Socioeconomic and environmental factors that impact vegetable production

Villegas-Cruz, Elvia[1]; León-Merino, Aurelio[1*]; Vázquez-García, Verónica[1]; Pérez Olvera, Ma. Antonia[1]; Hernández-Ordoñez, Ofelia[2]

1 Colegio de Postgraduados-Campus Montecillos, Programa de Posgrado en Estudios del Desarrollo Rural, Carretera México-Texcoco km 36.5, Montecillo, Texcoco, Estado de México, C. P. 56230.
2 Universidad Autónoma Chapingo, Departamento de Fitotecnia, Academia de Fisiología Vegetal, km 38.5 Carretera México – Texcoco, Estado de México, C. P. 56230.
* Correspondence: laurelio@colpos.mx

ABSTRACT

Objective: To analyze the factors that contribute to the reduction of vegetable production in the San Vicente Chicoloapan *ejido*.

Design/Methodology/Approach: Sixty out of a total of 150 *ejidatarios* who produced vegetables in 2022 participated in a convenience sampling. Producers who agreed to be surveyed were interviewed in their plots.

Results: The *ejidatarios* have an average of 1.47 agricultural ha (minimum: 1 ha; maximum: 5 ha), considering both irrigated and rainfed lands. The use of the sample studied was divided as follows: 43.3% of the owners sold their land to developers who built housing units and new houses; 38.3% cultivated their own land or those they rented; and 18.3% rented out their lands. The *ejidatarios* suffer from vegetable theft, particularly pumpkin (45.0%), artichoke (31.7%), onion (13.3%), chard (8.3%), and cabbage (1.7%).

Study Limitations/Implications: Designing a random sample was impossible given the lack of access to a register of *ejidatarios*. Estimating the harvested area or estimating yield based on the production volume was impossible, since producers grow several crops in their plots, besides vegetables.

Findings/Conclusions: Vegetable production in the San Vicente Chicoloapan *ejido*, State of Mexico, is at risk of disappearing, as a consequence of economic and social issues and a lack of support. The *ejidatarios* who still grow vegetables have tried to mitigate these problems; however, their future as producers is severely limited and older people have chosen to sell their land, which are used by developers to build houses.

Keywords: Vegetables, polycultures, agricultural land sale, land use change, peri-urban agriculture.

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INTRODUCTION

In 2021, the irrigated area used to grow vegetables in Mexico consisted of 492,690 ha, which represented 8.44% of national agricultural area (5,839,756 ha) and 22.25% of production value (SIAP, 2022). Given their intrinsic characteristics —such as a short shelf life (Anaya *et al.*, 2020)—, vegetables must be marketed immediately after harvest or preserved under controlled atmospheres or cold hours in an adequate infrastructure (Pinto *et al.*, 2016). Regarding marketing, vegetable prices undergo a great variation (market risk) from one day to the next (González, 2013), while small-scale producers face intermediaries, known in Mexico as coyotes (Lugo *et al.*, 2010). For these reasons, not all small producers can produce vegetables; furthermore, vegetables have a higher production cost than basic grains (Echánove and Steffen, 2006).

The San Vicente Chicoloapan *ejido* is part of the peri-urban agriculture area in the eastern Mexico City Metropolitan Area (MCMA). It covers the municipalities of Texcoco, Chimalhuacán, Chicoloapan, Nezahualcóyotl, Ixtapaluca, and La Paz. In the year 2000, the population of the six municipalities of the eastern MCMA was 2,508,689 inhabitants and it increased by 24% in 20 years, reaching 3,107,012 by the year 2020 (INEGI, 2020).

The municipality of Chicoloapan had an area of 41.03 km^2 (4,103 ha) and, in 2020, it had a population of 200,750 inhabitants, resulting in a population density of 4,892.7 inhabitants/km^2 (INEGI, 2020).

The population of the municipality of Chicoloapan has settled on irrigated agricultural lands where vegetables used to be the main production activity. This situation resulted in an annual decrease of 5.84% in the 2006-2020 period (Figure 1).

The Mexico City Metropolitan Area is the result of the fusion of two or more municipalities with more than 10 thousand inhabitants (Sánchez, 2009), exceeding the boundaries of the original municipality. In the east, the growth of the MCMA is putting strong pressure on agricultural lands. The objective of this article is to analyze the factors that contribute to the reduction of vegetable production in the San Vicente Chicoloapan *ejido*.

MATERIALS AND METHODS

The San Vicente Chicoloapan *ejido* borders to the north with the municipality of Texcoco; to the south with the municipalities of La Paz and Ixtapaluca; to the east with the municipalities of Texcoco and Ixtapaluca; and to the west with the municipalities of Chimalhuacán and La Paz (IEEM, 2015) (Figure 2). The extreme coordinates of the municipality are 19° 26' 07" and 19° 20' 54" N and 98° 56' 40" and 98° 48' 05" W (Galeote, 2018).

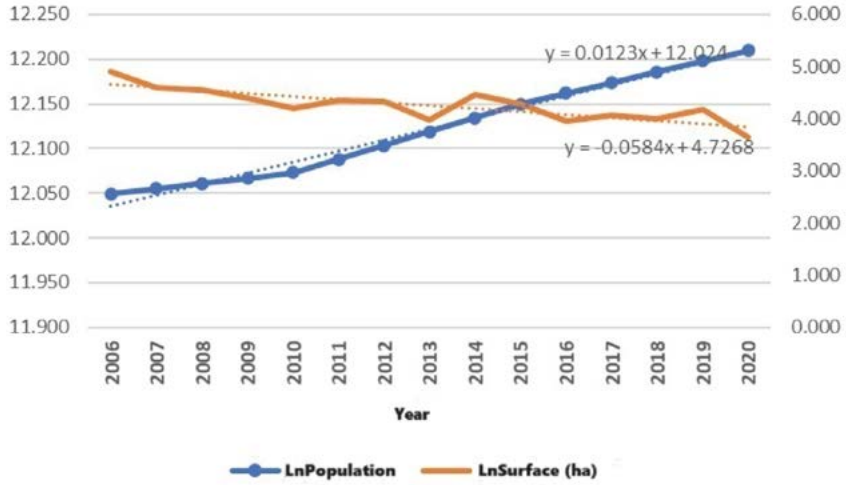

Figure 1. Population growth trends and vegetables crop area (ha) decrease trends in the municipality of Chicoloapan, State of Mexico (2006-2020).
Source: Table developed by the authors based on statistical data from the Agricultural and Fisheries Information Service (SIAP, 2022) and the National Institute of Statistics and Geography (INEGI, 2020).

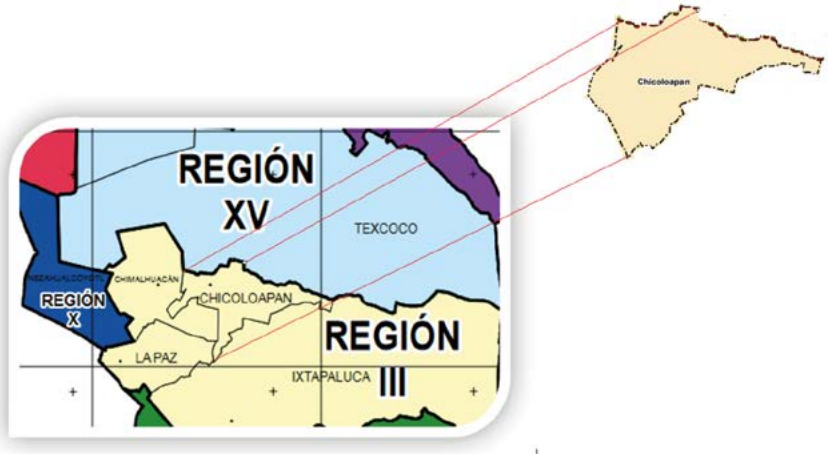

Figure 2. Study area location. Source: Regionalization 2017-2023, Comité de Planeación para el Desarrollo del Estado de México (COPLADEM) (2022).

A survey was used to obtain the data. The field work was carried out from September 12 to November 15, 2022. Sixty *ejidatarios* were surveyed out of a total of 150 producers who grew vegetables in the 2022 agricultural cycle.

The participating *ejidatarios* were working on their plots at the time of the survey and agreed to participate, resulting in a non-probabilistic convenience sampling. In order to identify the *ejidatarios* on their plots, an *ejidatario* accompanied the survey team during the entire process of collecting field information.

Excel and the Statistical Program for the Social Sciences (SPSS) were used for the statistical analysis of data obtained in the field.

RESULTS AND DISCUSSION

The San Vicente Chicoloapan *ejido* core has a register of 635 *ejidatarios* and an area of 1,865.49 hectares which, according to the Padrón e Historial de Núcleos Agrarios (PHINA, 2022), represents 45.45% of the municipal territory. The *ejido* lands are distributed as follows: 41.5% is parceled out (773.71 ha), 56.8% is common lands (1,059.72 ha), 0.7% corresponds to delimited human settlements (13.04 ha), and 1.0% features undelimited human settlements (19.02 ha).

In average, the producers were 61.98 years-old and 48.3% were 65 years or older. This percentage of older people contrasts with that of producers in the overall State of Mexico, where 30.9% were 65 years or older, according to the 2022 Agricultural Census (INEGI, 2022). The average age of the *ejidatarios* of San Vicente Chicoloapan was 61.98 years, with a minimum of 32 and a maximum of 90 years (standard deviation: 13.709). Based on the average age of the producers and the human life cycle, they belong to the elderly population.

Regarding their education level, 25% of the producers did not have the opportunity to attend school. However, all respondents pointed out that "they learned to read and write out of necessity, to take care of their interests as *ejidatarios* and [to prevent] others from taking advantage of their ignorance." Of those who attended school, 91.1% studied

until high school and 8.9% studied a bachelor's degree. Regarding marital status, 43% was married and 57% lived alone —either because they were divorced, widowers or widows or because they had never married.

More than three quarters (78.3%) of *ejidatarios* do not have the support of their children for agricultural activities and only a fifth (21.7%) have such support (average: 1.77 children).

Production unit size

Regarding the distribution of agricultural land, the initial *ejido* allocated consisted of one hectare per *ejidatario*; however, as time went by, through the purchase and sale of land, some producers were able to increase their production units. Of the total number of respondents, only 23 (38.3%) *ejidatarios* used their agricultural lands; in average, they cultivated 1.47 ha (minimum: 1 ha; maximum: 5 ha), considering both irrigation and rainfed systems. In the case of irrigated lands, the average was 1.09 ha (minimum: 1 ha; maximum: 2 ha), while rainfed plots recorded in average 1.67 ha (minimum: 1 ha; maximum: 3 ha).

Vegetable production system

The *ejidatarios* use the multiple crop system or polyculture to produce vegetables, combining different crops (Koohafkan and Altieri, 2011). In the same plot, the *ejidatarios* grow rows of vegetables and, at the same time, introduce other crops such as corn (*Zea mays*), oats (*Avena sativa*), beans (*Phaseolus vulgaris*), wheat (*Triticum sativum*), marigold flower (*Tagetes erecta*), and barley (*Hordeum vulgare*), as a strategy to reduce vegetable theft.

The main vegetables produced in the ejido are chard (*Beta vulgaris* var. *cicla*), artichoke (*Cynara scolymus*), pumpkin (*Cucurbita pepo*), onion (*Allium cepa*), cabbage (*Brassica oleracea* var. *capitata*), lettuce (*Lactuca sativa*), radish (*Raphanus sativus*), red tomato (*Solanum lycopersicum*), green tomato (*Physalis philadelphica*), carrot (*Daucus carota*), and cilantro (*Coriandrum sativum*). The most stolen vegetables are pumpkin (45%), artichoke (31.7%), onion (13.3%), chard (8.3%), and cabbage (1.7%).

All the vegetable producers stated that they suffered vegetable theft. Therefore, they do not plant a complete hectare, since it would easily attract the attention of neighbors, increasing the thefts. In an interview, an *ejidatario* mentioned that:

> "…not long ago, a whole family who live near my plot used to steal my vegetable crops. Even small children participated in this theft, taking advantage of the fact that I was away carrying out other activities. I immediately approached them and told them that I was going to report them if they did not return what they had stolen. At that time, the women told me that they would accuse me of assault if I did not let them go with the harvest. Since I was alone and they were three women, I had no witness and they took the vegetables. This family has already been caught on other occasions stealing vegetables with other companions and it is well known that this family sells vegetables, mainly on the roads near the *ejido*."

Regarding this issue, Espinoza (2020) states that some families make a living by entering plots and orchards to steal significant quantities of products which they later sell. This is

one reason why *ejidatarios* do not find it easy to plant entire hectares of vegetables, since they do not recover the investment and their loses are greater than their profits. In addition to the theft of crops, they also suffer the theft of water intended for agricultural irrigation by people who build residential houses for domestic use. Likewise, the plots are impacted by garbage pollution from those houses. The *ejidatarios* have implemented some strategies to reduce the abovementioned problems (Table 1). Some strategies are implemented adequately, but others cause long-term harm to the *ejidatarios*.

Vegetable sale points

The ejidatarios sell their products at different points. Most of them (69.6%) sell at the Central de Abastos of Iztapalapa, México City's supply center. Others (21.7%) sell at their plot and a few also do it directly to the consumer (4.3%) or to intermediaries (4.3%).

The *ejidatarios* who sell their vegetables at the Central de Abastos pointed out that having direct contact with buyers provides them the advantage of having a guaranteed sale for several years. And their disadvantage is the transportation or freight costs (12.5%), in addition to the price haggling with buyers (87.5%).

Ejidatarios who sell at their plot do not incur in transportation costs, but they do not always sell their entire harvest (40%) and they also must participate in price haggling (60%). Finally, those who sell directly to the consumer sell little and every client haggles over the price. The intermediaries also haggle over the price and the *ejidatarios* have no other choice but to lower the price to avoid keeping the harvest. Consequently, many *ejidatarios* have decided to sell their agricultural lands.

Land sale

From 1998 to 2008, urban growth in the municipality of Chicoloapan caused a change in land use and agricultural areas started to be taken over by housing constructions (Sánchez and Ontiveros, 2011). In 2003, the vegetable agricultural area was 164 ha, but it had decreased to 38.41 ha by 2020 (SIAP, 2022). The population of the municipality increased from 124,228 inhabitants (2003) to 200,750 inhabitants (2020). In other words, the population grew at an annual rate of 2.68%. At this growth rate, the population will reach 248,456 by 2027 —double the population that the area had in 2003.

Table 1. Main problems found in agricultural plots and the strategies implemented by ejidatarios.

Problem	Causes	Solution strategy
Vegetable Theft	- Creation of new housing areas (98.3%) - Presence of new colonies (98.3%) - Presence of people from outside the ejido (6.7%)	1.- Planting vegetables with basic grains. 2.- Substitution of vegetables for staple crops such as: oats (31.6%), corn (26.3%), wheat (15.8%), marigold flower (15.8%), beans (5.3%) and barley (5.3%).
Theft of water for irrigation of vegetables	Homes that do not have potable water are supplied by irrigation water, which increases irrigation hours and costs.	Decrease in irrigation hours for the plots, which in some cases is not enough for the crop, which means that the harvest has not a good quality.
Garbage contamination of vegetable plots.	The creation of housing complexes and new housing constructions are the cause for garbage contamination in the plots (98.3%).	The ejidatarios collect garbage near located and on their plots.

Source: Table developed by the authors based on data from field work (2022).

Urbanization —clearly seen in the building of houses— is taking over agricultural lands, consequently decreasing the area used to grow vegetables. Of the total respondents, 43.3% sold agricultural land that is currently occupied by residential houses; these sales occurred mainly in 2020.

Ejidatarios who sold agricultural land gave multiple reasons, mainly of a social nature, followed by economic reasons and, finally, political and market reasons (Figure 3).

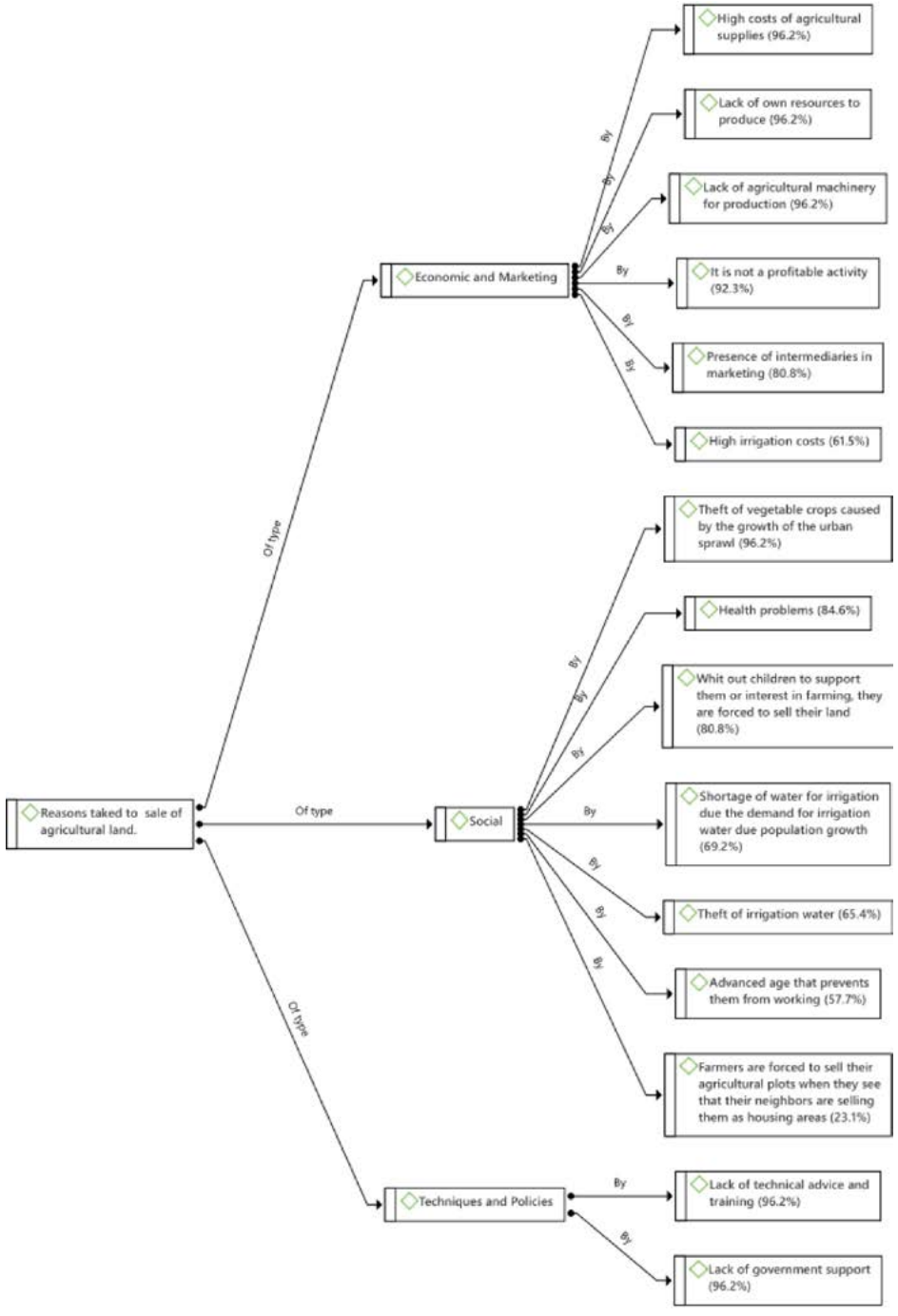

Figure 1. Reasons given by ejitadarios for selling agricultural land.
Source: Table developed by the authors based on data from field work (2022).

CONCLUSIONS

Vegetable production in the San Vicente Chicoloapan *ejido* is at risk of disappearing for multifactorial reasons (economic, social, and technical) and lack of support. The *ejidatarios* who still grow vegetables have tried to mitigate these problems; however, they do not believe that there is much future in the production of vegetables and the elderly have chosen to sell their lands, which are now used to build houses.

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