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Socio-agronomic characterization of agricultural farmers that survive in the community of San Diego, Texcoco

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ABSTRACT

Objective: to characterize farmers who still grow food in the San Diego community through knowledge of their agricultural production systems.

Design/Methodology/Approach: field visits and tours were carried out to the farmers' plots to obtain information that would allow the design of a questionnaire for the agronomic and social classification of farmers in San Diego. The questionnaire was applied to 26 of them; who narrated some historical facts about their survival in food production.

Results: most of the farmers interviewed are on average 55 years old, have a level of education equal to or higher than middle school, have three economic dependents, use the yoke for tilling their soils and hybrid seed. Likewise, they apply organic fertilizers and chemical fertilizers to their plots for the growth of crops, for the control of pests and diseases they use agrochemicals; and the control of weeds is done manually, supplying water for the crops through gravity irrigation.

Study limitations/Implications: this research was conducted during the CovID-19 pandemic. For this reason, only 26 farmers could be located. Most of them were at home.

Findings/Conclusions: in the community of San Diego, two types of farmers can be identified, those who carry out practices related to conventional agriculture, and others who maintain traditional practices, but combine them with conventional agriculture.

Keywords: urban agriculture, socio-agronomic characterization, land use change, agricultural survival.

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INTRODUCTION

The expansion of agricultural production systems based on the establishment of monoculture and the application of agrochemicals has generated a socio-environmental crisis worldwide, making it necessary to revalue rural production systems in a social and scientific way. Because those production systems are conditioned by the principles proposed by the Food and Agriculture Organization to achieve sustainable food and agriculture in the world (FAO, 2018). Such agricultural production systems provide elements for resilience to the environmental, health and food crises that affect us today. In addition, considering the conservation of natural resources such as soil and water during agricultural production and access to food for the population (Cuadras-Berrelleza *et al.*, 2021).

In Mexico, rural areas developed by traditional methods of self-sufficiency, as well as by modern agricultural methods, are affected by processes of deforestation, land use change, agricultural modernization and rural urbanization associated with industrialization; which in turn, devaluate and alter their environmental, sociocultural and economic environments (López-Valentín *et al.*, 2020). Land use change is the impact suffered by natural landscapes through changes in ecosystems, which has manifested itself in recent decades in the reduction of agricultural area to increase the spaces for the construction of urban infrastructures. This, in turn, generates various effects that are usually permanent such as the loss of biodiversity, climate variation, or degradation of natural resources (Amorim-Homem *et al.*, 2023).

In the municipality of Texcoco de Mora, the effects of the intensification of land use change and growth of the urban sprawl are manifested, such as accelerated population growth, overexploitation of natural resources. For example, it is highlighted that since 2020, only 1.89% of the total population carries out agricultural activities (Data Mexico, 2023). According to Tejeda-Sartorius *et al.* (2015) the community of San Diego is a particular area of Texcoco, because it has good quality irrigation water from wells.

In recent years, the abandonment of the Mexican rural areas has intensified in rural farming communities, due to the migration of their inhabitants to urban areas, seeking to improve their economic conditions (Sandoval-Genovez *et al.*, 2022). In communities like San Diego (Texcoco, State of Mexico) these environmental, cultural and socioeconomic processes affect the rural population, which has survived since past decades following the arrival of the green revolution, finding a way to continue producing food (Ascencio-López *et al.*, 2018).

MATERIALS AND METHODS

This study was established in the community of San Diego, located southeast of the municipality of Texcoco de Mora (State of Mexico) from February to April, 2022. The geographical coordinates are located between 19° 29' 51.04"-19° 30' 3.13" N and 98° 51' 20.04"-98° 52' 22.22" W and it has an area of approximately 1.81 km^2. The research integrated quantitative and qualitative methods. The qualitative aspect included visits and field trips in the plots of eight farmers, representatives of the community's irrigation organization. Through non-participant observation, the form of production of the main crops, historical facts, ways of thinking, main motivations and productive logic were known.

For the quantitative aspect, we worked with 26 farmers, selected through the snowball technique, to whom a questionnaire was applied as a data collection instrument. The questionnaire integrated two axes: 1) socioeconomic characteristics of the farmers and 2) management characteristics of the main crops. Based on the data of agricultural and socioeconomic variables, a hierarchical cluster analysis was carried out with the Statistical Package for the Social Sciences® (SPSS, 2020).

RESULTS AND DISCUSSION

Socioeconomic characteristics

According to the data obtained from the interviewed farmers, their average age is 55 years, with the youngest being 35 years old and the oldest being 76 years old. The younger

farmers are in the range 30 to 50 years old, representing 69.24% of the total number of farmers, while the remaining percentage correspond to older farmers in the range 50 to 80 years old. In 2020 the population over an age of 50 years was 10.29% in Texcoco de Mora, (State of Mexico, Mexico). It is worth highlighting that in 2022, 2.72% of total inhabitants in the State of Mexico worked in agricultural activities (Data Mexico, 2023).

Farmers over 50 years of age are vaults of traditional knowledge and awareness of local agroecosystems; all this knowledge was acquired in the experience of agricultural production. These farmers can provide important elements to improve food sovereignty and security at the regional scale (Pai-Natacuas *et al.*, 2022). In terms of marital status, more than half (65.38%) of farmers are married. In the aspect of education, 15.38% of farmers have elementary education, 26.92% have middle school, and 57.70% have a level of education equal to or greater than high school, coinciding with the results presented by Data Mexico (2023).

According to the farmers interviewed, complementing traditional knowledge acquired over generations with academic knowledge influences food production through traditional practices in combination with those of modern agriculture (Rodríguez-Fernández *et al.*, 2010); 70% of the farmers have three economic dependents, while 4% of farmers have six dependents. According to Alcázar-Sánchez and Gómez-Martínez (2022), in communities such as San Diego, agriculture is an activity of great economic importance for the maintenance of families, since they grow food both for small sales and self-supply.

Resources available for agricultural production

The total agricultural area of the farmers is 37.58 ha, of which 22% corresponds to greenhouses and 78% to the open field. According to the SIAP (Mexico's Agri-Food and Fisheries Information Service), during the last few years, greenhouse area has increased exponentially. So much that, in 2021 the area cultivated in open fields was less than 1% in the State of Mexico (SIAP, 2022). Montenegro-Gómez *et al.* (2022) pointed out that, in open-field production systems, soils have higher organic matter content and lower salinity, sodicity, and phytopathological disease indices.

In terms of soil tillage, 53.85% of farmers use the yoke, either totally or in combination with agricultural machinery. The use of the yoke increases both the efficiency of nutrients and water use in plants, and their retention in the soil, in addition to reducing production costs by avoiding the use of fossil fuels (Domínguez-Vento *et al.*, 2011).

Regarding the use of seeds, 73% of farmers use hybrid seed, either individually or in combination with native seed. While 46.15% of farmers plant native seed, either individually or in combination with hybrid seed. Farmers who sow native seeds commented that those are more resistant to lodging, pests, diseases and soil salinity problems compared to hybrid seeds. In addition to the fact that native seeds are more economically accessible, since farmers exchanged those seeds among themselves (Montaño *et al.*, 2021).

When it comes to crop fertilization, 84% of farmers apply inorganic and organic fertilizers to reduce production costs; to improve crop yields and the quality of their soils. The 57.69% of the farmers apply fertilizers through fertigation (46.15% in drip system and 11.54% in gravity fed irrigation); and 42.31% incorporate fertilizers directly into the soil (19.23% with

tractor and 23.08% manually). Farmers who have a drip irrigation system commented that they implemented it to save water and improve water use efficiency, compared to gravity fed irrigation. This statement agrees with the research of Montemayor-Trejo *et al.* (2012), where maize was irrigated with a drip system, thus using 75% of the volume of water used in gravity fed irrigation. In addition, crop yield was 30% higher when compared to gravity fed irrigation.

In the phytosanitary aspect, the pests that cause the most damage to crops in San Diego, are whitefly (*Bemisia tabaci*), fruitworm (*Heliothis virescens*) and green aphid (*Myzus persicae*). While the main diseases are powdery mildew (*Leveillula taurica*), late blight (*Phytophthora infestans*) and root rot (*Fusarium oxysporum*). The most used control for pests and diseases is the use of agrochemicals (76.92%), to a lesser extent is the use of biological control agents (11.53%). Also, there are some farmers who do not control, as they do not have considerable populations of insect pests or disease incidence. It should be noted that the constant applications of agrochemicals result in environmental pollution, genotoxicity, carcinogenic effects and various poisonings that cause damage to the nervous and reproductive systems in the surrounding communities where those products are applied (Rodríguez-López *et al.*, 2020; Zúñiga-Venegas *et al.*, 2022).

Regarding weed control, it is noteworthy that 73.06% of farmers use ecological techniques (42.30% manually and 30.76% carry out cultural control through plastic mulches). Farmers who opt for manual control collect wild plants for sale, mainly for their own food and medicinal use. According to González-Ortega and Fuentes-Ponce (2022), those farmers who choose alternative controls to chemical products reduce input costs and environmental impact derived from herbicides.

Water management in the community is widespread, 70.07% of the farmers indicated that they use gravity fed irrigation, while 29.93% have a drip irrigation system. It should be noted that 42.30% of the irrigation water used by farmers comes from wells, while 57.7% used water from wells and rainfall. The latter are strategies for water and food security at the local community scale (Suástegui, 2021).

Regarding the need for technical advice for crop management, about 38% of farmers are interested in being trained on organic agriculture, followed by pest and disease control (26%), and crop nutrition (11.5%). They also expressed the need to have access to government financing programs (23%). According to farmers, these issues are necessary to increase the sustainability of their agri-food systems in such a way that they are more environmentally and economically sensitive, and their operation subsidized by ecological processes of the soil (Mello-Fagundes and Pérez-Cassarino, 2020).

Production systems

Through hierarchical cluster analysis, two groups of agricultural farmers were obtained. The first group is composed of eight farmers characterized by an age range 40 to 45 years; they are married, have university studies and four economic dependents, who produce their crops mainly in greenhouses with their own machinery and hybrid seed. Also, they use inputs of chemical origin as a source of nutrition and as control agent of pests and diseases of their crops. They control wild plants through the passage of machinery, have a

drip irrigation system, and have complications in crops production due to high input prices and low harvest costs.

The second group is composed of 18 farmers described as being over 60 years of age, have middle school education, have three economic dependents. They produce their crops in open field with the help of rented machinery, use hybrid and native seeds, apply inputs of chemical and organic origin as a source of nutrition and control agent of pests and diseases of their crops. They control the weed plants in their plots manually, have a gravity fed irrigation system and have complications to produce their crops due to the damage caused by pests and diseases and the lack of knowledge regarding organic agriculture.

According to the classification of production systems established by Chávez-Caiza and Burbano-Rodríguez (2021), two production systems prevail in the community of San Diego: conventional (group 1) and semi-conventional (group 2). So, highlighting that in both systems, the type of soil tillage is with machinery, in the nutrition and control of crop pests and diseases, chemical synthesis products are used and the seeds used are hybrids. It is worth mentioning that, in the semi-conventional system, the aforementioned aspects are complemented by using organic products for the nutrition and control of pests and crop diseases.

In both systems, agroecological practices are implemented, such as the use of organic fertilizers, local seeds, living barriers, use of wild plants, manufacture of agricultural tools and implements, intercropping and crop rotation, creation of contour lines, incorporation of *Brassica* sp. remains, integration of the animal component, and the maintenance of pollinators; and conventional agriculture practices such as the use of chemical fertilizers for crop development, pest and disease control through the use of agrochemicals, soil tillage with agricultural machinery, use of hybrid seeds and monoculture.

According to the information from farmers, the two production systems are conditioned by the agricultural tradition inherited from their parents and grandparents. This is the main reason why farmers continue to work their plots despite the impact generated by the change in land use and local market conditions, where there are times when the price of their crops is too low and even the investment cost is not returned (López-Vazquez *et al.*, 2015; Ascencio-López *et al.*, 2018).

CONCLUSIONS

In the community of San Diego (State of Mexico, Mexico) there are two types of agricultural production systems. In the first one, farmers work with practices related to the conventional system; while in the second, they work jointly with the conventional and agroecological (semi-conventional) production schemes. The wholesale of crops and the combination of agroecological and conventional practices are strategies that allow these farmers to survive through their own food production within the community.

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