

Sociocultural and environmental benefits from family orchards in the Central Highlands of Mexico

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Photo 1.
Direct composting practice at the foot of trees.
Photo J. García.

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RÉSUMÉ

BÉNÉFICES SOCIOCULTURELS ET ENVIRONNEMENTAUX DES VERGERS FAMILIAUX DES HAUTS PLATEAUX DU MEXIQUE

Cette étude vise à analyser les perceptions des agro-écosystèmes sur le plan socioculturel et environnemental parmi les propriétaires de vergers familiaux situés dans la zone de transition écologique de l'État de Mexico. La méthodologie comporte trois étapes : 1) caractérisation géographique des localités et des agro-écosystèmes ; 2) analyse des bénéfices sociaux des vergers ; 3) potentiel des vergers et problèmes rencontrés. L'enquête s'est déroulée sur douze localités situées dans trois municipalités de l'État de Mexico, à l'aide d'entretiens semi-structurés complétés par des observations directes sur le terrain. Les vergers familiaux sont une source de nombreux bénéfices sociaux, environnementaux, écologiques et culturels : ils contribuent au bien-être des familles par la production de fruits, de condiments et de plantes utilisées dans diverses cérémonies, récoltées pour l'autoconsommation, la vente ou le troc. Ces vergers sont également une source de bois de feu, de bois de construction, de piquets et d'ornements. Ils sont ainsi à considérer comme des agro-écosystèmes de grande importance et dont le fonctionnement repose sur des relations complexes entre l'ensemble de leurs composantes. Les bénéfices socioculturels et environnementaux de ces agro-écosystèmes productifs aux fonctions multiples peuvent être un atout considérable pour la réussite de stratégies de cohésion sociale et de sécurité alimentaire en milieu rural, tout en contribuant à la préservation des ressources naturelles de la région.

Mots-clés : vergers familiaux, bénéfices socioculturels, familles rurales, bénéfices environnementaux, agro-écosystèmes, Mexique

ABSTRACT

SOCIOCULTURAL AND ENVIRONMENTAL BENEFITS FROM FAMILY ORCHARDS IN THE CENTRAL HIGHLANDS OF MEXICO

The aim of this study was to analyze perceptions of agroecosystems in terms of their sociocultural and environmental benefits among owners of family orchards in the State of Mexico's ecological transition zone. A 3-stage methodology was used: 1) geographic characterization of localities and agroecosystems; 2) analysis of social benefits from orchards; 3) analysis of the potential of family orchards and problems encountered. The investigation was conducted in twelve localities belonging to three municipalities in the State of Mexico, using semi-structured interviews complemented by direct observations in the field. Family orchards provide multiple social, environmental, ecological and cultural benefits: they contribute to the wellbeing of families as a rich source of edibles, condiments and ceremonial plants for home consumption, sale or barter. These orchards are also used for small-scale animal breeding as well as for fuelwood, building materials, fencing materials and ornaments. Family orchards should therefore be considered as important agroecosystems, in the knowledge that they function through complex relationships between all their components. The sociocultural and environmental benefits provided by these productive multifunctional agroecosystems could make important contributions to social cohesion and food security strategies for rural families, while also helping to preserve the region's natural resources.

Keywords: family orchards, sociocultural benefits, rural families, environmental benefits, agroecosystems, Mexico.

RESUMEN

BENEFICIOS SOCIOCULTURALES Y AMBIENTALES DE LOS HUERTOS FAMILIARES EN EL ALTIPLANO MEXICANO

El objetivo de este estudio era analizar las percepciones de los agroecosistemas, en su dimensión sociocultural y ambiental, entre los propietarios de huertos familiares ubicados en la zona de transición ecológica del Estado de México. La metodología comprendía tres etapas: 1) caracterización geográfica de localidades y agroecosistemas; 2) análisis de los beneficios sociales de los huertos; y 3) evaluación del potencial de los huertos y problemas encontrados. La investigación se llevó a cabo en doce localidades de tres municipios del Estado de México mediante entrevistas semiestructuradas completadas con observaciones directas de campo. Los huertos familiares proporcionan múltiples beneficios sociales, ambientales, ecológicos y culturales: contribuyen al bienestar de las familias procurando alimentos, condimentos y plantas ceremoniales para autoconsumo, venta o trueque. Asimismo, estos huertos proporcionan leña, madera de construcción, postes para vallas y adornos. Así pues, los huertos familiares deben ser considerados como agroecosistemas de gran importancia con un funcionamiento basado en complejas relaciones entre todos sus componentes. Los beneficios socioculturales y ambientales de estos agroecosistemas productivos multifuncionales pueden contribuir de modo significativo al éxito de las estrategias de cohesión social y seguridad alimentaria en medios rurales, ayudando al mismo tiempo a preservar los recursos naturales de la región.

Palabras clave: huertos familiares, beneficios socioculturales, familias rurales, beneficios ambientales, agroecosistemas, México.

Introduction

Family orchards, which conserve a wide variety of crops, have been developed over hundreds of years by peasant and indigenous communities (Albuquerque *et al.*, 2005; FAO, 2005). These areas contain trees, shrubs, vegetables, tubers, edible roots and herbs which provide foodstuffs, condiments and medicines. They are a combination of useful species for family consumption (GTZ, 2008; Rivas and Rodriguez, 2013). This has been achieved through adaptation to the location, cultivation techniques, climatic conditions and the soil. They are sources of products and income throughout the year, even without using industrialized agricultural inputs (FAO, 2005; GTZ, 2008). The composition and use of crops vary depending on the living conditions and family needs in rural areas (Lok, 1998; GTZ, 2008). They are sustainable agroecosystems developed by generations (Altieri and Nicholls, 2013); ecological, agronomic, cultural, social and physical processes take place within them (Nair, 1993; Rivas, 2014).

However, these agroecosystems entail environmental and sociocultural problems, including the existence of tree pests, inadequate or no systematic pest control, failure to plant new trees and deficient upkeep activities, causing a decrease in their productivity. Likewise, the loss of traditional knowledge for family orchard management, the reduced participation of family members in caring for the orchards, and subdivision of the areas because of inheritance threaten their continuity. Alongside this problematic situation, a lack of recognition of the benefits that Agroecosystems with Family Orchards (AEFO) provide for families leads to disinterest in preserving them. In addition, urban lifestyles exert pressure and result in these areas disappearing. For these reasons, families are beginning a process of abandonment and a consistent loss of the agroecological family orchard tradition.

In 2010, the Aichi Targets were proposed to reduce the loss of biological diversity; a second objective was for agricultural, aquaculture and forestry areas to be managed sustainably by 2020, warranting biology diversity conservation (CBD, 2010). It is important to seek examples of practices, activities and systems in view of that aim. In practice, depending on the purpose and context of studies, different terms, definitions and interpretations have been generated in reference to family orchards, such as solar, backyard, yard, homegarden and others (Mariaca, 2012). Family orchards are defined as being an intrinsic association of multiple-use trees and shrubs with annual or perennial crops, and animals; they are a traditional agricultural production system managed with family labor (Nair, 1993). They also serve as a meeting place for social and cultural functions, relaxation and welfare for family members and neighbors (Cano *et al.*, 2012). In addition, they provide tangible and intangible benefits of aesthetic and recreational value, based on the likes and preference of families (Lok, 1998).

The importance of this study is to highlight how families perceive the sociocultural and environmental benefits from family orchards for conserving biodiversity. The

hypothesis of this study was that families have a positive perception of benefits obtained from these agroecosystems; they are conducive to practices, activities and techniques for biodiversity use. The aim was to analyze sociocultural and environmental benefits perceived by families owning family orchards in three municipalities of the Central Highlands of Mexico, through field observation and the application of semi-structured interviews with 180 heads of household.

Theoretical framework

Social, environmental and sociocultural perception

An analysis of attitudes identifies cultural, symbolic and cognitive components that support the patterns of society interaction with nature and their use (Bertoni and López, 2010). For Cunha *et al.* (2010) it is a relationship between the physical environment and reflexions with it, and the subjectivity of each person; answers or events are the results of local knowledge, based on these perceptions.

Social perceptions of the environment take form in cognitive systems that recognize the presence of opinions, beliefs, values and norms regarding the environment; these determine attitudes to nature conservation. They are the product of a perception and a social valuation that is integrated by affective and cognitive components linked on beliefs and attitudes of the inhabitants towards natural resources (Bertoni and López, 2010). For Fernández (2008) the study of environmental perception refers to the relationships that occur between humans and the environment, related to natural resource management; it is based on the existing knowledge about products extracted from it, it considers factors such as cultural aspects, ecological and climatological processes, and how these play a significant role in society.

For Vallejo *et al.* (2013) socio-cultural perception is a subjective understanding of social action, an understanding of human behavior from meanings and motives that are generated in the individual conscience. As a result of this, actions generate experience and knowledge, called "common sense", which guides actions and forms of interaction that are socially accepted and known by community members.

Environmental benefits from family orchards. An agroecological strategy

Current family orchards are the result of interactions between people, soil, water, animals and plants (Gaytán *et al.*, 2001; Juan, 2013). They represent an ethnological heritage of first order with traditional knowledge passed down from generation to generation (Gispert *et al.*, 2010). For centuries, their role has been to provide food for the family, but nowadays includes leisure and occupational aspects; the major contribution to the in situ conservation of many species and varieties of cultivated plants should not be forgotten (Rigat *et al.*, 2009; Vilamajó *et al.*, 2011).



Photo 2.
Water tank component in an AEFO.
Photo J. García.

In this study, family orchards were conceived as agroecosystems, where families farm different plants and animals. AEFO is a traditional agricultural practice, integrating the following components: orchard, house, yard, water tank¹, fence, and areas for animal rearing, composting and growing vegetables. The orchard is usually located near the house, making care and maintenance activities easier for family members (Van der Wall *et al.*, 2011; Mariaca, 2012; Chablé *et al.*, 2015).

These traditional agroecosystems offer countless examples of sustainable agricultural practices: 1) They are based on polyculture planting; 2) They maximize crop safety using low levels of technology; 3) They have a limited environmental impact and are adapted to local conditions; 4) They contain a diversity of cultivated plants and adapted wild crops; 5) They do not depend as much on external inputs such as pesticides, fertilizers or artificial irrigation; 6) They make extensive use of renewable and locally available resources; 7) They have active nutrient recycling; 8) They conserve biological diversity; 9) They use production to meet local needs; 10) They are relatively independent of external economic factors; and 11) They are built on traditional knowledge and culture (Gliessman, 2002; Gliessman *et al.*, 2007; Altieri, 2009; Sarandón and Flores, 2014).

Cultural benefits from family orchards.

Preservation and transmission of traditional knowledge

The appropriation of nature is an expression of the implementation of a multiple-use strategy that responds to a rationality that is both ecological and economic. It is based on local ecological knowledge; it is a tradition that passes

¹ This means a construction made of cement containing water that people use for orchard irrigation, animal watering and cleaning operations.

from one generation to another (García-Frapolli *et al.*, 2008). For Massieu and Chapela (2007) traditional knowledge is closely related to cosmogony and the livelihoods of communities, because its purpose is to strengthen the values of the management of plants, seeds, animals and organization forms, as well as synchronization with solar and lunar cycles that guide crop sowing. Such knowledge is therefore essential for sustaining and preserving the important environmental role of subsistence farming (Vilamajó *et al.*, 2011), which promotes diversity and accumulated knowledge about plants and living organisms interacting as part of the ecosystem.

According to Toledo (2005), traditional knowledge is a product of a network of relationships and practices that have developed over thousands of years within peasant and indigenous communities. It consists of beliefs (*cosmos*), knowledge that people keep in their minds, the structure or the elements of nature, the relationships established between them and their useful application (*corpus*), as well as a set of productive practices, which combine in their knowledge system regarding their environment and their development in daily life (*praxis*).

The importance of preserving traditional knowledge associated with ecosystem management was recognized at the Biology Diversity Convention in 1992, mainly in agroecosystems, where the practices, beliefs, traditions and cosmology of villagers contribute to natural resource conservation (Toledo, 2005; Calvet *et al.*, 2014). People in AEFOs carry out processes for the management, adaptation and preservation of a wide range of agrobiodiversity, because they have supported a cultural identity for hundreds of years (Rigat *et al.*, 2009; Garnatje *et al.*, 2011; Calvet *et al.*, 2014; Rivas, 2014).

Social benefits from family orchards. A strategy for family food security

According to the FAO, 842 million people are chronically hungry because they cannot afford adequate food. Worldwide, 70% of people live in the rural areas of developing countries (FAO, 2015). Production systems need to meet the food requirements in these areas (Rebollar *et al.*, 2008; Gispert *et al.*, 2010). One option is family farming, whose priority is its labor force, with limited access to land and capital resources, use of multiple survival strategies and access to income generation (AFAC, 2011). This concept includes groups of farmers and farming families engaged in producing food for self-consumption, providing food and many other products for food supplies. They are a starting point, like a recognition of traditional knowledge and ancestral wisdom of farming families (FAO, 2015). They combine tradition, innovation and science to promote the environment, fair relationships and a good quality of life. They also empower communities to take control of their food production needs, providing locally adapted systems that can be handled by them sustainably. These small production units are the key to food security (AFAC, 2011).

Material and methods

The study area comprised three municipalities, in which 12 locations were chosen. The study population was families with a family orchard. The study was conducted from January to March 2015. The sample size was 180 heads of household aged 20 to 85 years; surveys were carried out at the home of each interviewee. The confidence level was 95%, with a sampling error of 5%. The “snowball” sampling method was used; this technique enables an informant network to be established (Santana *et al.*, 2013).

After field work, consisting of systematic visits and direct observation in the field, 15 orchards were selected at each location and a semi-structured interview was conducted that identified management activities, practices and techniques, and family perceptions of AEFO benefits. The interview was approximately 30 minutes long; the purpose was to ascertain family socioeconomic conditions, the features of the terrain, family orchard characteristics, and the perception of social benefits derived from having a family orchard. The Statistical Program for Social Sciences (SPSS) was used to analyze the results.

This work consisted of five stages: a) Characterization of the locations; b) Features of the AEFOs in the study area; c) Characteristics of the families keeping up the family orchard tradition; d) Analysis of the sociocultural and environmental benefits from family orchards perceived by the interviewees; e) Analysis of the potential and problems of AEFOs.

Geographical characterization began with the delimitation of the study area. Physical characteristics such as the relief, climate, geology, soil and vegetation were analyzed. To determine socio-economic characteristics, data from the

XIIth Population and Housing Census were processed (INEGI, 2010), making it possible to calculate the total population, the gender structure of the population, the education level, the Economically Active Population (EAP), the Economically Inactive Population (IEP), the population with access to medical care, and the characteristics of the houses.

The interviews helped to determine AEFO components, the practices implemented by the families, the area and location of the orchard in relation to the house, the animals present and protective fences. Related to the characteristics of the families, based on interviews, the main people responsible for maintenance were identified, along with the age of family members, the occupants in each house, the distribution of activities and the agroecological techniques applied to orchard care.

The social benefits analysis stage included aspects that were divided into three groups: 1) Ethical-aesthetics: this included variables of recreation, landscape and family organization for orchard maintenance. 2) Scientific-educational: this included an analysis of traditional knowledge, environmental education in agroecosystems and knowledge sharing between family members. 3) Aspects related to sustainability and food security, such as the strategy favored in aspects linked to human-nature relations and the food obtained.

For the analysis of AEFO potential and problems, Strengths, Weaknesses, Opportunities and Threats (SWOT) and a Frame Logic Analysis were used. Causes and effects that negatively affected the traditional practice were analyzed, but also their positive effects and importance for rural families.

Results and discussion

Characteristics of the locations

The study area was located in the Ecological Transition Zone (ecotone zone) of the State of Mexico, in which there are 24 municipalities. With the latitudinal and altitudinal gradients representing a region of geographical, ecological and socio-economic importance, being a transition zone between the Nearctic and Neotropical biogeographical realms, the area contained plants and animals representative of both realms. In the tradition of family orchards, there is an environmental, social and agroecological impact due to the association of plants, and to the traditional ancestral knowledge put into practice, allowing rural families to have a wide variety of trees and animals within the AEFO.

The locations analyzed belonged to the Malinalco, Tenancingo and Villa Guerrero municipalities, in the State of Mexico, Mexico. They were located between 18° 48' 58" and 19° 57' 07" north latitude, 99° 38' 37" and 98° 35' 45" west longitude, with an



Photo 3.
Animal component in an agroecosystem.
Photo J. García.

approximate territorial area of 614.19 km² (figure 1). The area displayed altitude differences, with the lowest points at Malinalco with 1,580 meters, and the highest at Villa Guerrero with 3,760 meters (INEGI, 2010). The latitudinal and altitudinal location of the study area was important because it promoted the existence of different climates, soil types and vegetation forms in these municipalities, which are conditions conducive to the traditional practice of family orchards.

The predominant climate was (A) Ca (w1) (w) (i')² semi-warm, sub-humid with summer rainfall, an annual average temperature of 18.5°C, with a maximum of 35.5°C and a minimum of 16.5°C, with 1,305 mm of rainfall per year on average (García, 1982). In the areas of higher and lower altitude, other types of climate existed, e.g. semi-cold, temperate and warm. The study area revealed igneous and sedimentary rock types. The most frequent types of soil were andosols, vertisols, luvisols and haplic feozems. The predominant forms of vegetation were mixed pine-oak forest, pine forest and deciduous forest (López *et al.*, 2012). The diverse climate, soil and vegetation forms prevalent in this region were of benefit to people in developing agricultural activities, achieving sociocultural adaptation and experimentation in family orchards with a vast agrobiodiversity of herbaceous plants, shrubs, trees and animals (Juan, 2013; White *et al.*, 2013).

² (A) Ca (w1) (w) (i') refers to Mexico's classification system of climate conditions.

Of the 12 locations included in the study area, three were municipal capitals and nine were rural communities. Its total population was 45,812 inhabitants, of which 52% women and 48% men. The population was divided into 11,269 minors, 30,387 adults and 4,156 people over 60 years old. With regard to schooling, 31% attended school, 26% did not attend school, 20% had a basic education, 18% had a post-basic education, and 5% were illiterate (INEGI, 2010). The formal education level was low, because people worked in agricultural activities, but these labor conditions helped to increase traditional knowledge of AEFOS.

The EAP in the locations amounted to 18,792 people and the EIP amounted to 14,868 people. Approximately 62% of the population had social security and 38% did not have that right as they worked in primary activities, had a low income and did not have access to medical care. These conditions led people to consider having a family orchard for the availability of dietary supplements and medicinal plants, highlighting the importance of traditional AEFOS practices.

There was a total of 10,922 inhabited houses, i.e. 84% were occupied, with an average of 4 persons per household. In terms of utilities, 70% of homes had access to electricity, drinking water, public drainage, the rest suffered from a lack of services. The house construction material was 78% durable materials such as bricks, blocks and reinforced concrete, but they were not finished buildings (INEGI, 2010). Given the conditions, the marginality level of the zone could be classed as medium.

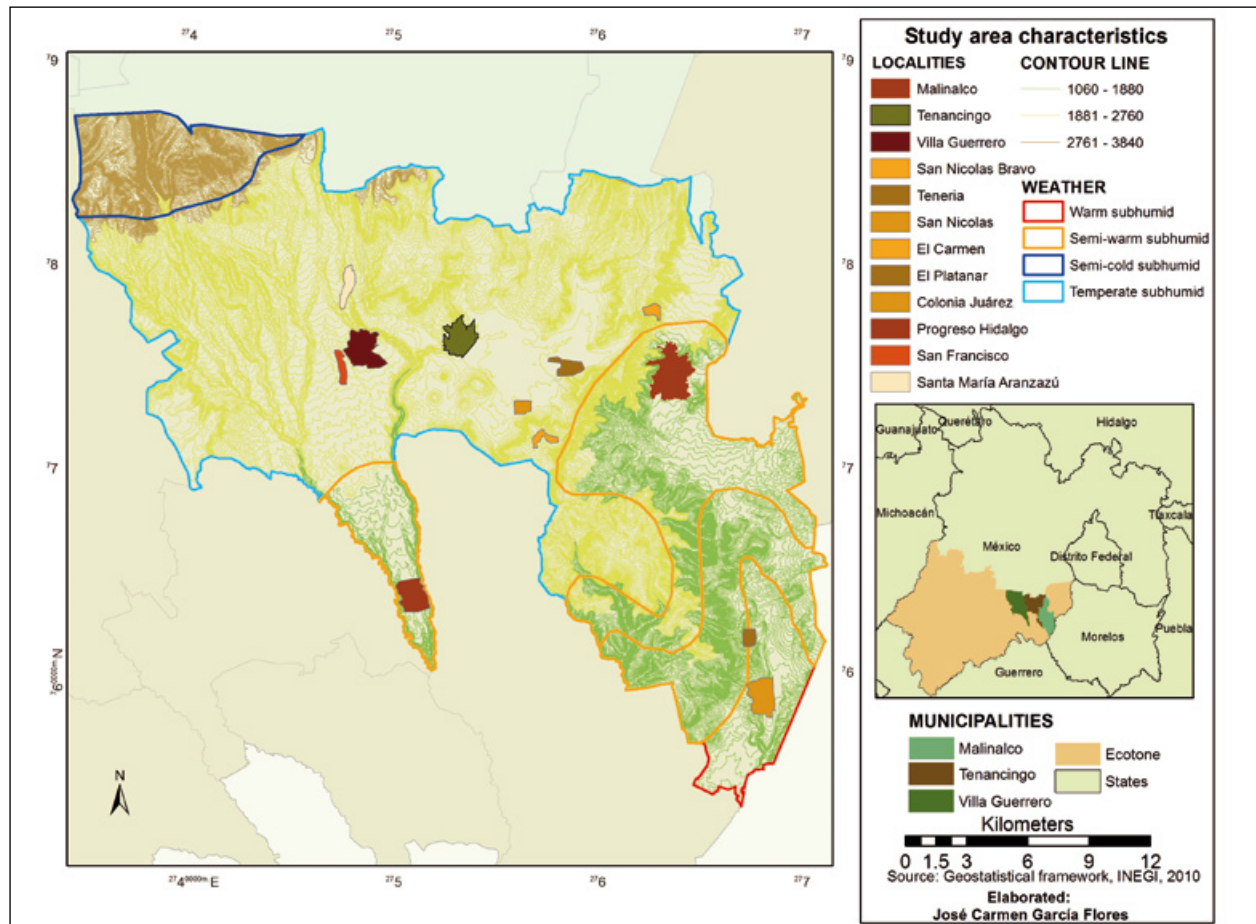


Figure 1.

Study area characteristics.

Source: Prepared based on the National Geostatistical Framework 2010 INEGI, 2015.

Characteristics of the agroecosystems with family orchards

In these areas there were trees, shrubs, vegetables, and herbs that provided food products, condiments and medicinal plants. There was a diversity of species combinations of use for family consumption. The species diversity found in family orchards in these municipalities was: 134 trees or shrubs, 54 herbaceous or vegetable plants and 13 animals. The products obtained were fruits, leaves, stalks, flowers, sap, meat, milk and eggs; the main use was self-consumption (148 cases); through exchanges (58) and sales of surplus (38), the families complemented their diet with products they did not grow in their orchards. The AEFO provided species used for food (177 cases), condiments (69),

medicines (69) and ritual purposes (45). Magaña (2012) mentioned that families use plants as a major strategy for their subsistence. Albuquerque *et al.* (2005) considered that the orchard provided products throughout the year. The results confirmed that AEFOs are important for family diet, as a way of contributing to family food security.

Table I shows AEFO components. The most common are the house, yard and water tank, with less than a quarter of these agroecosystems having composting and vegetable growing areas. Colín *et al.* (2012) found that spatial organization depends on the characteristics of the owners' property, water availability and terrain slope and area. Santana *et al.* (2015) and White *et al.* (2013) related it to family growth and land tenure. This research found that families' health conditions, responsible ages and management knowledge were also related to the organization of the agroecosystem.

Based on field work and information from the interviews, it was obvious that people did not devote time and space to composting and growing vegetables, perhaps because they had no knowledge or habits of organic waste recycling as compost, and vegetable growing requires labor and the shade cast by trees affects vegetable growth. Only a few of the people interviewed had the knowledge and habit of growing vegetables. The most common practice observed was the placing of leaves, branches, fruit peel and kitchen waste directly at the foot of trees, as a way of decomposing organic matter (photo 1).

The area of the family orchards was 560 m² in almost 40% of the cases, and between 561 and 1060 m² in 40% of the cases, including various AEFO components (photo 2). The results of Guerrero (2007), Juan (2013) and Santana *et al.* (2015) in Central Mexican orchards showed an area under 400 m², while in southeastern Mexico, Mariaca (2012) and Cahuich *et al.* (2014) reported over 800 m². Colín *et al.* (2012), Mariaca (2012) and Cahuich *et al.* (2014) considered the area to be very variable, but with an average of 500 m².

In terms of orchard location, 52% were located in front of the house, 19% at the back, 16% and 13% to the left or right. Juan (2013) found that 32% were behind of house. In 81% of cases, the distance between these components was 2 to 7 meters. Both the location and distance made for easy monitoring and maintenance; in accordance with Rivas (2014) and the FAO (2015), this characteristic simplified crop protection and upkeep.

In terms of family orchard condition, 70% were well maintained, the reasons for preserving them being product consumption, house decoration, and the provision of construction and fuel materials. It is considered that 15% of all AEFOs are being lost, some of the reasons for this being that knowledge is not passed down from generation to generation in few families, properties are subdivided when children marry, urbanization and migration processes, according to Guerrero (2007), Van der Wall *et al.* (2011), Colín *et al.* (2012), White *et al.* (2013) and Chablé *et al.* (2015). In addition, some other factors were identified: indifference of the younger generations, lack of maintenance activities, and economic woes leading to portions of the properties being sold off.

Table II shows the animal species found to be part of the agroecosystems. Chickens, hens, pigs and, to a lesser extent, horses, rabbits and sheep were found to coexist in most family orchards; these species provided various

Table I.
Components of the Agroecosystems with Family Orchards (AEFO).

Components	Number of orchards with different components
House	179
Yard	136
Water tank	134
Fence	96
Animal rearing area	75
Vegetable area	21
Composting area	18

Source: Prepared based on field work, 2015.

Table II.
Animals found in the Agroecosystems with Family Orchards (AEFO).

Animals ^a	Number of orchards where they were present
Chickens	73
Hens	64
Pigs	30
Horses	19
Rabbits	18
Sheep	11
Turkeys	6
Cows	6
Ducks	5
Goats	2

^a Several animal species could be present in the same orchard.
Source: Prepared based on field work, 2015.

Table III.
Type of fences in the Agroecosystems with Family Orchards (AEFO).

Type of fence	Number of family orchards with fences	Percentage
Barbed wire or mesh	77	42.8
Wall	50	27.8
Live fence	46	25.6
Stone fence (tecorral)	7	3.9
Total	180	100.0

Source: Prepared based on field work, 2015.

Table IV.
Schooling level of respondents.

Schooling level	Number of respondents	Percentage
Primary	42	23.3
Incomplete primary	57	31.7
High school	41	22.8
Incomplete high school	1	0.6
Preparatory	14	7.8
Incomplete preparatory	2	1.1
Undergraduate	6	3.3
No schooling	17	9.4
Total	180	100.0

Source: Prepared based on field work, 2015.

products and services for the family, and they had limited space requirements (photo 3). As regards animal manure, half of the respondents said they left animal droppings where they were, almost a quarter of the owners placed them directly on trees and another quarter relocated them to their agricultural fields. This provides evidence of a general unawareness of the composting technique, but they used animal manure directly as an organic component of the soil.

Table III shows the type of fences found in the agroecosystems; almost three-quarters of them used inert materials and barbed wire; a quarter of the owners applied the agroecological technique of a live fence, and only a few of them use the traditional technique of stone fences (tecorral³).

The live fences in the AEFOs comprised plants that were mostly fruit trees interspersed with shrubs, barbed wire or fencing, as a way to take advantage of the space to obtain plants and food. Just under a quarter of fences had plants

³ Tecorrals are stone stacks used to mark out ownership, sometimes with herbaceous plants growing up them.

with thorns, perhaps a little-used practice as a safety measure for children and animals, due to the proximity to housing.

Characteristics of families keeping up the family orchard tradition, activities and work division for handling AEFOs

Based on interviews in the 12 locations, 77% of respondents were female and 23% male. This may be because when the interviews were conducted the men had gone out to work and the women stayed at home. The interviewees ranged between 20 and 85 years old. The largest proportion of concentrated ages was between 31 and 60 years with 62% of respondents, and 18% were over 60 years old. The religion they mostly practiced was Catholicism (83%), with the rest

of the respondents holding different beliefs. The number of house occupants ranged from 1 to 19 people per household; in 85% of cases there were 2 to 7 people. In terms of schooling, 78% of respondents had a basic schooling level (table IV). Chablé *et al.* (2015) interviewed 160 owners in southeastern Mexico, 71% were women. Garnatje *et al.* (2011) reported that orchard owners in the Catalan Pirineo were evenly women and men, mainly older adults with a basic educational level; those studies reported similar aging and schooling conditions to our results.

When asked about household income, only 6% of respondents agreed to answer, maybe due to the insecurity they perceived, or the variable income making it difficult to calculate. They earned from 1,800 to 2,900 pesos monthly, approximately 100 to 161 dollars as overall formal family income. In addition, the family orchards generated income because the owners sold fruits, animals and plants, which had a high value on the regional market. According to Toledo *et al.* (2008), Colín *et al.* (2012), Juan (2013), Chablé *et al.* (2015) and Santana

et al. (2015), it is a strategy of multiple uses of resources and maintenance for rural families, in a low employment and low income context. The main occupation was a housewife with 67% of cases, followed by 13% for farming activities (table V). For family orchards in the Mazahua zone, Guerrero (2007) reported similar incomes and occupations.

Just over half of respondents were natives of the town, with an average of between 27 and 50 years of residence; they liked the zone's favorable climate. In 52% of homes there was a family which had lived with its orchard since birth, with an average of 18 to 41 years growing their family orchards.

As regards the time devoted to that task, 79% of respondents spent between 2 and 8 hours per week, in which they undertook maintenance activities (photo 4). Only 1% spent more than 24 hours per week, as these agroecosystems did not require as much care as an ornamental and decorative garden. According to Nair (1993), in these systems care is provided with the participation of the whole family.

Men carried out various activities: pruning trees, as well as composting work, weeding by uprooting or cutting grasses, pest control by chemical or natural preparations,

and painting the base of tree trunks with a mixture of prickly pear, lime and water, to prevent insects and pests from climbing them. Men had the knowledge to carry out this work, which also involved physical exertion (table VI).

On the other hand, women were responsible for cultivation in the family orchards, because they stayed at home longer, so they spent part of the time taking care of the plants. The activities attributed to women's responsibilities included planting trees, cleaning family orchards by sweeping up the fallen leaves of trees, and watering the plants, along with harvesting. This is because women were responsible for providing food, so they chose new trees to plant and decided which fruits could be used to supplement the family diet (table VII).

Weeding was carried out in 169 family orchards, manually, with a machete⁴, a hoe or by tearing off the grass by hand; in 11 cases brush cutting equipment was used and on 4 occasions herbicide was used. Manual weeding was carried out because it was a very selective activity, due to complex species associations, which are a feature of agroecosystems. The owners used different sources of water to water their family orchards. In 134 family orchards they used water from the municipal drinking water systems, and in 15 cases water from washing dishes and clothes was reused; this may be attributed to water distribution for the various activities related to their use. The most common irrigation technique used was a bucket (105 cases), perhaps because women carried out this activity, consequently they managed and provided water from inside the home.

The frequency with which the owners of family orchards produced compost amounted to 41% of the agroecosystems; they reserved an area of the property for this practice of processing organic matter. The organic materials

⁴ Metal tool used to cut branches, stems or grasses.

Table V.
Occupation of respondents.

Occupation	Number of respondents	Percentage
Housewife	121	67.2
Peasant	24	13.3
Dealer	17	9.4
Crafts	12	6.6
Unemployed	6	3.5
Total	180	100.0

Source: Prepared based on field work, 2015.

Table VI.
Activities of the father with help from other members.

In charge	Pruning	Natural fertilizers	Weeding	Pest control	Liming of trees
Father	108	32	100	32	31
Mother	23	13	26	10	4
Son	18	13	31	6	12
Daughter	1	0	5	0	1
Grandfather	4	1	0	0	1
Grandson	2	0	1	1	2
Total	156	59	163	49	51

Source: Prepared based on field work, 2015.

Table VII.

Activities of the mother with help from other members.

In charge	Tree planting	Cleaning family orchard	Irrigation	Crop products
Mother	32	132	104	87
Father	24	34	42	52
Son	8	8	18	10
Daughter	3	8	8	6
Grandfather	2	0	0	1
Grandmother	1	4	4	0
Grandson	1	0	0	0
Total	71	186	176	156

Source: Prepared based on field work, 2015.

Table VIII.

Materials used for compost.

Compost material	Number of times materials used
Tree leaves	68
Domestic waste	42
Manure	31
Weeding and pruning	21
Ash	15

Source: Prepared based on field work, 2015.

used were tree leaves, household waste, manure, grass and ashes (table VIII). Compost was applied to the orchard in 52 cases, while on 18 occasions it was carried to the agricultural plot. It is clear that composting did not exist in many family orchards, probably because the owners were unaware of the benefits of composting techniques and did not spend time in processing it.

A strategy applied by families to use organic waste from the kitchen was feeding animals in 62 cases, as a cheap strategy to maintain small animals. Fifty-four respondents answered that waste was deposited in a garbage truck.

Sociocultural and environmental benefits derived from family orchards

One meaningful question put to the respondents was why the family had an orchard, in order to bring out the importance an AEFO represented to them. Table IX shows the motives for having and caring for family orchards. The main reason for having them was to meet food requirements; this was due to the number and variety of trees and plants growing in family orchards and providing foods that complemented their family diet. In relation to ethical – aesthetic aspects, families quoted the use of these agroecosystems for recreation purposes, family meetings, leisure time and social events. Cano *et al.* (2012) also reported social and cultural functions.

Associated with sustainability and food security objectives, the products and services provided by the agroecosystems included food products that the families consumed from the AEFO (perceived in 177 cases); family orchards gave them fruits, but also medicinal plants for health care, condiments for food preparation. Less often they took advantage of plant leaves, vegetables, stalks, eggs and milk, showing that it was a system from which a variety of food and medicinal products were obtained.

The main use made of the AEFO by the family was food production. However, the space was also used for other purposes, such as carrying out recreational and decorative



Photo 4.
Maintenance activities by women in a family orchard.
Photo J. García.

Table IX.
Motives for having an Agroecosystem with Family Orchards (AEFO).

Reasons	Replies	Other uses	Replies
Meet food needs	105	Recreation	86
Shade	67	Ornamental	78
Nice weather	46	Family meetings	42
Income generation	8	Leisure time	12
		Social events	11

Source: Prepared based on field work, 2015.

Table X.
Sociocultural benefits and environmental services that owners and communities receive from the Agroecosystems with Family Orchards (AEFO).

Goods and services	Number of people who consider the benefit
Shade contribution	130
Animal shelter	124
Maintains humidity	88
Animal feed	71
Stick or branch supports for vegetable	62
Provides leaves for composting or animal feed	60
Fence branches	38
Repels pests	30
To Avoid grass growth	20
Prevents soil erosion	12

Source: Prepared based on field work, 2015.

activities as listed in table IX. Both recreation and decoration highlight the importance of these agroecosystems for families in obtaining enjoyment, linked to ethical-aesthetic aspects (photo 5).

Table X shows some of the social and cultural benefits and environmental services that people perceived they obtained from family orchards; the most frequently mentioned were their contribution as a source of shade and an animal shelter, followed by maintaining humidity and food for animals. But the interviewees identified various uses that they made in other activities, such as functions related to different traditional ecological techniques that they had preserved and which were linked to varied environmental services that promoted productivity and quality of life. For Garnatje *et al.* (2011) and Calvet *et al.* (2014) these agroecosystems maintain traditional ecological knowledge, since they contribute directly or indirectly to the conservation of biological diversity.

The families also perceived that the AEFO provided them with various sociocultural benefits, such as the provision of shade (130 cases) with two main functions: creating a comfortable home microclimate, and as a way of retaining moisture in the agroecosystem; these benefits were achieved by intercropping trees, shrubs and herbaceous plants to maintain soil cover and prevent rapid evapotranspiration. They served as an animal shelter (124 cases), not only for wildlife, but also for raising chickens, which at night were kept safe and protected in the branches of trees to avoid being attacked by predators. The use of branches as supports refers to the fact of sowing plants at the foot of a tree, such as species of climbing vegetables like squash (*Cucurbita pepo* L.) or chayote (*Sechium edule* Sw.), so that the tree serves as a support for growth and production (photo 6). In terms of these functions Calvet *et al.* (2014) reported that in these agroecosystems, families applied traditional knowledge for the management, use and care of biocultural diversity.

In these agroecosystems, tree leaves were used for three purposes: firstly leaving them where they fell as ground cover to retain moisture, secondly for feeding small animals such as rabbits, and thirdly composting them for organic fertilizer. Branches in some family orchards were used to delimit the property. In some family orchards, the owners found that growing certain plants could be useful as repellents, such as rue (*Ruta graveolens* L.). Among other benefits, it was understood that the accumulation of leaves and the presence of trees and shrubs could even prevent the growth of undesired grasses and erosion processes.

The owners' perception of the benefits derived from their family orchards revealed that 121 respondents had a positive opinion about the products obtained and used for household consumption, 70 said they contributed to their health through the healthy products consumed, which were produced without agrochemicals. They also perceived clean air generation and a variety of medicinal plants that helped them to treat illness; they remarked that the existence of the plants favored their family's well-being. They highlighted economic benefits from product sales and exchanges, providing money that complemented the family diet in 15 cases.

In terms of scientific-educational benefits, most owners considered that family orchards provided recreational activities, taught their children to take care of nature and share their knowledge with other family members. In 127 cases, the main reason why people were responsible for maintaining the family orchards was because they loved nature and enjoyed it. Forty-seven of them mentioned obtaining food as their motivation; just over 25% of respondents considered



Photo 5.
Recreational use of family orchard.
Photo J. García.



Photo 6.
Growing vegetables using tree branches as supports.
Photo J. García.

taking care of family orchards was a recreational activity. Lok (1998) affirmed that they provide aesthetic benefits. They also perceived ethical-aesthetic benefits offered by the presence of birds and other wildlife that came to eat fruits or to sleep at night.

The traditional knowledge that families maintained and reproduced in AEFOs, had led them to preserve traditional crop management, which had been acquired through the empirical practice of these activities and through continuous and systematic observation of natural processes functioning

in the agroecosystem. As regards the knowledge they possessed for maintaining the family orchards, 64% of respondents received it from their parents, because it was a traditional practice passed down from generation to generation, from parent to child. The transmission of knowledge was shared by 53% of owners. They shared that knowledge with their children (72 cases), with grandchildren (12) and with neighbors (9). Ninety percent of them had not received any technical assistance for agroecosystems maintenance, as it was considered traditional knowledge in these municipalities. However, 50% of families were interested in receiving training to improve the condition of their family orchards.

Potential and problems of family orchards

Identifying social benefits means considering family interactions and relationships with other people. More than two thirds of the respondents believed that family orchards allowed conviviality between family members and neighbors; this corroborated the importance of family orchards for family integration and social cohesion. The ways in which family orchards enabled people to relate were mostly linked to the exchanging of products and knowledge sharing.

There were a few problems associated with family orchards. In 11 cases, animal incursions were mentioned; this may have been because the AEFOs often had barbed wire fences, through which small animals could enter and affect the agroecosystem. Invasion by neighbors' house plants was mentioned in 10 cases, along with falling leaves, or branches affecting others' property, or fear that a tree might affect someone's house. However, very few family orchard owners had problems with their neighbors due to the presence and maintenance of their agroecosystem; most did not give rise to disputes because AEFOs were an ancient tradition that they had practiced for many years.

Among the most common problems for the maintenance and persistence of AEFOs, 103 families considered the lack of space as a major obstacle when property divisions occurred, to build homes for their married children. In 62 cases, a lack of knowledge and a lack of time were limiting factors for continuing the tradition of family orchards. These social conditions affected the area and threatened the traditional practice of family orchards.

Conclusions

Through the management of family orchards, farming is developed because it forms part of traditional knowledge, traditions and beliefs about the use of objects for plant protection and the use of plants to treat respiratory and digestive diseases and diseases of a cultural nature. In these agroecosystems, people have made local adaptations that contribute to the conservation of trees, shrubs, herbaceous plants and animals *in situ*, resulting in benefits and traditional knowledge.

Agroecosystems with Family Orchards highlight the economic benefits for families as surplus products from the orchards are sold or exchanged, contributing to family income in seasons when jobs are scarce, although the main destination for AEFO products is home consumption. There is alternative income generation for families, derived from the sale of surplus produce that enhances family household savings driven by self-consumption.

Being a traditional practice where people participate and natural ecosystem processes are imitated, it is possible to maintain biodiversity over time, and ensure its preservation. This allows family integration through work distribution for AEFO management, and even relations with other families through the exchange of products such as fruit, seeds, leaves and plants.

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