developed from hypotheses. That is, the development of the study was guided by prior knowledge of the biophysical conditions (production systems), also the theoretical framework in terms of the socioeconomic conditions of the PSU in the new rurality (schooling and main occupation), as well as drivers of differentiation (type of tenure) (Álvarez *et al*., 2018).

Based on the above, the difference in available surface area and the proportion of female and male owners corresponds to the operating conditions of the PSU in Mexico, as the type of ownership is related to the extension of peasant farms, because from 1991 to 2007, the average size of ejido production units was reduced to a lesser extent than that of the private sector (De Ita, 2014).

In Gutiérrez Zamora, two trends are observed for the period 1991–2022: an 89.3% increase in the number of production units with private ownership, compared to 36.5% on ejido lands. There is also a reduction in the average plot size, from 21.5 to 10 ha in private ownership and from 8 to 4.1 ha in ejido ownership (INEGI, 1996, 2022a).

The above trends are influenced by legal institutions and social norms regarding land inheritance, given that in ejido land tenure, regulations restrict the sale or delivery of land in succession in a fractional manner; therefore, in the ejido inheritance scheme, succession to the eldest son (male) is common, which has fostered a mechanism of masculinization of land tenure [SCJN (Suprema Corte de Justicia de la Nación), 2010]. In private land tenure, the predominant inheritance model is known as "ranchero," where the inherited land among children is relatively similar, regardless of gender or marital status (Arias, 2012).

Combined with inheritance models are differences in the aging of PSU holders. Article 17 of the Agrarian Law empowers landowners to inherit such rights at the time of their death (Agrarian Law, 2024). In practice, heirs receive the land at middle or advanced age (Robles, 2005). For the surveyed ejido owners, the practice tends toward succession after death. The Agricultural Census tables do not make it possible to generalize this practice to all of Gutiérrez Zamora, as the data on producers' age ranges do not distinguish between types of land tenure. However, it is estimated that, of the 1,779 production units, 33% of those responsible for these units are 65 years of age or older, 47.2% are between 45 and 65 years of age, and the rest are younger (INEGI, 2022b).

Furthermore, in terms of the basic agricultural work carried out in the PSUs surveyed, the production systems largely reflect differences in soil fertility. This is a common characteristic in the citrus-producing regions of Veracruz, where productive capacity is attributed to favorable agroecological conditions (Acosta and Carmona, 2017). This circumstance is inherent to productive specialization, the comparative advantages of the territories, as well as the

agro-export orientation of the neoliberal model (Bernstein, 2012; McMichael, 2021).

In Mexico, productive specialization has been based on the favorable natural conditions of each region, demand and prices in the domestic and foreign markets, as well as technological innovations (Sánchez-Gómez, 2019; Vargas-Canales *et al*., 2022). In citrus farming, the level of investment and innovation derive from the size of the farm, as from an area of 5.2 ha, PSUs depend to a greater extent on citrus farming, which turns out to be the articulating axis of social and economic life. Consequently, citrus growers implement better cultivation practices, with productive, organizational, and commercial innovations (Lara and Cervantes, 2014).

The above explains why the development of citrus farming, like the Mexican fruit sector, is extensive. That is, the increase in production is driven by increased harvested area, rather than yields (Cruz-Delgado *et al*., 2013; Pat *et al*., 2023).

Regarding the main occupation variable, Arias (2005) recognizes that peasants have always developed diverse productive activities. The difference lies in the capacity of agriculture to structure the lives of families and local economies. Similarly, the possibility of employment outside of agriculture is mediated by the structural transformations of territories, for example, urbanization processes, the formation of industrial or agro-industrial centers, as well as the social relations involved in these processes (Rello and Saavedra, 2013).

An example of this is the municipalities of Álamo Temapache and Martínez de la Torre, which are citrus-producing regions and agro-industrial hubs (Bada *et al*., 2013, 2017; Fernández-Lambert *et al*., 2015; Hernández and Botello, 2017). The profile of Gutiérrez Zamora is different, as the citrus wholesalers concentrate production to supply the agro-industry (Bada and Rivas, 2010). They also select and wax the fruit, which is destined for the domestic market (Oble-Vergara *et al*., 2019).

In this context, educational attainment, while not a guarantee, does enable employment in higher-paying activities than agricultural ones (Kay, 2007). However, the transition to non-agricultural activities also depends on asset ownership, social networks, and locally available infrastructure (Canabal, 2020; Martínez-Domínguez *et al*., 2018).

The main occupation and the yield per hectare are linked to the internal work scheme of the PSU. However, the latter does not define the meaning and type of self-exploitation of labor, as proposed by Chayanov (1974), as currently, it is a matter of self-exploitation towards the outside (Torres, 2015). That is, the meaning of self-exploitation is not defined through agricultural work within the PSU, but rather by the addition of occupations or jobs (pluriactivity) to satisfy consumption needs.

To clarify the above, it is necessary to review Schneider's (2014) types of agricultural establishments: the rural household, whose agricultural income is zero or very low; the pluriactive household, where agricultural income is considerable, but not the main source; and the specialized household, in which agricultural income is higher than that provided by other sources. Of these, the rural household stands out for three reasons. Firstly, this type of household cannot be considered a peasant household; however, this does not prevent the owner from being pluriactive in non-agricultural occupations. Secondly, the owner of this type of household may or may not have professional qualifications. Thirdly, regardless of whether the household is a peasant household or not, it does not necessarily have to be located in a rural area (Pérez-López and Mazzotti, 2022).

As described above, among the agrarian ejido citrus PSUs and the private pluriactive PSUs, the direction of self-exploitation occurs outside the PSUs, in agricultural or other activities. In contrast, non-farming households enter, resume, or maintain agriculture as a survival strategy, regardless of whether they have a peasant background (Table 6). Although no PUs without a peasant background were identified in the sample, this is a possibility in the new phase of capitalism in agriculture (Bernstein *et al*., 2018).

Finally, the typology of citrus-growing PSUs is linked, due to its analytical nature, to the peasant agriculture segment described by Schneider and Escher (2014). However, it differs from this because it proposes studying PSUs based on the variables that define the identified types. That is, without separating PSUs from their context, while attributing less importance to the family labor employed.

According to the Agricultural Census, in production units, at the national level, in Veracruz and Gutiérrez Zamora, the hiring of labor (day wages) is present, as it is practiced in 50.1, 58.2 and 49.8%, respectively (INEGI, 2022c). This suggests that the issue is not about determining the level of labor employed as in Schneider (2014) and Yúnez *et al*. (2013), but rather about prioritizing the recognition of the predominant economic activity in the production units.

CONCLUSIONS

The typology presented presents a differentiated representation of the operating conditions of citrus-producing peasant socioeconomic units. The differences between the five categories lie in the type of land tenure, the production system, the wages paid, and the educational level of the unit owners. Together, these internal and external variables allow for an analysis of the operation of the PSUs, and therefore the proposed hypothesis is not dismissed.

The combination of internal and external variables for the analysis of peasant citrus farming in a specific context, such as that of Gutiérrez Zamora, although

they may not be generalizable to the citrus sector as a whole, helps explain how PSUs function in similar citrus environments.

At the level of the peasant socioeconomic unit, the proposed typology expands the explanatory capacity of the main occupation and the concept of self-exploited labor. The main occupation simplifies the identification of peasant and non-peasant production units. At the same time, two meanings and types of self-exploitation can be appreciated, depending on the predominant economic activity.

In general terms, primary occupation has a positive effect on family labor employment. However, the strength of this relationship is attenuated by yields per hectare. Understanding the complexity of this relationship offers valuable input for developing differentiated public policies based on the type of PSU in the citrus sector.

Further research is needed to identify the ways in which non-farming households gain access to or maintain ties with agriculture, as well as the types of social relationships that arise from differentiating variables between the various categories of peasant citrus growers.

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