

BIOCULTURAL EVALUATION OF THE MAZAHUA MILPA IN A COMMUNITY IN THE NORTHEAST OF THE STATE OF MEXICO

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ABSTRACT

The biocultural value of the Mazahua milpa and its contribution to food sovereignty has been little studied. The objective of this research was to explain the relationships that develop in the mazahua milpa system, in order to understand its social, cultural, symbolic, economic importance and its contribution to the diet of the population. This work was undertaken in an extended family in San Antonio la Ciénega, a Mazahua community in the northwest of the State of Mexico. Data were obtained through participant observation, in-depth interviews, from a diary and from field assessments. Information was analyzed with reference to Pierre Bourdieu's theory. The maize field generates a dynamic of sociocultural relationships, manifested in local knowledge, economic and symbolic relationships (seven rituals); related to the use and destiny of both cultivated and non-cultivated species. Women, mainly control the sharing of maize field products, reciprocating with social groups in the community. We describe 34 morpho species of weeds that support food diversity and the family economy. The milpa system helps families achieve human food security from maize (295m² are required for the system to supply *per capita* consumption); however, production for the total consumption of the production unit is not achieved, due to the limited family cultivation area. Faced with the scenario of the current civilizational crisis, the need arises to reevaluate the Mazahua milpa, as a production system, based on mutual help and family and community reciprocity.

Key words: community, food sovereignty, life strategy, native maize.

INTRODUCTION

Dynamic interrelationships between nature and society form a part of cultural diversity that is constructed and co-evolves (Buizer *et al.*, 2016; Elands *et al.*, 2019; Bridgewater *et al.*, 2019; Hanspach *et al.*, 2020). From this holistic approach, the links between cultural diversity and biological diversity and even language diversity reveal their importance (Díaz *et al.*, 2015); as well as knowledge, uses and management, which have permitted the conservation of areas, where indigenous peoples exist in their environment (Lukawiecki *et al.*, 2022). In this sense, Toledo and Barrera-Bassols (2020) comment that the landscapes of each region or territory evoke a particular mode of cultural appropriation, in conformity with nature to manifest a historical process of biocultural coevolution.

Biocultural approaches to conservation are very likely to achieve efficient results, for which, among other aspects, respect and incorporation of different worldviews and

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knowledge systems must be considered in their planning (Gavin *et al.*, 2015). The milpa, in particular, is a system that represents an essential part of the identity of native peoples, as it generates links between peasant families and the community; for them, it forms part of their culture and represents a productive system that provides food and income to their families (González *et al.*, 2018). This system is part of the productive unit and constitutes a complex life logic, where values and social relationships converge, based on reciprocity and communality (Collin, 2017).

The milpa is considered typical of cultures of Mesoamerican origin (Martín-Castillo, 2016; González *et al.*, 2016), developed and perfected over time by man's effort to domesticate this species, in order to achieve polycultures (Toledo and Barrera-Bassols, 2020). The milpa promotes the association of maize, beans, squash, chili (Morales and Arenas, 2018), tomato and other crops. Likewise, it incorporates non-cultivated species, referred to as weeds (Guzmán, 2018), the latter are pioneer species that grow wild, they are considered of ecological and economic importance, in relation to their use as: medicine, food, forage or for rituals (Linares and Bye, 2015). In the Mazahua area, Vieyra-Odilon and Vibrans (2001) identified 74 species of weeds; of which, 11 serve as food for peasant families or for other uses, such as forage, medicinal and ornamental purposes.

In its entirety, the milpa makes possible the food self-sufficiency of peasant families and provides diversity and food sovereignty for their diet (Jácome and Montes, 2014; Linares and Bye, 2015; González *et al.*, 2016), understood as the right of peoples to define their own food and agricultural strategies, concerning a means of food production that conforms to their particular worldview (Medina *et al.*, 2021).

Currently, the milpa system is disappearing, because it faces competition as monoculture systems are adopted (Toledo and Barrera-Bassols, 2008), based on high-impact technological developments. The small areas of land destined for the cultivation of maize fields (Macías, 2013) mean that production is not profitable for families (Bastida-Francisca, 2023); besides this, the countryside is being abandoned by young people, who migrate to the city, in search of new forms of subsistence (Vizcarra-Bordi *et al.*, 2013).

In the case of the Mazahua peasant families in the northern part of the State of Mexico, the milpa has enabled them to subsist for generations (Vizcarra and Marín 2006). The study of the milpa is important from a biocultural perspective (Gavin *et al.*, 2015; Elands *et al.*, 2019; Hanspach *et al.*, 2020). Its value and contribution to food sovereignty should be recognized, based on ancient production methods. Therefore, this research was carried out in the Mazahua community of San Felipe del Progreso, in the northwestern part of the State of Mexico, aiming to explain the relationships that develop in the Mazahua milpa system, to illustrate its social, cultural and symbolic importance, as well as its contribution to food, plant diversity and Mazahua family income. The conjecture of this work was that: the "milpa system" persists and adjusts over time, despite social, economic, political and cultural transformations, due to its adaptability, relationship to identity, and its contribution to food, as well as the socio-environmental and cultural relationships of those who participate; its importance is such that that no other productive procedure has managed to replace it.

THEORETICAL FRAMEWORK

This research can be interpreted from two perspectives: the social and the productive economic. To account for the sociocultural aspects of the Mazahua milpa in the study community, we referred to Pierre Bourdieu's theory of social fields (1989). He bases his analysis on a critical-methodological apparatus to study social structures and their relationships, taking a complexity approach. Factors or aspects that constitute social space include: the field, capital, *habitus*, practices and the participant. The field is understood as a specific social space, where relationships are defined, based on the accumulated power or capital of each participant (Bourdieu *et al.*, 2001); in this field, we consider the relationships, alliances, strategies of these participants, as well as their struggle to occupy a position.

Capital exists in different contexts and represents a type of power inherent in the set of accumulated goods that are produced, distributed, consumed, invested and finally lost, resulting in the need to enter and be part of a social field (Bourdieu, 1989). In the power category, four types of capital are present: economic, cultural, social and symbolic (Bourdieu *et al.*, 2001); economic capital refers to goods or assets, which can be converted into money, either directly or indirectly. Regarding cultural capital, this can be represented in three ways or forms: in an internalized or incorporated state, that is, in the form of durable dispositions (*habitus*), related to a certain type of knowledge, ideas, values, skills; in an objectified state, taking the form of cultural goods, paintings, books, dictionaries, instruments; and in an institutionalized state, meaning a type of objectification, such as a variety of school certificates, diplomas, courses, conferences or specializations (Bourdieu *et al.*, 2001).

For this research, we were guided by Bourdieu's perspective on cultural capital in its embodied and internalized form. This perspective emphasizes the importance of the collaborators' level of education and highlights the role of the family as an institution that generates knowledge and acts as an agent for preserving and enriching local knowledge related to the milpa. The identification of cultural capital is based on knowledge inherited from generation to generation through oral tradition and the practical management of the milpa. Although this knowledge may not be validated by formal institutions or documented records, it is legitimized through the oral tradition passed down through generations and sustained by existing social networks, both within and outside the family, community, or social group. In the context of this research, the knowledge associated with the maize field serves as evidence of this transfer of cultural capital.

In relation to social capital, this is understood as a set of obligations and social connections that are linked to the possession of a lasting network of relationships, which may or may not be institutionalized. Social capital represents the totality of resources derived from being part of a group, where people jointly support each other and there is an exchange of material and symbolic goods (Bourdieu *et al.*, 2001). This was identified by locating the family, community and institutional networks that are generated or reinforced by

the practical work of the maize field. These relationships are manifested in constant negotiation on the part of community members, in different social situations, in general and during the productive and cultural rituals, associated with the maize field. Finally, symbolic capital is the form adopted by different types of capital, which are perceived and recognized as legitimate, through recognition, prestige and honor (Bourdieu, 1997); this capital was studied, considering the productive and religious connections that Mazahua farmers make in relation to the maize field.

When discussing *habitus*, internal social structures are presented, such as roles within families, roles in the community, roles in specific situations such as stewardships or organization of patron saint religious celebration ; modes of action and thinking on the part of agents, which are not acquired naturally, but throughout their social trajectory, in relation to the position that the agents occupy in the field and which, as these are longitudinal, undergo change. To mention an example of this, it is common for the children of a member of the community, who has repeatedly been a steward at religious festivals, to begin their public life occupying the lowest echelons of festivity organization and to gradually ascend, until adopting the role of steward, following their father's example. Once the agent internalizes the *habitus*, this is externalized through practice, and social practices emerge, which unite them and identify them as belonging to a community, where they have a shared empathy in terms of lifestyles (Bourdieu, 1997).

As an integrative concept, Lindholm and Ekbiom (2019) approach the biocultural heritage as local ecological knowledge and practices; the biological richness of a defined location, including the characterization or features of the landscape, both at a biological and cultural level; the latter integrates aspects of collective memory, inheritance and practices or uses that persist in managed or created environments. We thus consider that the maize field forms part of the Mazahua biocultural heritage, as it integrates knowledge, also known as wisdom, through participation, but above all, it represents intergenerational transfer both within and outside families; likewise the traditional rituals associated with the milpa, constitute not only religious rituals, but also have economic impact; culture understood as the accumulation of actions in a specific community, enabling the community to persist over time; the practice of accumulating previously mentioned activities, in this case related to the milpa, considering both an economic and social perspective and likewise the biological diversity that coexists in the milpa, including maize, weeds, edible green sprouts (*quelites*), and also fauna in the form of birds, reptiles and insects.

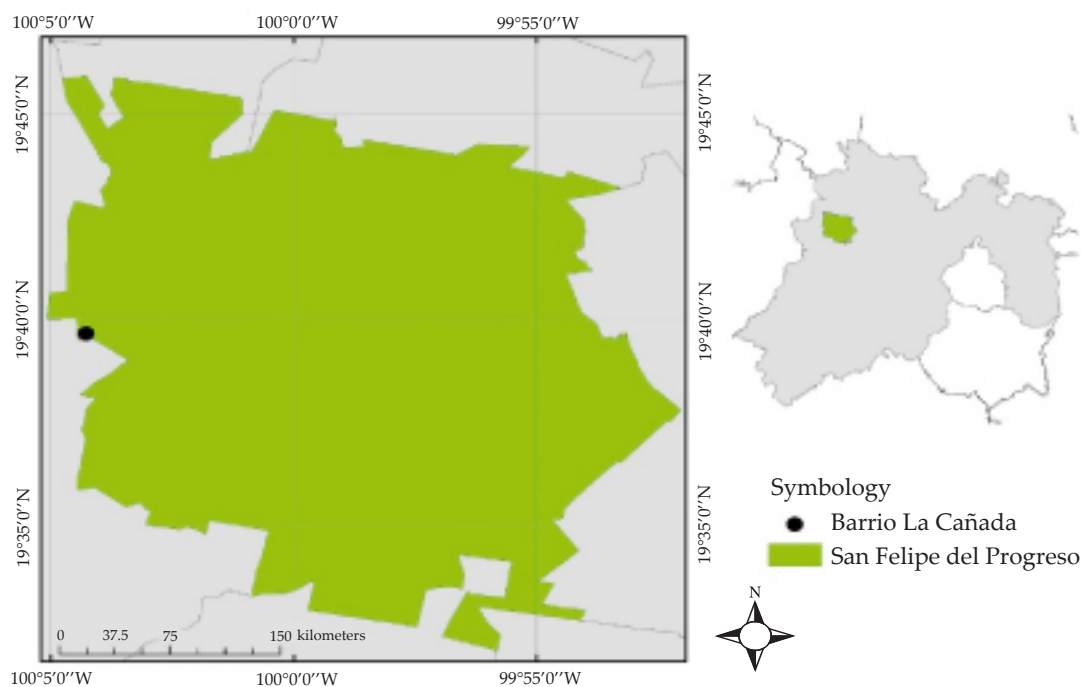
METHODOLOGY

The present research takes the approach of a hybrid research model to analyze sociocultural studies. Qualitative and quantitative methods were used to explain the relationships that develop in the Mazahua milpa system, applying a socioeconomic analysis, in order to assess their importance. The study was carried out in the Mazahua community of Barrio la Cañada, in San Antonio de la Ciénega, Municipality of San Felipe del Progreso, State of Mexico (Figure 1). This is located between the coordinates 100°03'40.731

W, 19°39'20.240 N, at 2,621 meters above sea level, there are 1,583 inhabitants and 485 homes. The main economic activities of the inhabitants include maize cultivation, construction work, raising livestock for consumption or sale and the production and sale of handicrafts. The principal authorities consist of the municipal delegate, the commissioner and stewards. Principal social conflicts involve land ownership and political preferences. Damage due to natural phenomena is mainly caused by drought, frost and hail (Instituto Nacional de Estadística y Geografía-INEGI, 2020).

Inclusion criteria for the study area and collaborators

San Antonio la Ciénega is a community that is representative of Mazahua culture, with about 40% of the population speaking an indigenous language and living according to cultural tradition. Based on dialogue, community authorities gave their authorization that in August 2019, the extended family should be defined according to the following characteristics: that they had milpas sustaining polyculture, herbicides were not used, native or creole species were planted (native corn, broad beans, beans or other species); these were managed by peasants, including the elderly with interaction of the family unit in the maize field. In October 2019, the Martínez family was contacted, with whom, by mutual agreement during the research project, they agreed to collaborate in activities related to the maize field and daily life. Subsequently, these collaborators were described.



Source: self-elaborated with data from INEGI, 2020.

Figure 1. Location of the community of San Antonio la Ciénega, San Felipe del Progreso municipality, State of Mexico.

The work was carried out with an extended family of 20 members, pertaining to four generations, in charge of managing four maize fields. The plots in the study consisted of a surface area of less than one hectare of ejido land, cultivated under rain-fed conditions, using native seeds (Table 1).

Analysis of social, cultural and symbolic relationships

To identify the social, cultural and symbolic elements that are generated in the system's milpa, and which add varied capital for those who work it, we undertook analysis and coding of the qualitative and quantitative data in Pierre Bourdieu's theory of social fields (1989, 1997, 2001). Between January 2020 and July 2021, three methods were used to collect and record information in the field: participant observation (Bautista, 2011; Angrosino, 2012), in-depth interviews (Álvarez-Gayou, 2003; Bautista, 2011) and a field diary, during the productive and religious activities related to the mazahua maize field. Capital was identified by participant observation during the productive and religious activities of the four study milpas, during the February-October 2020 productive cycle. Information was recorded in the field diary and complemented with four in-depth interviews and informal talks. For the interview design, categorization was implemented, in order to reach indicators that included these.

Analysis of diversity, economic and contribution to food security

To identify economic capital, an analysis of the diversity and an estimate of useful biomass of non-cultivated species was carried out, as well as an estimate of yields of cultivated species based on the recommendations of Morales and Arenas (2018); for this, five quadrants were established, each measuring 2.4×2.1 m², with a total of 25.2 m² of sample space for each maize field, in each of the four plots evaluated. The quadrants were established at the end of July 2021, after the second fertilization in the vegetative growth stage. One quadrant was placed at the center, two at the ends of the maize field along the access roads

Table 1. Characteristics of milpas studied over the Spring-Summer 2020 cycle, in Barrio la Cañada, State of Mexico.

Type of milpa	Surface area (m ²)	Species cultivated	Family members involved in management
A	1,193	Cone shaped, blue and white native maize, broad beans and squash.	3
B	871	Broad beans, squash and cone shaped, white native maize.	6
C	833	Squash and cone shaped, white, blue and red native maize.	5
D	3,494	Cone shaped, yellow and white native maize.	6

All plots under seasonal cultivation.

Source: self-elaborated with data from collaborators, 2020.

(tracks) and another two, between the center and the edges. The first weed harvest was made in September and the second in October.

Ethno taxon classification work was carried out in conjunction with the peasant family, who manages the maize field. The biomass of freshly cut weeds was weighed according to species; undertaken in this way, because in this locality, they use these as *quelites* or for fodder. The data obtained were recorded in a logbook and processed in Excel to estimate the extrapolated yields from 1 ha⁻¹.

To estimate the maize yield, in November 2021, ears from each quadrant were harvested and counted. Grain moisture was determined with a John Deere portable meter (SW5300®, Ill. USA) and stubble moisture was determined using the gravimetric method, with a drying oven (LU-MISTELL® HTP-42). According to performance, the Human Food Security Index (HFSI) and the Food Security Index of the Productive Family Unit (FSIPFU) were calculated, applying Huato and Toledo's formulae (2016).

$$HFSI = \frac{(Y)(PA)NMF}{109.5}$$

where *HFSI*: Human Food Security Index; *Y*: Yield per ha⁻¹; *PA*: Planted area (ha); *NMF*: Number of members in the family. *Factor that considers that *HFSI* exists when each family member has 109.5 kilograms of maize per year. If the value of *HFSI*<1: *ISAH* does not exist; but if *HFSI*≥1: then *HFSI* exists.

$$FSIPFU = \frac{(Y)(PA) / NMF}{500}$$

where *FSIPFU*: Food Security Index of the Family Productive Unit; *Y*: Yield in ha⁻¹; *PA*: Planted area (ha); *NMF*: Number of members in the producer's family. * Factor that considers that *FSIPFU* exists when each family member has 500 kilograms of maize per year (Huato and Toledo, 2016). If the value of *FSIPFU*<1: *FSIPFU* does not exist; but if *FSIPFU*≥1: *FSIPFU* exists.

$$PA = \frac{(HFSI)(109.5 \text{ kg})(NMF)}{Y}$$

where *PA*: Planted area (ha); *HFSI*: 1; *Y*: Yield from the plot in ha⁻¹ *NMF*=1; 109.5: kg of maize *per capita* consumption in rural areas.

At the end of the crop cycle, net income from the milpa system was estimated, considering production costs and an estimate was made of the income generated from the sale or use value of cultivated and uncultivated products (weeds) from the milpa. We calculated net income, by applying the following formula:

$$NI = TI - (FC + VC)$$

where *NI*: Net Income; *TI*: Total Income; *FC*: Fixed Costs; *VC*: Variable Costs.

RESULTS

Characterization of collaborating families

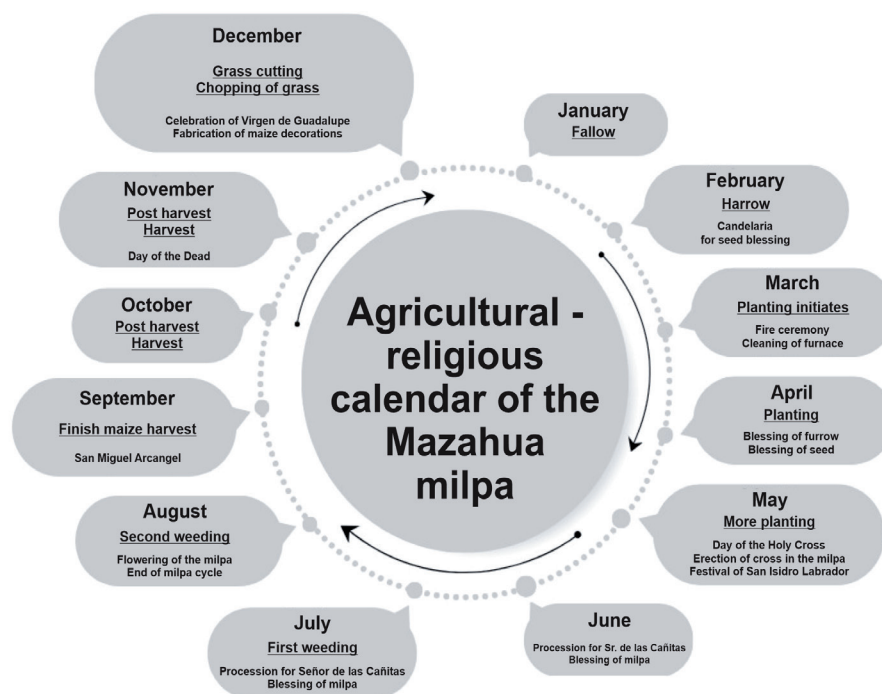
The upper generation of the extended family, consisting of two members between 80 and 90 years old, had no education. In this case, the man's main activity was management of the productive unit, and the woman was mainly dedicated to the home and supporting the productive unit. The four members of the middle generation were between 40 and 67 years old and had incomplete primary schooling; the men were dedicated to agriculture and the women to the home and support work in the productive unit. The seven members of the next generation were between 14 and 50 years old, with incomplete primary education. The men were mainly involved in construction work and the women were mainly dedicated to the home and support work in the productive unit; with care of the productive unit, representing a secondary occupation. The seven members of the fourth generation ranged in age between three and 30 years; some of the members of this generation have completed secondary school, adult men are employed in construction work and the productive unit; women as domestic employees and support of the productive unit.

Social factors

Associations were found between the maize field, the community and the family. The role played by each member of the family is important and encourages collective endeavors. Women fulfill the role of mothers, wives and daughters; they tend to the maize field and take care of the animals. Their work is particularly important in terms of transformation of species harvested from the maize field, from the nixtamalization of maize, the grinding and preparation of tortillas, as well as the collection and preparation of stews using edible weeds. They oversee choosing the type of seed to plant and are the intermediary for generating networks of reciprocity, by giving away maize, squash or maize kernels to neighbors and family. Men are the ones who define planting dates and other productive activities and serve as the main economic providers. The family's social relationships are expanded by being part of other groups: political parties, stewardships, art and culture (dancers) and as auxiliary authorities.

Cultural and symbolic factors

In the study community, a single native maize cultivation cycle is undertaken, between the month of March and November (Figure 2). The work of the Mazahua maize field involves various activities, which depend on the knowledge that is enriched and transformed in each crop cycle; this is inherited from generation to generation, orally and through practice. These activities are combined with symbolic factors that result from religious



Source: self-elaborated with data from collaborators, 2020.

Figure 2. Agricultural-religious calendar, presenting the cultural and symbolic capital of the Mazahua maize field, case study of the Martínez family, San Antonio la Ciénega, San Felipe del Progreso, State of Mexico.

syncretism. Seven rituals were identified that evidence the presence of symbolic factors in the Mazahua maize field. Through agricultural activities, peasant families identify as part of a group, leaving aside the anthropocentric concept, recognizing that work in the maize field will not suffice; rain, favorable climatic conditions and divine grace are also required (Figure 2).

Agricultural-religious calendar of the Mazahua milpa

Diversity analysis

Regarding agrodiversity, the maize fields studied are home to 34 morphospecies of weeds (Tables 2 and 3). Of these, nine edible species were identified by the mazahua or name: *ioca*, *xito*, *mortaza*, *xipi*, carretón, paletaria, sanguinaria, *ixi* and malva. Others are used for forage: jaltomatera negra, *xito* con perita, malva cimarrona and acahual, among others. Medicinal uses are given to two weeds: pericón and epazote de perro.

In their entirety, these weeds generate a cycle of economic, social and symbolic relationships, because of their different destinations: self-consumption, reciprocity, commercialization or productive unit. Those for food and medicinal use are intended for self-consumption and reciprocity. Weeds for rituals fulfill important functions related to religious activities, such

as the preparation of wreaths (distinctive floral decorations for stewardships). The purpose of those species, referred to as green manure, is to fertilize the plot. Weeds used for forage go to feed livestock, then meat from livestock is used for reciprocity, self-consumption and marketing, and the manure returns to the production unit, as fertilizer (Table 2). Economic analysis of the Mazahua maize field. From the worldview of the Mazahua peasant, weeds from the maize field contribute to the sustenance of the productive unit. The destination of species from the milpa is family consumption; these are not commercialized; however, accounts of income indicate family savings to the economy. When estimating biomass, the following data were obtained: per hectare $2,237 \pm 883.82 \text{ kg ha}^{-1}$ are produced for food use. In case of sale, these would represent a gross income of 22,370 pesos 00/M.N. Regarding weeds for forage $10,132.5 \pm 3,057.5 \text{ kg ha}^{-1}$ were obtained, which represents a gross income of 6,180.82 pesos M.N. As for those for medicinal use, $12.5 \pm 12.9 \text{ kg ha}^{-1}$, which represent 125 pesos M.N. And those used for ritual produce $60.25 \pm 88.92 \text{ kg ha}^{-1}$, which represents an economic input of \$602.5 M.N (Table 3).

Contribution to food security

Regarding the HFSI for maize, it was found that two out of four of the study families were able to fulfill human demand for food (Table 4). It was estimated that, using this cultivation system, the planted area required to achieve HFSI, averaged 295 m² per member. Regarding FSIPFU, none of the four families accomplished this, due to the limited extent of farmland.

DISCUSSION

The Mazahua farmer worldview, regards the milpa as a “sacred polycultural space that is alive and dynamic, where species that interrelate and function collectively, exist and coexist, to provide food, transmit knowledge, and foster economic, social and cultural relationships between family and community.” The mazahua milpa is principally cultivated to produce food for peasant families. The milpa system provides access to various foods

Table 2. Morphospecies found in the Mazahua maize field of the Martínez family, San Antonio la Ciénega, San Felipe del Progreso, State of Mexico.

Use	Number of Morphoespecies			
	Milpa A	Milpa B	Milpa C	Milpa D
Food	4	7	9	9
Forage	13	14	14	16
Ritual	0	1	0	0
Medicinal	0	0	1	1
Total	17	22	24	27

Source: self-elaborated.

Table 3: Average yield of fresh weeds, from maize fields in the study, in San Antonio la Ciénega, in the municipality of San Felipe del Progreso 2020.

	Morphoespecies	Use	Biomass (kg) extrapolated to 1 ha			
			Milpa A	Milpa B	Milpa C	Milpa D
1	Acahual flor morada (not summer heatwave)	Forage	2,375	1,427	13	856
2	Arvense blanca	Forage	-	-	-	83
3	Oats	Forage	-	-	44	-
4	Calabacilla cacahuacintle	Forage	-	-	-	909
5	Calabacilla enredadera (tres espinas)	Forage	1,661	2,232	295	112
6	Carretón, trébol, carretilla	Edible	-	19	1	2
7	Chilillo	Forage	-	-	-	63
8	Cosmos, mirasol	Forage	-	-	472	-
9	Diente de león	Forage	-	201	-	-
10	Enredadera, paletaria	Edible	66	150	422	596
11	Epazote de perro	Medicinal	-	-	30	-
12	Flor amarilla grande hojas con pelos	Forage	198	-	1,282	7
13	Flor amarilla para collar (espinas)	Ritual	-	28	-	213
14	Flor blanca chica mucho centro amarillo	Forage	3,005	1,482	5,492	1,483
15	Flor de juanita amarillo	Forage	25	50	168	205
16	Flor de Juanito azul	Forage	-	35	40	415
17	Flor de juanita Morado (uña de gato)	Forage	920	329	308	146
18	Flor de juanita rosa	Forage	-	-	7	168
19	Flor morada con garrita	Forage	463	32	-	-
20	Hojas tipo cilantro flor blanca grande	Forage	388	329	2,254	189
21	Ioca papita huilona	Edible	-	7	158	417
22	Ixi flor amarilla	Edible	-	-	-	4
23	Jaltomatera negra	Forage	360	19	186	621
24	Malva	Edible	60	130	0.4	238
25	Malva Cimarrona	Forage	68	20	48	21
26	Mortaza	Edible	-	-	56	296
27	Palmita con coquito	Forage	-	-	-	21
28	Pasto	Forage	71	115	541	317
29	Pericón	Medicinal	-	-	-	20
30	Sanguinaria	Edible	-	-	389	-
31	Xipi, coyul, Gallito	Edible	79	13	30	56
32	Xita flor roja (amaranto silvestre)	Forage	588	12	-	-
33	Xita con Perita	Forage	465	1,483	3,983	2,253
34	Xito sin mancha	Edible	2,239	967	371	1,358
	Total		13,032	9,080	16,589	11,068

(-) morph species not found in the sample space.

Source: self-elaborated.

Table 4. Productive conditions and Food Security Indices in Mazahua milpas of San Antonio la Ciénega, San Felipe del Progreso municipality, Spring - summer 2020 cycle.

Productive Unit	Performance (t ha ⁻¹)	Surface area planted (ha)	Number of participants	HFSI*	FSIPFU**	PA***
Milpa A	5.08	0.1193	3	1.84	0.40	215.55
Milpa B	3.77	0.0871	6	0.50	0.11	290.45
Milpa C	3.59	0.0833	5	0.55	0.12	305.01
Milpa D	2.95	0.3494	6	1.57	0.34	371.19

*HFSI: Human Food Security Index. **FSIPFU: Food Security Index of the Family Productive Unit. ***PA: Surface area required per person to achieve food security with the farming system, as documented.

Source: self-elaborated.

during the growing cycle, such as: squash, broad beans, maize ears and quelites (González *et al.*, 2016). In this study, 34 morphospecies were found, of which nine are edible, in contrast to the 74 species of weeds identified by Vieyra-Odilon and Vibrans (2001) in Ixtlahuaca, another area in the Mazahua region.

In the plots studied, there was an average maize grain yield of 3.85 ± 774 t ha⁻¹. In contrast, data from the Agri-Food and Fisheries Information Service (SIAP, 2021) for the State of Mexico, in the spring-summer 2021 cycle, report a yield of 3.5 t ha⁻¹, produced under rain-fed conditions. Regarding the four family units in the study, only two of them manage to cover 100% of family requirements, while the other two units only cover 80%. This can be explained by different indices. The HFSI indicates that each member of family unit A and D has 109.5 kg of maize for their food, whereas family unit B and C do not have that amount of maize. This FSIPFU indicates that none of the four families has 500 kg for each member to satisfy human consumption, and food for livestock and poultry. Similar results were found by Huato and Toledo (2016), who studied farmers from Cohetzala and San Nicolás de los Ranchos, where each member of the family group in the first community has access to an average of 339 kg of maize, while those in the second community have access to 726 kg.

These researchers attribute the low yields to conventional management. In contrast, in this study, we attribute this to the small extensions of crop land, as the estimated area planted in the system studied showed that 295 m² per person are required to achieve human food security. Apparently, the crop area required per person varies, depending on the agrosystem. González and collaborators (2018), in their study of the Mazahua maize field in San Pedro el Alto, State of Mexico report that those with less than 0.5 hectares find themselves needing to buy maize for personal consumption.

The indices provide data to assess the amount of maize production and surface area required to cover demand; however, the Mazahua family diet is supplemented by other species from the milpa: squash, broad beans and quelites, among others (González *et al.*, 2016); as well as other products derived from their productive units, aspects that require

assessment, in order to define whether these help fulfill dietary needs, thus permitting them to live well.

The different types of capital mentioned by Bourdieu (1997) are present in the maize field. Cultural capital, in its internalized state, is manifested in local knowledge in the productive practices of the milpa, incorporated through the collective and participatory work of various participants. The symbolic capital and cultural capital of the Mazahua milpa, presented in Figure 2, are interrelated through agricultural and ritual activities in the milpa cycle. The first are manifested in the family effort to work the land. The latter represent a symbolic exchange between the earthly and the divine. The mazahuas offer incense, candles, flowers, firecrackers and tithe payments. Offerings are made to obtain rain, a good harvest and to protect the maize field, in case of any climatic catastrophe (early frosts, hail). Social capital is created by belonging to groups, giving rise to family and community solidarity, based on participation in the maize field. Economic capital consists of the family productive unit, dependent on the maize field, backyard animals and the tools with which they work the land. This is how the maize field fosters a dynamic of exchange in terms of capital and social relations, which can be analyzed through social fields.

The analysis of the maize field, following Bourdieu's social fields approach, allows us to understand this as a social concept that unites not only at the present time, but also by historic and collective memory. This is related to Lindholm and Ekbiom's (2019) perspective on bioculturality in a broad sense and biocultural memory (Toledo and Barrera-Bassols, 2008), as this enables us to understand the maize field as a space in which Biological diversity has been managed and preserved through practice, and then transmitted down the generations and throughout territories, with multiple cultural manifestations.

CONCLUSIONS

The maize field of San Antonio la Ciénega, State of Mexico, is worked by families, consisting of up to four generations. The importance of the milpa system is based on ecological, cultural and social contributions. The contributions of the maize field to identity and diet, as well as socio-environmental and cultural relations have an important value for the families involved, who have not been able to satisfy themselves through any other productive system.

Among the limitations to this study, we understand that Pierre Bourdieu's theoretical framework of social fields is an analytical model related to French thought from 40 years ago, which may therefore have limitations for the analysis of the Mazahua maize field, as this represents a complex system with various aspects requiring study. Regarding the method used in this study, we present a hybrid research model approach to sociocultural studies, in which qualitative and quantitative methods were used to integrate knowledge from different disciplines. The research was carried out during a pandemic, which limited comprehensive participation in all rituals that took place in the Mazahua maize field.

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