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Article

Functions of peasant family farming in the municipality of Calpan, Puebla

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Abstract

The concept of multifunctionality assumes that agriculture fulfills non-market functions, such as food, environmental, social, and cultural functions. It is a way to move towards a sustainable agriculture more respectful of human beings and the environment, which persists in different agricultural territories. However, it is pressured by economic activities for business purposes, which has generated its deterioration. The research objective was to identify the main functions of peasant family farming in the municipality of Calpan, Puebla. A survey was applied in 2020 with the aim of capturing information on the different social processes related to the multifunctionality of family farming. A stratified random sampling (SRS) with Neyman distribution was applied to determine the sample size, resulting in a sample of 81 producers. Among the main functions are: the sociocultural ones, 81% base their agricultural practices on the lunar phases; in the environmental ones is the conservation of agrobiodiversity; in the economic ones, agriculture is the primary source of income for 45%, generates jobs for 100% and contributes to food security in corn and beans for 53%. Finally, in the territorial ones, the intergenerational replacement stands out, 75% of young people who wish to continue participating in agricultural activities. It is concluded that peasant family farming is fundamental since it preserves social, cultural, economic, environmental, and territorial functions that benefit families, the environment, and society.

Keywords:

traditional agroecosystem, agricultural diversity, multifunctionality.

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Introduction

The concept of multifunctionality of agriculture encompasses all environmental, economic, and social functions related to agriculture. This approach is based on the notion that agricultural systems are by nature multifunctional and have always fulfilled other functions besides the main one, which is the production of food, fiber, and fuels. Multifunctional analysis helps to understand the possible relationships and commitments that make it possible to achieve sustainable agriculture and rural development (Atance-Muñiz and Tió-Saralegui, 2000).

One of the recent innovative concepts in the agricultural sector is that of 'multifunctionality', which infers the different functions that agriculture provides, which are requested by society in terms of the production of foods and raw materials with different approaches: territorial, cultural, economic, and environmental (Parra-López and Sayadi-Gmada, 2009). According to Segrelles-Serrano (2007), the concept of multifunctionality was first used at the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992.

The concern about food security, productivity, and sustainability in the future makes it substantial to study the multifunctionality of agriculture, to represent a way to analyze the activity from a more comprehensive perspective. Since it considers the totality of products, services, and externalities provided by agriculture in a given space and involves a direct or indirect impact on the economic, environmental, and social sectors (Ayala-Ortiz and García-Barrios, 2009).

Family farming has been an essential activity for man for 10 000 years because it plays a vital role in solving problems such as hunger, poverty, food security, and nutrition, improves the quality of life, promotes environmental protection, and achieves sustainable development (FAO, 2014). It is important to highlight that the year 2014 is declared the international year of family farming, and with this, the fact that industrial agriculture had a great failure in its enormous task of feeding the planet and also contributed impressively to environmental deterioration and the increase in poverty and inequality figures becomes visible (Ramírez-Miranda and de la Tejera-Hernández, 2014).

Peasant family farming continues to be preserved in many agricultural areas of Mexico; however, it is under pressure from urban growth, industrial and tourism projects, industrialized agriculture itself, climate change, and low public policy support.

Such is the case of the municipality of Calpan in the state of Puebla, Mexico; on the one hand, it presents favorable agroecological, climatological, and cultural conditions for the production of a wide variety of crops and animals in a planted area of 2 256 ha practiced by 2 488 family production units (SIAP, 2016). On the other hand, there is a change of land uses to urban, industrial, and housing (housing developments, landfill, gas pipeline, Wal-Mart) that puts at risk peasant farming, which is and has been fundamental for its various contributions, the objective was to identify the main functions performed by family farming in the municipality of Calpan, Puebla.

Materials and methods

Area of study

The study was conducted in the municipality of Calpan, Puebla (Figure 1), which is made up of four localities: San Lucas Atzala, San Mateo Ozolco, San José Pueblo Nuevo, and San Andrés Calpan (municipal seat). The municipality is located between the following geographical coordinates: 19° 06' 36" and 19° 41' 12" north latitude and 98° 23' 54" and 98° 32' 24" west longitude; its altitude varies between 2 200 and 3 200 m. Its climate is subhumid temperate with rains in summer (85.11%) and subhumid semi-cold with rains in summer (14.89%) with an annual temperature between 12 and 18 °C (INEGI, 2010).

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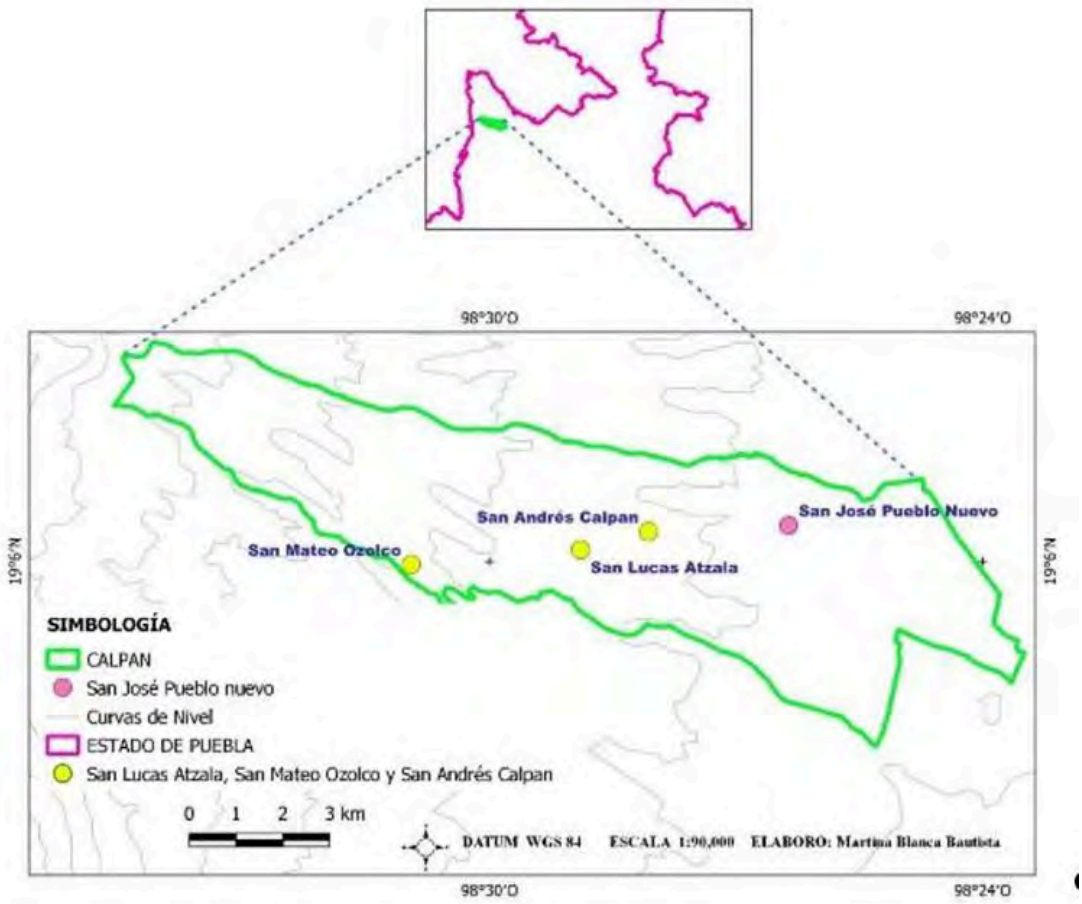
Figure 1. Geographical location of Calpan, Puebla, Mexico. Prepared with the QGIS program (Version 3.22), with data from CONABIO (2020).



It covers an area of 66.9 km^2, of these, 71% is for agricultural use with a planted area of 2 256 hectares (INEGI, 2017), 16% forest, and 13% urban (INEGI, 2010). It presents different types of soil: Arenosol 38%, Phaeozem 26%, Cambisol 8%, Andosol 8%, Luvisol 7%, and Leptosol 13%(INEGI, 2010). The population is 15 271 inhabitants (INEGI, 2020).

Techniques

It was a research with a quantitative, descriptive approach in order to search for characteristics, properties, and profiles of people, groups, and localities in order to measure information jointly or independently through concepts, variables, or defined components (Hernández-Sampieri *et al*., 2014). The data generation used the survey, and the questionnaire as an instrument, to address various topics: characteristics of producers, family data, family labor, fruit production, family livestock production, forestry production, participation of lunar phases, and sociocultural and religious practices related to family farming.

The unit of analysis was peasant families that practice family farming activities. For the determination of the sample size, a stratified random sampling (SRS) with Neyman distribution was applied, in which each community was considered as a stratum, based on the following formula:

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$$n = \frac{\left(\sum_{i=1}^{k} N_i s_i\right)^2}{N^2 V + \sum_{i=1}^{k} N_i s_i^2}$$

Where:

$$n = \frac{N_i s_i}{\sum_{i=1}^{k} N_i s_i} n$$

$$V = \frac{d^2}{Z^2_{a/2}}$$

Sample size for the strata.

Where: N= number of producers (575); S= variance (x); d= precision (0.1); Z= reliability (95%). Result: n= 81 families, San Andrés Calpan 40, Atzala 23, Ozolco 6 and Pueblo Nuevo 12. Twelve variables organized into the following four general functions were studied: environmental, economic, sociocultural, and territorial (Table 1).

Table 1. Func ons and variables of family farming.

Functions	Variables
Environmental	Fruit species
	Weed species
	Forest species
	Practices that mitigate climate change
Sociocultural	Worldview
	Seed conservation
	Culinary uses of corn according to its color
Economical	Markets
	Products consumed in the daily diet
	Cultural events
Territorial	Intergenerational replacement
	Type of property

Results and discussion

Data from the producers interviewed

Producers' ages range from 19 to 98 years, with an average of 61 years. Seventy-five percent mentioned being married, 10% single, 14% widowed, 1% in a common-law relationship. In schooling, 22% finished primary school, 26% junior high school, 17% high school, 5% bachelor's degree, 3% postgraduate degrees, and 27% have incomplete primary school.

The families of the interviewees are made up of four people on average, it is vital to highlight that 26% of the families are considered as extended families. Forty-one percent combine their agricultural activities with masonry (7%), trade (12%), or have some trade, such as a carpenter, plumber, electrician, or hunter (27%), public servant (12%), professional service provider (12%), employees in factories outside the municipality (30%). The producers have 1.7 hectares of

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agricultural area on average, 99% are rainfed, 74% are ejido lands, 85% of producers obtained them by inheritance (up to three generations), and 15% bought them.

On average, they have been engaged in agriculture for 43 years. As owners of their agricultural land, the oldest was 82 years, and the lowest was three years, with an average of 29 years. The lands have gone through three generations on average in a period of 84 years, the oldest in its land is four generations. It is essential to point out that all the interviewees are from the municipality.

Sociocultural functions

Worldview. It was found that they still relate productive activities with their ancient knowledge about the lunar phases. In agriculture, 81% of producers base their activities on the lunar phases, of this percentage, 66% used this knowledge at the time of sowing: 5% sow on a new moon, 71%on a full moon, 12% in the first quarter and 12% in the last quarter. Regarding fruit growing, 49%oriented themselves in the lunar cycle, 56% in pruning, 39% at the time of grafting, and 6% in pest control.

Seventy-two percent carried out these activities on a full moon, 11% on a new moon, 11% in the first quarter, and 6% in the last quarter. This coincides with what Pezo-Araujo (2019) pointed out, that the moon directly influences the productive activities of the agricultural, livestock, and forestry sector, based on popular beliefs and scientific research. In the same sense of lunar phases, 58% of the interviewees used this type of knowledge in livestock farming, specifically 53% to decide the best time to castrate pigs and 47% in the crossing of their animals. In these activities, 11% performed them on a new moon (tender), 79% on a full moon, and 10% in the last quarter.

This coincides with what was reported by Restrepo-Rivera (2005), who points out that the best time for castration of animals is the full moon phase because cattle suffer less, excessive and dangerous hemorrhages are avoided, in addition, the wounds have fast and better healing.

Seed conservation. Ninety-three percent of producers keep their native seeds, and 7% use commercial and native hybrid seeds. Ninety-five percent get them from the previous harvest, and 5% buy them, either native or, in some cases, hybrid.

To select the seeds to use in sowing, they choose the largest ears with more uniform rows. Forty-eight percent keep them in a cool and dry place, usually a troje (type of barn) or barn, and 20% keep them in plastic bags (bran), 12% in chiquihuites (palm leaf baskets) with the addition of an anti-weevil pill (Phostoxin), 10% keep them in the same husks (totomoxtle), 7% in cans or bottles with lids and 2% in wooden boxes. Before using the seeds in sowing, they are blessed on February 2, in the religious celebration of Candlemas Day.

This coincides with what was found by Reyes-Reyes *et al*. (2020), where families preserve native seeds, which go through an arduous selection process by family members to achieve better quality and use them in the next cycle. In the same sense, Gómez-Martínez *et al*. (2019) affirm that conserving seeds is a family strategy of food sovereignty and is even considered a basic human right since, without it, it is difficult to guarantee agriculture under family control.

In addition, in traditional agriculture, corn seed is saved for the next harvest, a tradition that stems from farmers' mistrust of commercial hybrid seed, which represents an expense when acquiring it each year. Culinary uses of corn according to its color. The use of corn will depend on its color; the white ones are used to make tortillas, tamales, tostadas, tortilla chips, and atole; the blue ones are used to prepare pinole, cookies, snacks, tostadas, tortillas, and tortilla chips.

Red corn is used to prepare tortillas, snacks, and tamales, and yellow corn is used for animal (pigs, horses, and calves) feed because they classified it as of lower quality. According to their ancestors, the most nutritious corns were dark-colored ones. According to Žilié *et al*. (2016), dark corns, such as red, purple, or blue, are used to prepare culinary specialties such as tamales, tortillas, and bread. For their part, Mayorga and Pérez (2019) point out that dark-colored corns have a higher protein and mineral content, as well as a greater antioxidant capacity.

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Environmental functions

Fruit species. In the municipality, there is a wide agrobiodiversity; it was found that 75% of producers practice fruit growing: 56% have pear, 51% Mexican hawthorn, 40% black cherry, 37% peach, 33% plum, 28% apple, 14% walnut and 9% other fruits, such as apricot, raspberry, blackberry, and grape.

This coincides with the study conducted by Mendoza-Robles and Hernández-Romero (2018), where they reported that in the area of the Sierra Nevada of Puebla, the main fruit species that are produced are: peach, apple, pear, and apricots of different varieties. Méndez *et al*. (2017) mention that, in the municipality of Calpan, prior to the conquest and the colonial period, the agricultural landscape maintained a certain homogeneity in the milpa crops (corn, beans, and squash).

Subsequently, a miscegenation arises in the territorial agricultural landscape by mixing milpa crops with fruit trees introduced by the Spanish, an arrangement that continues today. It should be noted that Calpan is known as the cradle of the common walnut because the first walnut trees were brought from Spain by the Franciscan friars and were cultivated in the garden of the former Franciscan convent located in the municipality seat of Calpan (SADER, 2020); however, it is a crop that has been given less importance in recent years (Rojano-Hernández *et al*., 2017).

Diversity of weeds. Within the family units, there is also a natural biological diversity (weeds); that is, those plants that are naturally born within the land and that have medicinal or nutritional use, such as purslane (*Portulaca oleracea* L.), present in 58% of family units, quelites (*Amaranthus hybridus* L.) found in 31%, quintoniles (*Amaranthus* spp. L.) 28%, alaches (*Anoda cristata* L. Schltdl) 11% and some other weeds (5%), mainly arnica (*Arnica montana* L.) and huehuitos (*Phaseolus vulgaris* L.).

In this regard, Blanco and Leyva (2007) explain that weeds play a valuable role such as preventing soil erosion and recycling nutrients and minerals by forming a reservoir of beneficial organisms. Some are used as medicinal plants and others for animal feed because of their contribution of crude protein and greater digestibility (Martínez-Loperana *et al*., 2011).

Forest diversity. Regarding forest species, 65% of producers have some species on their land, such as ocote (*Pinus montezumae* Lamb.) with 36%, oak (*Quercus ilex* L.) with 21%, colorines (*Erythrina coralloides* D. C.) with 6% and oyamel fir [*Abies religiosa* (Kunth) Schltdl. et. Cham.] with 2%. These are mainly used for wood and charcoal. It should be noted that they use the most mature trees for these activities.

These species generate ecosystem services within family units, such as CO_2 uptake, reduction of noise pollution, erosion control, birds nesting, creation of favorable microclimates for other species, and water and air purification. Molina *et al*. (2016) argue that the conservation of native forest species is fundamental and of utmost importance because it contributes to the conservation of native forests.

Agrobiodiversity in family units is very diverse. According to Sarandón (2009), agricultural diversity is essential to meet the basic needs for foods of the population and security of livelihoods, in which farmers are the ones who manage this agricultural biodiversity. Studies such as those by Toledo (2002) argue that Mexico is one of the most biologically, ecologically, and culturally diverse countries on the planet, ranked fifth in the world in terms of biodiversity, and much of this is found in the Mexican countryside.

Practices that mitigate climate change. Thirty-one percent of producers carry out reforestation, 15% conservation of native varieties, 19% polyculture, 33% combine all of the above, and 2% incorporate organic matter into the soil (instead of burning it) and participate in campaigns to clean ravines, forests, and green areas.

The set of variables fulfills environmental functions aimed at developing climate-smart agriculture, which is defined as one that sustainably increases productivity, adaptation, and reduction or elimination of greenhouse gases (FAO, 2012). In the case under study, there are different

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practices that have changed, such as the burning of agricultural stover for its incorporation as organic matter into the soil to improve the moisture retention capacity of the soil, which allows facing periods of water scarcity to avoid emissions to the environment caused by burning.

Economic functions

Market. In the family units of the municipality, a great variety of crops are harvested, among which corn, beans, squash, broad beans, peas, a diversity of fruit trees, medicinal, aromatic plants, and backyard animals stand out. Of the products produced in family units, 27% are for sale, 7% for consumption, and 65% both. Their main market is the municipal seat of Calpan (83%), Cholula (11%), Huejotzingo (4%), and the city of Puebla (2%).

According to López *et al*. (2018), in the municipality of Calpan, it is considered that the economically less profitable crops are: Mexican hawthorn, apple, and peach, so their production has decreased. On the other hand, Reyes-Reyes *et al*. (2020) mention that the various fruit trees, such as Mexican hawthorn, peach, plum, pear, and black cherry, are destined for the market for income generation.

Products consumed in the daily diet. Of the products sown by families, all always consume a part of what they produce: corn, they consume on average 11 kg per week, beans three kg per week, and chili, 1 kg. Fifty-three percent do not buy corn and beans at any time of the year; that is, families have food security in these products. Authors such as Pantoja (2022) mention that family farming is under constant valuable and significant contributions to the food security of peasant families due to the high diversity of crops they sow.

As for livestock farming, 68% of families carry out this activity: 40% raise pigs, 26% sheep, 16% cattle, 26% horses, 2% goats, 2% rabbits, and 42% poultry. Except for horses, they are used as food in family events and patronal feasts, and another part is sold to generate income. In this sense, Centeno-Bautista and Manzo-Ramos (2018) affirm that family livestock farming is the most important in Mexico since a good part of the income of the localities and their peasants depends on it, in addition to fulfilling different functions for their benefit.

Cultural events. Product of all the benefits and cultural importance of the common walnut, in San Andrés Calpan, annually in August, the traditional chile en nogada fair is held, where the common walnut is the main ingredient for the preparation of this dish. The fair is an event to show the culinary culture, where the traditional dish of chile en nogada is sold, and the sale of ingredients that make it up grown by the same producers, which has generated jobs for men and women.

Other products of agricultural origin that have been given added value, as well as local handicrafts, are also sold. There are other thematic fairs, such as the Mexican hawthorn fair, which takes place in November in the municipal seat, the mole fair, which takes place in June in the locality of San Lucas Atzala, and the pulque fair, which takes place in March in the locality of San Mateo Ozolco.

According to Islas-Moreno *et al*. (2021), festive events are wide and varied, they can be distinguished from one society to another by their content and the intensity of certain elements and can be typified in different forms of festive expression, among which we can find parties, festivities, and fairs. In this sense, fairs as events of a mainly commercial nature, with the purpose of promoting products and services and generating economic income for the participants (Pizano-Mallarino *et al*., 2004).

Territorial functions

Intergenerational replacement. Seventy-four percent of producers receive help from their children in agricultural activities, but all of them do so without receiving any type of economic remuneration as payment for their work since this is done as part of their duties as children and as support for family farming. Seventy-five percent want to continue participating in agricultural activities, 11% want to continue since they consider them an inheritance from their parents and

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grandparents, 28% like agricultural activities and the environment in which they take place, 17% because of tradition, and 23% due to the production obtained in each harvest.

In this sense, Duarte-Quapper (2011) points out that the future of agriculture is one of the most common concerns due to the lack of generational replacement; in this sense, the rural youth condition has been practically invisible for rural studies, which is why it is of utmost importance to discuss them since they are the future of rural agricultural territories (Roa, 2017). In the same order of ideas, Rubio-Herraez (2006) argues that the population engaged in agricultural activities has decreased by 16% due to the marginalization suffered by the small producer and the lack of opportunities in the countryside.

Type of property. Three types of property were found: ejido (75%), communal (17%), and private (8%). According to Rubio-Herraez (2006), the territory is the most visible unit of the rural world with a fusion of processes, conflicts, and findings. For her part, Velázquez-Hernández (2019) mentions that in Mexico, the most prevalent type of property is the ejido type, as a consequence of the Agrarian Law of 1992, it is the property most threatened by urbanization.

Conclusions

Peasant family farming systems have a wide range of functions that go beyond the economic and food ones, a clear example of this is found in the municipality of Calpan, where this activity is carried out, which integrates sociocultural, economic, environmental, and territorial functions, which provide families with food, income, jobs, in addition to conserving biological and cultural diversity.

This large number of functions that the agricultural systems of the municipality have explains the persistence of peasant family farming in the area and the strong desire of young people to continue developing in this environment and contribute to the permanence of the system. For this reason, it is of vital importance to rescue these systems of peasant family production, which are constantly evolving by providing multiple benefits to families, the environment, and society.

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