AGRO PRODUCTIVIDAD

Colegio de Postgraduados

Peasant strategies for the use and conservation of native corn in Juchitepec, Estado de México

González-De la Mora Rodrigo[1]; Navarro-Garza Hermilio[1*]; Ortega-Paczka Rafael[2]; Flores-Sánchez D.[1]; González-Santiago V.[2]

[1] Colegio de Postgraduados en Ciencias Agrícolas, Montecillo, Texcoco, Estado de México, México. C.P. 56230.
[2] Universidad Autónoma Chapingo, Texcoco, Estado de México, México, C.P. 56227.
*Correspondence: hermnava@colpos.mx

ABSTRACT

Objective: To determine the evolution that native corn has had in the municipality of Juchitepec, as well as to describe and analyze the strategies that peasants families are currently implementing for its use and conservation.

Design/methodology/approach: A survey was carried out with 20 peasants in the municipality of Juchitepec, chosen from a random sample obtained from the register of the Producción para el Bienestar program. Additionally, a series of semi-structured interviews were conducted with key informants, in order to identify the most important issues around corn in the region.

Results: An elderly population was found ($\bar{x}$=61), but with some young people working decisively in its production units. Seventy-five percent own less than 6 ha, mostly communal land property. Eighty-nine percent of the farmers interviewed continue to grow native corn. They achieve this by adapting their practices and knowledge to the soil and climate conditions of their plots, modifying, for example, the sowing date, the variety or species cultivated, and the place of cultivation. Seventeen percent grow hybrid corn. Two native varieties have recently been introduced as a strategy to obtain greater profitability: ancho and cacahuacintle. Some practices are being modified based on the equipment and the economic resources available, such as the "de dos" labor that only 50% of the farmers carry out. Eighty percent do not have agricultural equipment. The use of chemical fertilizers and herbicides is widespread. The sale of corn husks is an economically important activity. Peasants frequently exchange seeds, usually with other members of their own community. The Ozumba market represents a vitally important marketing channel for native corn. The guaranteed prices established in 2019 were low for this type of corn. Peasants are not formally organized for corn cultivation. Sixty-five percent consider themselves peasants.

Study limitations/implications: The study of local agrarian systems with a focus on peasant strategies should contemplate acting under different circumstances, preferably in several work cycles, to better understand their adaptability.

Findings/conclusions: Native corn survives in the region, preserved in a socio-productive system based on peasant knowledges, strategies and socio-technical practices that enable its reproduction and recreation. Peasant strategies for the cultivation and use of these corns strengthen their conservation.

Keywords: *in situ* conservation, plant genetic resources, traditional knowledge.

Citation: González-De la Mora, R., Navarro-Garza, H., Ortega-Paczka, R., Flores-Sánchez D., &González-Santiago, V. (2022). Peasant strategies for the use and conservation of native corn in Juchitepec, Estado de México. *Agro Productividad*. https://doi.org/10.32854/agrop.v15i3.2180

Editor in Chief: Dr. Jorge Cadena Iñiguez

Received: October 8, 2021.
Accepted: February 17, 2022.
Published on-line: April 4, 2022.

Agro Productividad, 15(3). March. 2022. pp: 129-143.

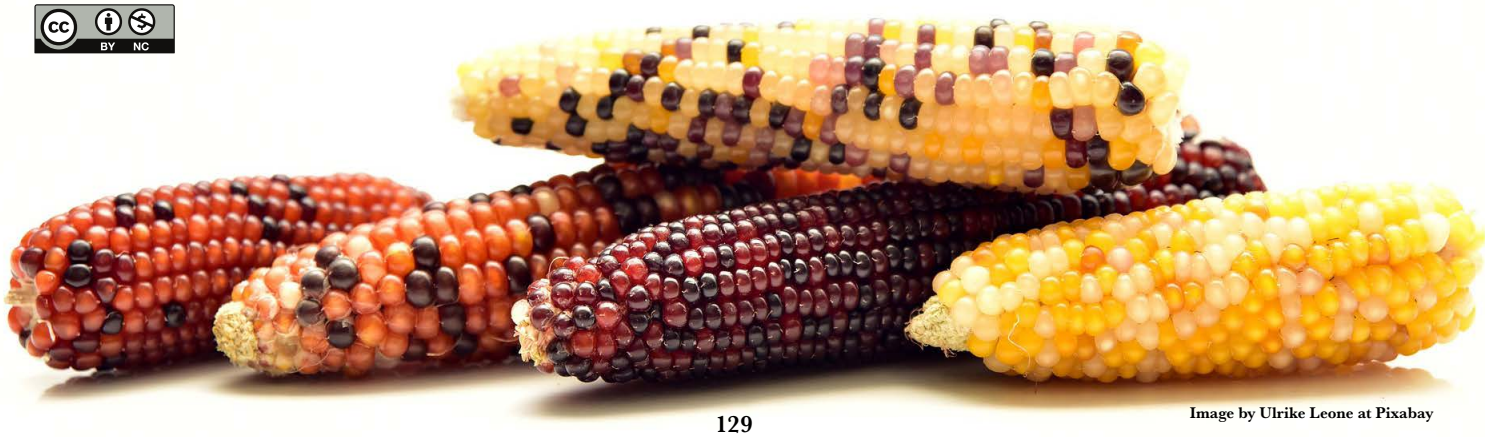

Image by Ulrike Leone at Pixabay

INTRODUCTION

Corn (*Zea mays* L.), a prodigious plant of the Mesoamerican peoples, continues to provide sustenance for a large number of farmer families and to be the main food of a large part of the Mexican population to this day. In 2007, more than two million production units were dedicated to corn cultivation in Mexico (INEGI, 2007) and, in 2020, more than seven million hectares were sowed with corn (Secretaría de Agricultura y Desarrollo Rural, 2021).

Despite facing modernizing processes, peasant families still exist and resist and, with the means at their disposal, they maintain and recreate their way of life. Likewise, they continue to be repositories of inherited knowledge, wisdom, practices, and technologies. The persistence today of this way of life and the seeds that sustain it show that they have constantly played a key role in the national culture and economy throughout time.

Mexico —the center of domestication of this globally important plant— has the greatest genetic diversity of this species in the world (CONABIO, 2012), which is important for the survival of the communities that maintain it and for humanity as a whole. However, this heritage is threatened by the imposition of a modern agricultural system and the introduction of improved varieties. The objective of this research was to determine the evolution that native corn has had in the municipality of Juchitepec, to describe and analyze the strategies that farmer families currently implement for its use and conservation, to identify key elements to increase the territorial agroecological articulation, and to design public policies that promote and strengthen this activity.

METHODOLOGY

The study was carried out in Juchitepec, located in the southeast of the Estado de México, Mexico. It is part of the Amecameca socioeconomic region and borders Mexico City and the state of Morelos. The municipal seat is located at 2531 masl. The region has a temperate subhumid climate. Located in the Eje Neovolcánico, less than 30 km from the Popocatépetl volcano, its soils —predominantly regosols, andosols, and leptosols— have a high influence of volcanic activity.

A survey was carried out with n=20 farmers from the municipality of Juchitepec: 16 were interviewed in the municipal seat and 4 in the town of Cuijingo. These peasants were drawn in a random sample obtained from the register of the Producción para el Bienestar program of the Secretaría de Agricultura y Desarrollo Rural. They were granted the economic support that this program provides to small and medium grain producers.

RESULTS AND DISCUSSION

Socioeconomic data

The average age of the people interviewed was 61 years. However, the presence of relatively young farmers who are currently in charge of family exploitation is noteworthy; several of them bring a business approach to agriculture, which results in favorable prospects for the continuation of this activity (Figure 1). Table 1 shows average data for some aspects of the family unit.

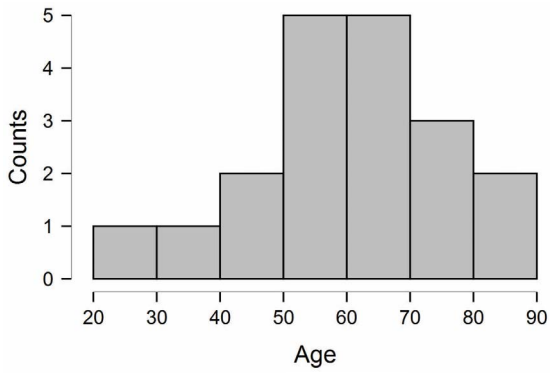

Figure 1. Distribution by age range of the farmers interviewed in the municipality of Juchitepec, Estado de México.

Table 1. General information of the farmers interviewed (average values).

Surveyed farmers	20
Age	61
Years of study	6
Farming experience (years)	39
Household members	4
Cultivated area (hectares)	6

Although the average cultivated area was 6.0 ha, 2.5 ha, the extension of a communal land plot was the most frequent value. Seventy-five percent of the surveyed peasants own less than 6.0 ha. Private property is rare: only 15% reported having this type of property.

Figure 2 shows the area occupied by different crops in 2019: grain corn (51%), oats (29%), and wheat (12%), and others.

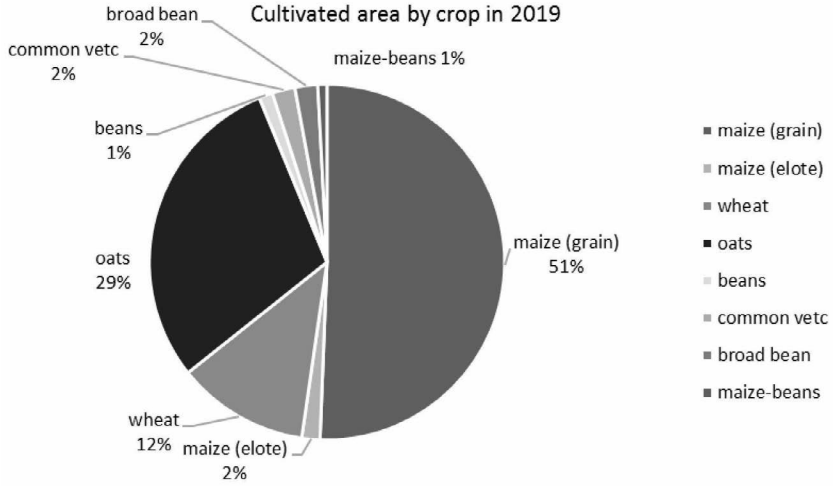

Figure 2. Area destined per crop in 2019.

Regarding livestock, a third of the respondents has animals. The most frequent livestock in the region is sheep and the interviewees mentioned that there are still large herds in the area. Some farmers commented that cattle production was an important activity in the region until the Compañía Nacional de Subsistencias Populares (CONASUPO) started importing milk, an event that modified the local agricultural system configuration.

Physical environment

Peasants identify five types of soil, the most abundant being black (31%), yellow (25%), and sandy (31%) (Figure 3). Black soils maintain more humidity and are said to be the most productive. They mainly look at the moon to predict the weather, indicating that, when the first quarter has a certain inclination, it is going to rain; they also observe other natural elements such as clouds, wind, flora, and fauna.

Three types of environments have been locally identified: cold, temperate, and warm. The warm environment has the smallest proportion, and this area is located in the lower parts of the municipality (Figure 4). The effect of frost is reported from September to January, although some farmers mention that the weather has changed a lot, which makes it difficult to predict this phenomenon; they even consider that the frequency with which it affects crops has decreased. Figure 5 shows the average daily temperatures for the 1976-2015 period, based on which a noticeable increasing trend is identified.

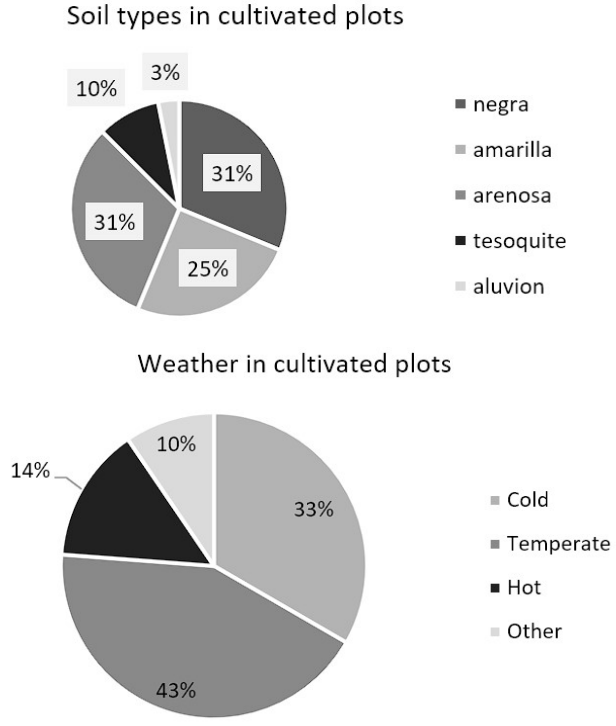

Figure 3. A: Soil types present in the plots according to the local nomenclature. B: Climate type present in the plots according to their perception.

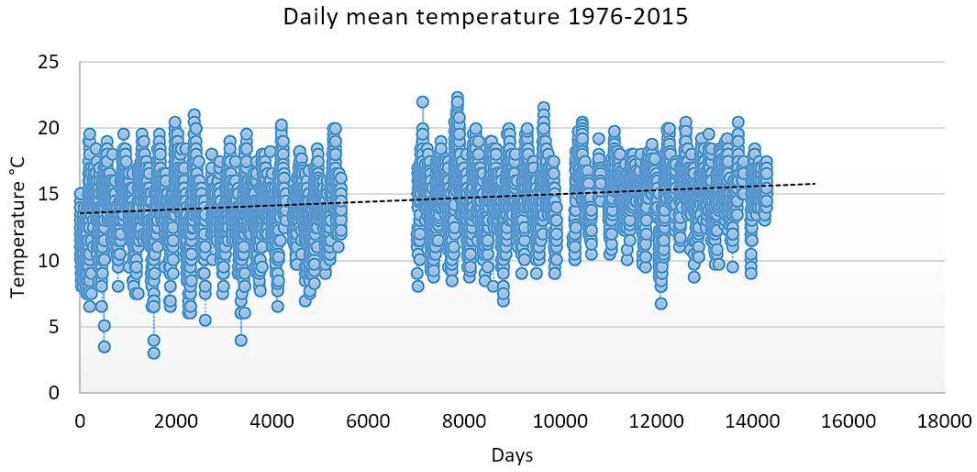

Figure 4. Temperature trend based on average daily temperatures 1976-2015 (CONAGUA, 2020).

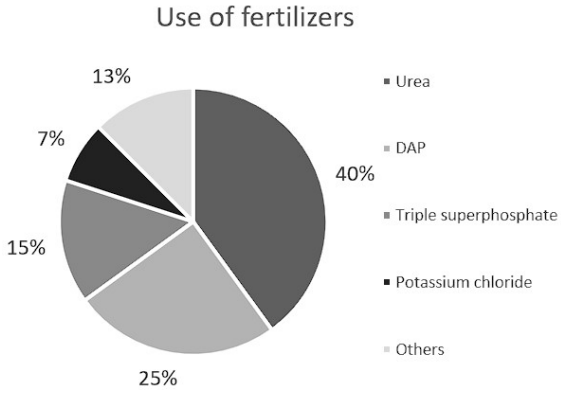

Figure 5. Type of fertilizer used by farmers.

Corn crop

Of the peasants surveyed, 89% continues to cultivate native or *criollo* corn (as it is locally known), 72% exclusively cultivates native corn, 11% only hybrids and 17% both types. Table 2 shows information about the native corn types found in the municipality.

Some farmers mention that they have stopped growing certain types of corn for various reasons. The most mentioned type was white (*tamalero*) and the main reasons are stalk lodging problems, the vast amount of work required, theft, pests, and the low price. Other types that have been abandoned by some farmers are the red (*xitocle*), blue, *cremoso*, and yellow *criollo*; however, none of these types has completely disappeared from the region.

As for the new cultivated varieties, it should be noted that *ancho* and *cacahuacintle* are native varieties that have been introduced to the region to obtain a better selling price. Hybrid materials were the most mentioned type of recently cultivated corn; however, compared to other regions of the country, their introduction is quite recent (less than ten years).

Table 2. Native populations corn types found according to local name.

Type of maize	Number of surveyed farmers that keep the seed	Crop cycle length	Mentioned maize purpose
Blanco (tamalero)	9	long	tamales, tortillas
Azul	5	middle	tortillas, atoles, appetizers, forage
Cremoso	3	long	Tortillas
Rojo (xitocle)	2	short	pinole, atole
Cacahuacintle	2	short	pozole, elote
Ancho	2	middle	pozole
Amarillo criollo	2	short	tortillas, forage

MANAGEMENT

Cultural labors

The farmland is prepared after the previous cycle ends, subjecting the land to what is called "primer rompedura": harrowing the land just after making corn shocks (amogotar) to seal the land and retain residual moisture. When the sowing time approaches, peasants may proceed to plow the land (70% mentioned that they do); otherwise, they harrow the land again, a process called "asegundada". Subsequently, the soil is furrowed on the day that the farmers decide to sow. Once the crop is established and it has developed, a task called "de uno" is carried out; it consists of using a cultivator or a plow to "borrar surco". Later another labor called "de dos" is carried out, which consists of forming a small pile around the plant with more soil, so that the plants can strengthen its grip on the ground and obtain better nutrition. The final cultural task is the "cajón" or "despacho", which provides the plant with enough support to finish its productive cycle.

Farmers mention that the "de dos" labor has been disappearing: only 50% mentioned doing it. Currently, the most frequently performed tasks are "de uno" and the "cajón". One of the reasons for this phenomenon is the cost and investment of work; another major reason is the introduction of agricultural equipment that makes it difficult carrying out the three cultivation tasks, once the plant reaches a certain size.

Sowing

The peasants of Juchitepec take into account various factors to determine the sowing date (mainly the moisture accumulated in the soil) and to avoid early frosts. They also mentioned the use of the moon as an indicator that determines whether it is time to sow or not. Table 3 shows the period that each interviewed farmer considers appropriate to carry out the sowing according to his purpose.

Eighty percent of the interviewees sow with residual moisture; the remaining 20% wait for the rainy season. A reference date in the region is April 25, day of the festival in honor of Juchitepec's patron Saint, Señor de las Agonías; most of the sowings are carried out around this date. Some people comment that the sowing dates have been delayed and that this activity used to be carried out earlier in the year.

Table 3. Sowing dates for different purposes according to each farmer interviewed.

jan				feb				mar				apr				may				jun			
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							
12																							
13																							
14																							
15																							
16																							
17																							
18																							
19																							

Early sowing (elote)
Early sowing (grain)
On time sowing
Late sowing
Hybrid sowing

Fertilization

All the interviewed farmers use chemical fertilizers. Figures 5 and 6 show information on the most used sources and the moment of application. In average, the following formula is 148:78:39. Fifty percent use manure to complement the fertilizer.

The use of herbicides is also widespread; the most used are shown in Figure 7. Some peasants mention that their use has intensified, especially in minimum tillage systems, where the suggested technological package includes a great use of this type of agrochemicals.

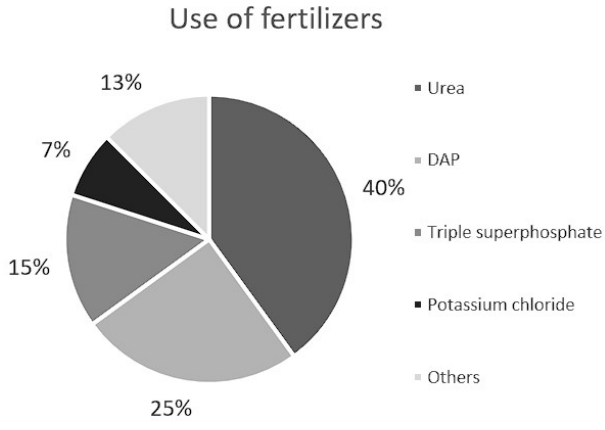

Figure 5. Type of fertilizer used by farmers.

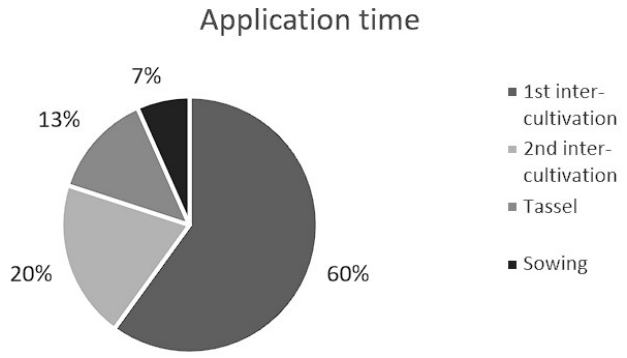

Figure 6. Timing of fertilizer application.

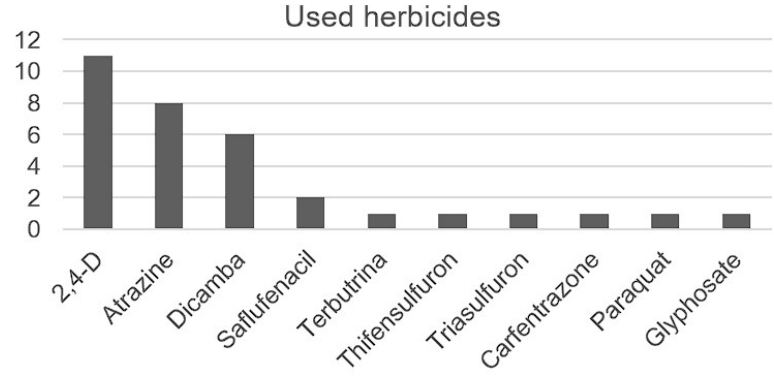

Figure 7. Herbicides used and their frequency.

Meanwhile, 75% reported using insecticides. The most common active ingredients are chlorpyrifos and aluminum phosphide. The former is used to control fall armyworm, but, as a result of its environmental toxicity, it has been classified as an organophosphate, which is highly toxic to bees. The latter is used to control warehouse pests, but it is considered acutely toxic by the European Union, because the gas it produces is fatal if inhaled.

Regarding herbicides, 2,4-D is considered to have long-term effects, according to the Global Harmonized System (GHS), a system that has been promoted since 2002.

Equipment

Eighty percent of the interviewees do not have agricultural equipment and consequently must rent it. The remaining 20% has elements such as tractor, cultivator, harrow, plow, mechanical grain drill, and, in one case, pneumatic grain drills. Four interviewees said that they carried out cultivation work with a yoke, either their own or rented; in this activity, they used such equipment as the "avión", the "arado extranjero", the "zeta", and the "cultivadora".

Harvest

Although it is an expensive task, 70% of the interviewed peasants carry out the practice of making corn shocks, because it provides benefits such as better preservation of grain and forage, as well as of the soil moisture. Only 10% carry out the mechanized harvest

(in hybrid materials) and 20% harvest while the plant is standing. The harvest method often depends on whether or not the corn husk will be used for tamales. Farmers employ different strategies: sometimes they associate with crews who perform the harvest work in exchange for the corn husk. In this way, the farmer keeps the clean ear of corn and the crew gets to sell the husks. When the family itself is responsible for harvesting the corn husk, the covered ear is harvested and stored for later use. Figure 9 shows information about who is responsible for selecting the corn husk.

In Cuijingo, the use of corn husks for tamales is an economic activity that employs most of the inhabitants of the town. The production system has grown so much that there are small business owners who direct groups of workers that even travel to other states to obtain the corn husk. For local farmers, the sale of corn husks can be an income that equals or even exceeds the income obtained from the sale of grain.

Storage

Figure 10 shows the different ways that peasants store the harvest: 70% store the ears of corn and 15% the grain. Sixty percent used chemical control to avoid warehouse pests; they used the following substances: aluminum phosphide (42%), chlorpyrifos (16%), and

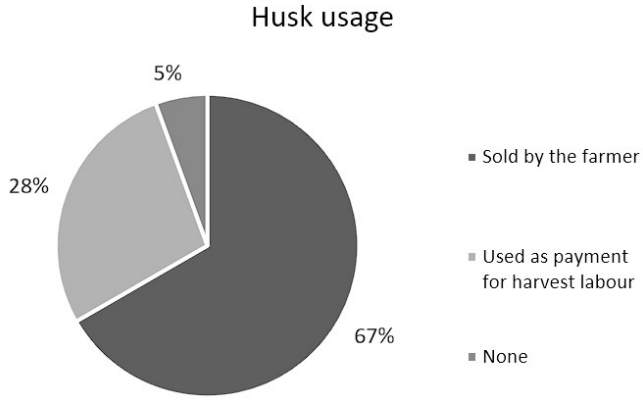

Figure 8. Use that farmers give to the corn husk.

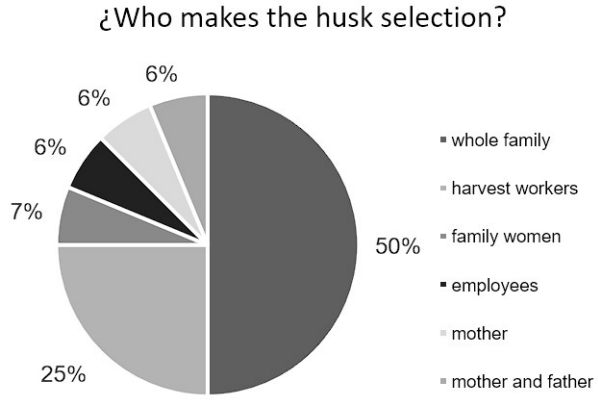

Figure 9. People involved in corn husk selection.

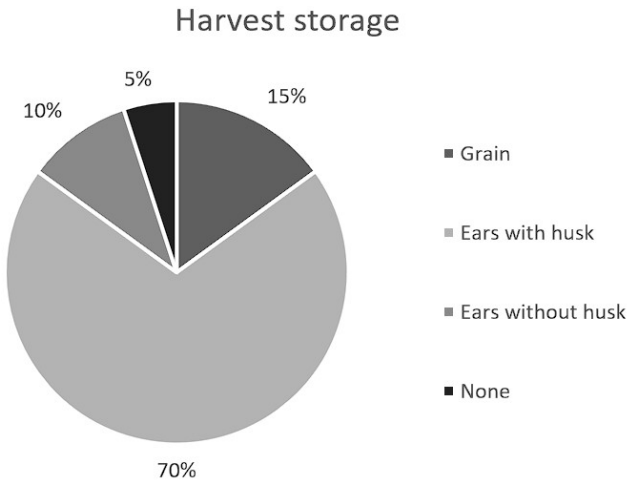

Figure 10. Production storage methods.

malathion (5%). They also mentioned methods such as proper drying of the grain, use of lime, and cooling the place to avoid the incidence of these pests.

Seed selection

All peasants who grow native corn carry out seed selection. Only one person mentioned selecting the seed on the plot; the others make the selection at home, once the harvest has been gathered and the corn is being shelled. Usually, the family father is in charge of this task and is occasionally helped by his children and wife. Figure 11 shows some desirable characteristics in the ears chosen for seed. The main characteristics are: large ears (42%), healthy ears (19%), and other characteristics (23%).

In addition to selecting the seed for the next cycle, farmers also change the seed from time to time. Figure 12 shows the reasons behind this practice, the main ones being: to renew their corn (54%) and to try other varieties (33%).

Meanwhile, Figure 13 includes information about the place where they acquire the new seeds; farmers prefer to acquire them from their neighbors (friends, children's godparents,

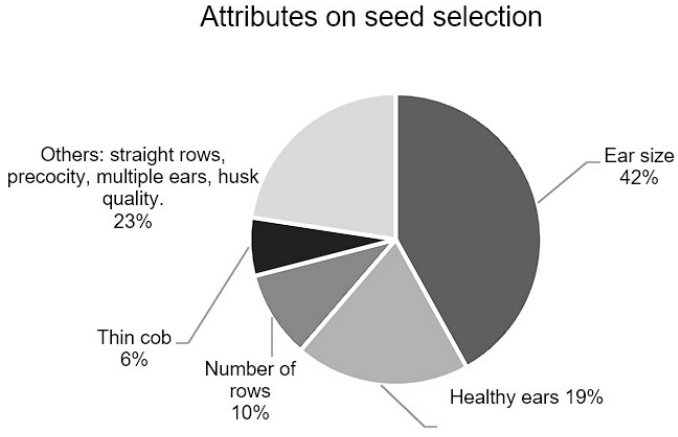

Figure 11. Characteristics that farmers take into account to select the seed.

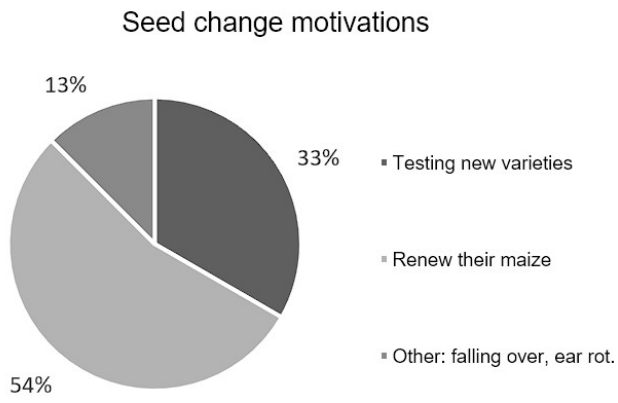

Figure 12. Reasons considered by farmers to change their seed.

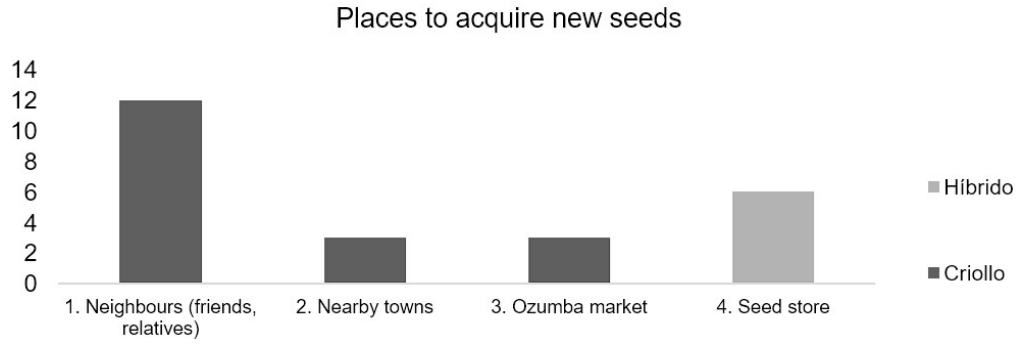

Figure 13. Place where farmers obtain their seeds.

or relatives) and less frequently in other towns or in the regional market of Ozumba. Hybrids are acquired in seed stores, and it should be noted that there is no record of their acquisition by programs or even Instituto de Ciencias Agropecuarias del Estado de México (ICAMEX).

Self-consumption and sale

Seventy percent of the interviewees consume less than 30% of the grain they produce; the rest of the grain is sold. In all cases, the corn produced manages to satisfy family demand. Only four people mention having at some occasion ran out of grain to feed themselves, as a consequence of disasters that impacted the crop; however, this phenomenon is rare.

The two main options for the sale of native corn are the Ozumba market (44%) and direct sale at home (37%); some take their production further with buyers from Mexico City. in 2019, the price for white and blue corn ranged from 6 to 8 pesos; the price for special corn (such as *ancho* and *cacahuacintle*) reached 14 pesos per kilogram. From 2019, Segalmex warehouses were an important sales destination for hybrid corn. Through the price guaranteed program, the price of corn was raised from around $4.50 to $5.60 pesos per kg.

Family income

On the one hand, Figure 14 shows the family income proportion that comes from agriculture: for 45% of the families, their agricultural income varies between 10 and 50%; for 35%, it represents more than 90%. On the other hand, according to Figure 15, 90% of the families have one or more members who are engaged in an economic activity other than agriculture. In 40% of the cases, this member is also responsible for carrying out activities on the farm. Some activities that they commonly carry out are: laborers in the field or in construction, traders, migrants, workers, and professionals.

Workforce

Fifty percent of the farmers mentioned hiring labor (usually two people) only in the most active productive stages; 40% do not employ labor outside the family; and only 10% have permanent staff throughout the year (either one or two people).

Government support for production

The sample of farmers in this study was obtained from the register of producers of the Producción para el Bienestar federal program; therefore, all of them are beneficiaries

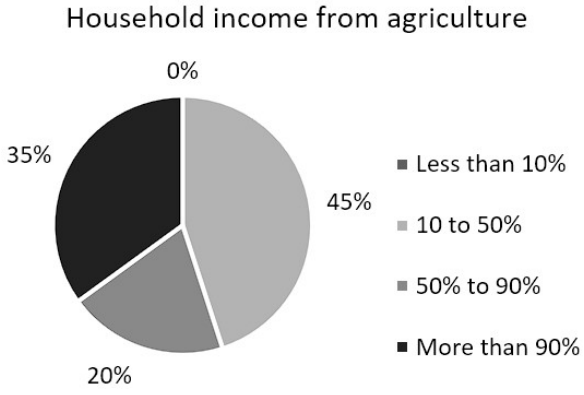

Figure 14. Family income percentage that comes from agriculture.

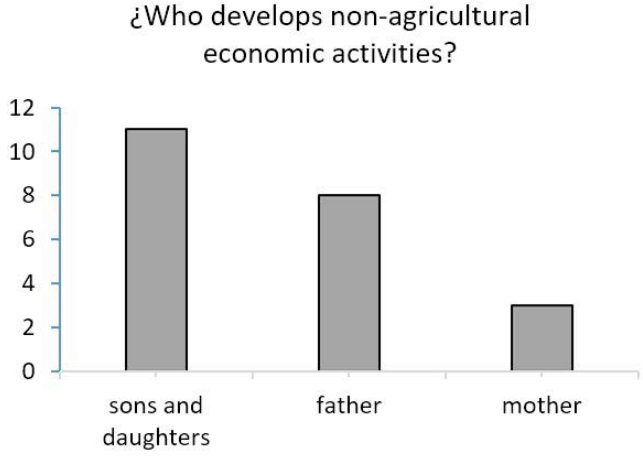

Figure 15. Family members who carry out non-agricultural economic activities

of this program. Additionally, 45% mentioned having received support from the state government on some occasion, but none of them mentioned the municipal government.

Organization for production and identity

The interviewed farmers do not belong to any organization for the production of corn. Only two mentioned belonging to agricultural organizations, but those groups are focused on wheat and chamomile crops and mainly support them with the marketing aspects. When the farmers were asked how they perceived themselves (modern farmer, traditional farmer, producer, other), they responded as follows:

Table 4. Farmers self-perception.

Peasant (65%)	**Producer** (35%)
• Because I work the land. • Because I work the land. • We have no other work, just farming • I work the land and cultivate it, and I have faith in the harvests, little or much they give. • Because of the size of the production unit • Smaller scale • To be a farmer you need more land and tractors. • We have always liked the countryside, sow the land. Ours is the peasant village. I like the countryside, working, having animals. I am proud to be a peasant. • We live in the countryside all the time. • I have always liked the countryside; I have never left it. • I sow little. • I know the countryside well	• Because everything I take, I make it produce. • (My husband) He has always considered himself as a producer, not as a peasant, because he grows a little more, he tries to make the land produce as much as possible. • Because I like to produce. • Small farmer: Here a farmer is a full-time farmer. Producer is more than 10 hectares and small producer is less than 10 hectares. • For the amount of hectares, he manages. The peasant is smaller

Table 5. Importance of maize for surveyed farmers.

¿What does maize means for you?	
• Very necessary. • Many things, a very sacred thing because from there we have food both to consume and to sell. • It is my life, I grew up with maize, I live on maize, and I will die with it. • The family patrimony • It's my "wire cutter". That's where I live. • It is a seed that serves as food. • Source of life. • Maize is better than everything, it is the foundation of our livelihood.	• A natural food. • A blessing from God. If you don't work the land, who would? • Basic sustenance • A nutritious food. To sustain us. • Priority food. • In short, it is the sustenance and food for my family. • In the past it was a mainstay, but now they pay it very cheap. • Life, without maize we are nothing.

The diversity of native corn found in the region was consistent with the reports of previous studies; however, certain changes can be perceived, mainly in the introduction of improved varieties. At least five hybrids are used in the region. Although some farmers report having first heard about hybrids approximately 20 years ago, the greatest advance of these grains in the region occurred in the last 10 years.

Several factors may account for this phenomenon, starting with the fact that modernization did not take place at the same time in different agricultural environments in Mexico. It begun in the lands considered to have the greatest productive potential —mainly those with irrigation and those located in warmer areas (Sweeney *et al.*, 2013)—, where the substitution of corn varieties has a greater dynamism (Perales R. *et al.*, 2003). However, the consolidation of transnational seed companies in the country and their need to expand their market opened new horizons for modernization. In 2010 the MasAgro program was established, coordinated by the CIMMYT and financed by Mexico's government; it sought to "modernize traditional Mexican agriculture" mainly through the adoption of "innovations" such as Conservation Agriculture and improved varieties (Camacho-Villa *et al.*, 2016). Along with the development of more adapted materials, this led to the expansion, through government support, of improved varieties in the region. Currently, modern varieties show a greater advance; however, a strong persistence of traditional varieties is also observed. These varieties have also been strengthened with the introduction of native materials from other regions, which provide an alternative for the increase of profitability, without depending on improved seeds: such is the case of *cacahuacintle* and ancho corn.

It is important to record the changes in the local technical itineraries. In the case of the Juchitepec region, an important phenomenon for native corn was reported: the decrease in the frequency of one of the cultivation tasks, from three ("de uno", "de dos", and "cajón") to only two ("de uno" and "cajón"). This phenomenon may be important, as a consequence of the tendency of native corn to lodge more easily during seasons with a lot of air and humidity. This phenomenon makes it difficult to grow and preserve corn.

There are important factors for the preservation of native corn in the area:

- Compared to other areas, little work has been made to obtain improved varieties for the Valles Altos area, although it is currently being carried out and varieties for these environments are already available, and their adoption has received strong government support.
- The quality and their high adaptation of the native materials leads to good harvests.
- The sale of corn husks for tamales represents an important income, sometimes even higher than the income obtained from the sale of grain.
- The existence of accessible markets for the commercialization of native corn, as is the case of the Ozumba market. It is worth mentioning that the recent policy of state purchases under a guaranteed price did not directly benefit the cultivation of native corn, mainly because the established price did not reach what farmers can obtain in local markets. Those who grew improved materials were benefited and others may have felt encouraged to adopt these varieties.

Analyzing in depth the dynamics of seed exchange and their impact on the genetic structure of native populations is necessary. Several farmers reported making periodic exchanges with the purpose of renewing their materials, although simultaneously they assured that they kept certain seeds for years and even generations.

This seems to indicate that native varieties are created and recreated in a community dynamic, adapting over time to the different environments of a given region and developing a regional identity for these varieties. Even in the event that no exchange takes place, the average farmer knows that he needs to rotate the seed between his own plots, to avoid "seed boredom".

The enrichment in the use of the native populations or varieties concept is proposed, through the incorporation of concepts that underline this dynamic, for example: "community territorial varieties".

CONCLUSIONS

Peasant strategies allow the permanence of native corn populations. These strategies make up in themselves a corpus of wisdom and lore historically developed by a certain social group in a certain eco-geographical area. These strategies constitute a very rich and highly important biocultural heritage readily available for their repositories. However, at the same time, they are constantly threatened by new forms of production and technological changes. Its study, understanding, new appreciation, and integration in the design of public policies and programs can guarantee their success, improving their operation and increasing the effectiveness of the benefits they provide to local populations.

ACKNOWLEDGEMENT

The authors would like to thank the farmers of the municipality of Juchitepec who kindly participated in this research. They would also like to thank the Consejo Nacional de Ciencia y Tecnología for the scholarship granted for the MSc studies under which this research was carried out.

REFERENCES

Camacho-Villa, T. C., Almekinders, C., Hellin, J., Martinez-Cruz, T. E., Rendon-Medel, R., Guevara-Hernández, F., Beuchelt, T. D., & Govaerts, B. (2016). The evolution of the MasAgro hubs: responsiveness and serendipity as drivers of agricultural innovation in a dynamic and heterogeneous context. *Journal of Agricultural Education and Extension*, 22(5), 455–470. Doi: 10.1080/1389224X.2016.1227091

CONABIO. (2012). Razas de Maíz en México. *Biodiversidad Mexicana*, 5. Disponible en: http://www.biodiversidad.gob.mx/usos/maices/razas2012.html

CONAGUA. (2020). Datos de la Estación 15039 Juchitepec. Inventario de Registros por Década Año. Disponible en: https://smn.conagua.gob.mx/tools/RESOURCES/Estadistica/13098.pdf

INEGI. (2007). Censo Agrícola, Ganadero y Forestal 2007. Disponible en: https://www.inegi.org.mx/programas/cagf/2007/#Tabulados

Perales R., H., Brush, S. B., & Qualset, C. O. (2003). Landraces of maize in central Mexico: an altitudinal transect. *Economic Botany*, 57(1), 7–20. Doi: 10.1663/0013-0001(2003)057[0007:LOMICM]2.0.CO;2

Secretaria de Agricultura y Desarrollo Rural. (2021). No Title. Disponible en: https://nube.siap.gob.mx/avance_agricola/

Sweeney, S., Steigerwald, D. G., Davenport, F., & Eakin, H. (2013). Mexican maize production: Evolving organizational and spatial structures since 1980. *Applied Geography*, 39, 78–92. https://doi.org/10.1016/j.apgeog.2012.12.005