

Participation of women and men in the post-harvest of native corn in rural communities

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ABSTRACT

Objective: To analyze the post-harvest practices carried out by women and men for the conservation of native maize in Tlaxcala, and to identify the limitations they face throughout the process.

Design/Methodology/Approach: The study employed a mixed-methods approach, combining qualitative techniques (participant observation and workshops) with quantitative data collection (structured questionnaire). A survey was administered to 117 individuals across two communities.

Results: Post-harvest practices for conserving native maize are largely similar between women and men in the studied communities of Tlaxcala. However, women play a more prominent role in tasks such as shelling, drying, selection, and transformation for household consumption. The knowledge underlying these practices stems from traditional knowledge systems that have evolved over time. Despite this, both women and men face several limitations in executing these practices.

Findings/Conclusions: The primary barriers to effective post-harvest conservation of native maize particularly for women include limited access to training, tools or modern technologies, financial resources, labor, time, and physical capacity.

Keywords: post-harvest management, native maize, food security.

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INTRODUCTION

Maize (*Zea mays* L.) has been a staple in the diet of numerous families across Latin America, owing to its versatility as a multifunctional grain. It serves as a fundamental food for household consumption, a key input in animal feed, a source of income, and a central element of cultural identity for many communities. In rural areas, maize represents a cornerstone within a wide array of family and community strategies, where its production, processing, and conservation are of vital importance (Esponda & Galindo, 2024). Peasant agriculture accounts for 80% of the land dedicated to maize cultivation and contributes approximately 60% of total maize production. Native maize varieties predominate in these systems and play a fundamental role in ensuring household food security (Guzmán, 2021). Both women and men actively participate in maize production and post-harvest conservation practices. While agricultural activities are crucial for obtaining the grain,



post-harvest management practices are equally important, as their proper implementation helps reduce losses, ensure grain availability for self-consumption, and, in some cases, generate marketable surpluses (Hodges & Stathers, 2013; Tefera *et al.*, 2011). Post-harvest losses are linked to contamination risks stemming from abiotic (physical, chemical, and mechanical) and biotic (insects and microorganisms) factors. In this context, implementing safe practices throughout the entire chain from production to consumption is essential. In Mexico, post-harvest maize losses range from 20% to 40% in tropical regions, 10% to 20% in subtropical zones, and up to 10% in arid areas (García-Lara *et al.*, 2010). In the state of Tlaxcala, there are no specific records of post-harvest losses of native maize nor of gender-differentiated participation in such practices. Therefore, the objective of this study is to analyze the participation of women and men in the post-harvest conservation of native maize and to identify the main limitations they face in this process.

METHODOLOGY

The study was conducted in two Indigenous communities in the state of Tlaxcala, Mexico: Guadalupe Tlachco, in the municipality of Santa Cruz Tlaxcala (19° 12' 42" N, 98° 05' 24" W), and San Felipe Cuauhtenco, in the municipality of Contla de Juan Cuamatzi (19° 18' 48" N, 98° 07' 19" W). Both communities cultivate native maize varieties with high cultural, productive, and nutritional value.

A mixed-methods approach was adopted, integrating both qualitative and quantitative methods. The qualitative component included exploratory visits, participant observation, and participatory workshops involving both women and men affiliated with the peasant organization Grupo Vicente Guerrero (GVG), which promotes agroecological practices as well as the production and conservation of native maize. The workshop in Guadalupe Tlachco included eight women and six men, while the workshop in San Felipe Cuauhtenco included five women and one man. These workshops focused on identifying and analyzing native maize production practices, post-harvest management, and uses in both communities.

For the quantitative component, a structured survey was administered to women and men from the two localities. In Guadalupe Tlachco, the sampling frame was based on the National Agrarian Registry (RAN, 2023) list of ejidatarías and ejidatarios, which was later verified with the local ejido committee. In San Felipe Cuauhtenco, the list of beneficiaries of the fertilizer program served as the sampling base. The sample size was determined using the maximum variance formula, with a 95% confidence level and a 10% sampling error. Once the sample size was established for each community, a proportional stratified sampling approach was used to ensure representation of both women and men in each population stratum. In total, 117 surveys were conducted: 76 in Guadalupe Tlachco (25 women and 51 men) and 41 in San Felipe Cuauhtenco (17 women and 24 men). The instrument used was a structured questionnaire comprising the following sections: 1) personal and socioeconomic characteristics; 2) agricultural and livestock activities; 3) uses and post-harvest management of native maize; and 4) gender-differentiated participation in management practices. The data collected were processed using descriptive statistics in Microsoft Excel and the Statistical Package for the Social Sciences (SPSS), version 24.

RESULTS AND DISCUSSION

General characteristics of the surveyed population

The surveyed population in both communities belongs to a rural context. In Guadalupe Tlachco, women reported an average age of 66 years, while men had a mean age of 68 years. In contrast, San Felipe Cuauhtenco showed a relatively younger population, with an average age of 55 for women and 57 for men.

Regarding educational attainment, the overall average level of schooling was six years, indicating that most respondents had at least completed primary education. Notably, in San Felipe Cuauhtenco, 12% of women and 13% of men reported having completed university studies. As for marital status, a low proportion of married individuals was observed in both communities. In Guadalupe Tlachco, only 16% of women and 51% of men reported being married; in San Felipe Cuauhtenco, these percentages were 29% and 49%, respectively. Although many did not report being in a formal legal union, they described themselves during the interviews as widowed or divorced. In this context, it was common for interviewees to rely on support from daughters, sons, or daughters-in-law within extended family households.

With respect to family structure, an average of three children per family was identified in both communities. Only 9.4% of the total surveyed population reported having no offspring, and few cases of large families with up to eleven children were recorded. In terms of economic activities, women in Guadalupe Tlachco primarily engage in domestic work, with limited participation in agricultural tasks. Men mostly work as day laborers, though they also engage in the cultivation of native maize. In San Felipe Cuauhtenco, women also dedicate time to domestic and agricultural work, with some involved in textile-related labor. Men in this community combine farming on their own plots with jobs in construction and textile manufacturing.

The native maize cropping system

In both communities, the predominant agricultural system is polyculture, which includes various species such as common bean (*Phaseolus vulgaris*), squash (*Cucurbita* spp.), oat (*Avena sativa*), wheat (*Triticum aestivum*), and fava bean (*Vicia faba*), with maize (*Zea mays* L.) serving as the central crop in local production systems (Table 1). This approach reflects a traditional model based on diversification, characteristic of many agricultural areas

Table 1. Percentage of crops cultivated by women and men in the study communities.

Crop	Guadalupe Tlachco		San Felipe Cuauhtenco	
	Women n=25 %	Man n=51 %	Woman n=17 %	Man n=24 %
Corn	100	100	100	100
Bean	32	31	76	46
Beans	28	33	53	27
Pumpkin	24	33	35	10
Oats	8	16	0	5
Wheat	4	8	0	2

in Tlaxcala, where agrobiodiversity is actively promoted through complex agroforestry systems or milpas, commonly referred to as metepantles (Vincent-Fequiere *et al.*, 2024). Crop diversification and the use of various native maize varieties are part of family strategies aimed at mitigating both environmental and socioeconomic risks. Moreover, this practice ensures the availability of a broader range of food products for household consumption, thereby strengthening food security in peasant production units (Sánchez *et al.*, 2017).

Both communities are characterized by the continued cultivation and conservation of native maize varieties, among which white, yellow, blue, and cacahuacintle maize stand out. To a lesser extent, other varieties such as tepite, pink maize, and arrocillo are also cultivated. The land area allocated to each variety primarily depends on land availability and preferences related to their culinary and cultural uses.

The average area dedicated to white maize cultivation in both communities is 1.4 hectares, with no significant differences between women and men in terms of the land sown. While most respondents indicated that they maintain a diversity of native varieties (blue, yellow, cacahuacintle, pink, arrocillo, and tepite), the land area allocated to these varieties does not exceed one hectare. These are mainly grown for their complementary value in the family diet and for specific uses such as nixtamalization, ceremonial or medicinal purposes, among others. It is worth noting that there is a marked preference for native varieties. It is estimated that approximately 90% of the agricultural area in the state of Tlaxcala is planted with native maize, predominantly from the conical race group (Ramírez & Guevara, 2017). In terms of yields, an average of 1.7 t ha⁻¹ was reported for white maize, 1.0 t ha⁻¹ for yellow maize, and values below 1.0 t ha⁻¹ for blue and cacahuacintle maize. Varieties such as pink maize, tepite, and arrocillo show yields below 0.1 t ha⁻¹. Although these yields are relatively low, the primary purpose of their cultivation is to meet household food needs in both quality and quantity. In some cases, surpluses are used to feed backyard animals or are sold locally, generating income that helps cover family expenses such as food (meat, sugar, coffee), clothing, footwear, medicines, or agricultural inputs for the next planting cycle. The low productivity observed in recent years has been attributed to various factors, including changes in rainfall patterns, mid-season droughts, hailstorms and heavy rains, poor soil fertility, pest and disease incidence, and rising production costs (Vega, 2022).

Uses and consumption of maize

In the studied communities, maize is highly valued not only for its nutritional role but also for its cultural significance. Both women and men recognize that the use of maize varies depending on kernel color. White maize is preferred for making tortillas, while other varieties such as blue, tepite, arrocillo, and pink maize are primarily used in traditional foods like tamales, burritos, and atoles. Some informants also indicated that colored maize varieties possess medicinal properties. In the specific case of cacahuacintle maize, its use is almost exclusively reserved for preparing pozole. In the community of San Felipe Cuauhtenco, a different perception of yellow maize was observed, as it is mainly designated for animal feed due to the belief that its consumption by humans could cause intestinal problems. Regarding weekly family maize consumption, a difference was noted between the two communities. In Guadalupe Tlachco, the average consumption was 14.5 kg per

family, while in San Felipe Cuauhtenco it was 10.8 kg. This variation may be related to the larger average family size in Guadalupe Tlachco. Concerning the supply of maize produced during the 2022 agricultural cycle, most families reported having met their annual food needs. In Guadalupe Tlachco, 80% of respondents stated that production was sufficient, while 20% reported otherwise. In San Felipe Cuauhtenco, 83% reported sufficient production and 17% indicated they did not meet their yearly requirements. Among those who did not achieve self-sufficiency, the average duration of their maize reserves was approximately seven months. In such cases, families resorted to purchasing grain or tortillas to supplement their consumption.

Post-Harvest practices for native maize and the participation of women and men

Post-harvest practices carried out by women and men comprise two phases (Figure 1). Phase 1 includes activities performed in the field, while Phase 2 involves those conducted at home. These practices are the result of a body of traditional knowledge built and transmitted across generations over time.

Phase 1: Post-harvest activities in the field

In the first phase, traditional practices such as *dobla*, *amogotado*, and *engavillado* are less frequently used than in the past, when they were widespread. *Dobla* is a Mesoamerican technique consisting of bending the maize stalk below the ear once the grain has reached physiological maturity. Its purpose is to accelerate drying in the field, prevent bird damage, and protect the ear from moisture, thus reducing the risk of rot. Producers who still use this method reported that they only implement it under favorable weather conditions specifically when there is no rain and the maize can be left in the field longer. Although it is effective in preserving grain quality during storage (Centurión *et al.*, 2016), it is highly labor-intensive and involves both women and men. Sun drying maize in the field, either standing or laid on the ground, is a common traditional practice aimed at reducing moisture content and preventing fungal damage. It is widely practiced in both communities by women and men alike. *Amogotado* involves cutting maize plants at ground level, laying them out, and then forming them into a conical structure. This technique enhances ear ventilation, reduces

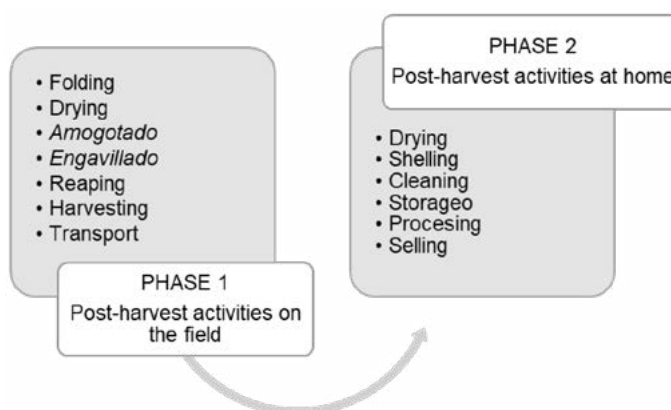


Figure 1. Post-harvest phases in the study communities carried out by women and men.

moisture, and prevents rot, while also allowing the leftover stalks (zacate) to be used as livestock fodder. This practice is performed exclusively by men. Another traditional method is *engavillado*, which consists of cutting the stalks with a sickle and stacking them in bundles with ears attached. This facilitates field drying, eases transportation, and allows the plant residues to be reused as animal feed. *Segado* (cutting of stalks for fodder) also forms part of this phase, though it is now less common and is still practiced by some men. One of the most representative activities of this phase is *pizca* or harvesting, which involves cutting the ears from the plants. This can be done manually using *pizcalones*, puncturing tools, or by hand, as well as mechanically with harvesters or threshers. In both communities, harvesting shows a strong female involvement. In Guadalupe Tlachco, all respondents reported harvesting manually. In San Felipe Cuauhtenco, 100% of the women harvest manually, while 83% of the men do so, and only 17% use mechanical methods. Women in this community explained that mechanization is not suitable for them because their plots are small, machinery is not adapted to their conditions, and it leaves too many impurities in the grain, making cleaning difficult. Finally, the transport of the harvest to the home marks the end of this phase. Maize is transported in sacks or bundles using various means: personal trucks, rented vehicles, carts, or even on foot. In Guadalupe Tlachco, some women with plots close to their homes carry the maize in wheelbarrows or on their backs, demonstrating their active role in all stages of the process.

Phase 2: Post-harvest activities at home

In this second phase, one of the key activities identified by participants is drying the ears at home. This involves exposing the ears to sunlight to ensure proper moisture loss and prevent mold or rot. Some people choose to harvest maize before it is fully dry in the field due to fear of theft, which makes it necessary to complete the drying process at home. In Guadalupe Tlachco, drying is typically done in patios or on rooftops. Women expressed a preference for patio drying, as it requires less physical effort than carrying ears to rooftops. Patio drying also allows them to monitor the maize more easily during unexpected rain or weather changes, giving them greater control over the process. A subsequent step is shelling, which involves separating the kernels from the cobs. This process may be done manually using *oloteras*, stones, or bare hands, or with mechanical shellers. In both communities, mechanical shelling is the predominant method; however, its use varies by gender and equipment availability. As shown in Figure 2, manual shelling is more common among women, who often opt for this method for economic or practical reasons particularly when dealing with small quantities or lacking machinery. In contrast, men tend to use mechanical shellers more frequently, either their own or shared, especially when working with larger volumes. These activities reflect not only a gender-based division of labor but also a system of practical knowledge passed down through generations. Decisions regarding how and where to dry or shell the maize are shaped by both material factors (such as access to technology, physical characteristics of the home or plot) and symbolic ones (social construction of gender roles and ownership of technical-traditional knowledge).

Once shelling is completed, the next post-harvest step is maize cleaning, performed by both women and men, though more frequently by women. This process aims to remove

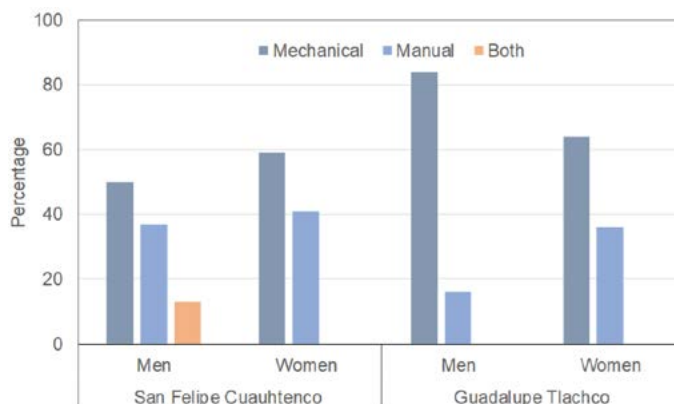


Figure 2. Shelling method in the study communities.

impurities such as stones, husk fragments, dust, and pests. Cleaning is often conducted concurrently with shelling using traditional tools like sieves, sifters, and, in some cases, winnowing.

After cleaning, the maize is stored a critical stage in post-harvest management, as it involves preserving the grain for several months while ensuring it remains free from mold, pests, and contaminants. Both women and men participate in storage, utilizing various containers and structures: woven polypropylene sacks, hermetic plastic bags, plastic buckets, hermetic silos, traditional granaries (*trojes*), barrels, as well as purpose-built rooms and storage facilities. In both communities, over 50% of respondents prefer woven sacks. However, women in San Felipe Cuauhtenco reported broader knowledge of post-harvest technologies such as hermetic bags and silos and noted the continued, albeit limited, use of traditional granaries, contrasting with practices in Guadalupe Tlachco. Two main approaches to grain preservation during storage were identified: conventional and agroecological. The conventional method includes using lime and chemical products such as aluminum phosphide. In Guadalupe Tlachco, 52% of women and 51% of men reported using aluminum phosphide, typically applying two tablets per 50 kg of stored grain. Although effective against pests at all life stages, the compound is extremely toxic, releasing phosphine gas upon contact with moisture posing serious health risks to humans and animals (Rodríguez, 2022). Agroecological methods were mentioned by fewer than 10% of respondents in Guadalupe Tlachco, while in San Felipe Cuauhtenco, 29% of women and 21% of men reported using alternative pest-control methods involving plants and fruits with insecticidal properties. These include castor (*Ricinus communis*), prickly poppy (*Argemone munita*), ragwort (*Senecio cinerarioides*), fruits such as hawthorn (*tejocote*), and vinegar. These alternatives hold strong potential for storage pest management, though further research is needed to develop appropriate formulations, dosages, and safe application protocols.

Following storage, the grain is processed for household consumption a process managed exclusively by women. They handle every step: preparing the nixtamal (*nixcon*), milling the maize, and producing traditional foods. Women possess in-depth knowledge of the culinary properties of each maize variety and demonstrate specialized processing skills

(Sarmiento *et al.*, 2017). Men acknowledge their limited involvement at this stage, typically only assisting with placing the nixtamal to cook. The sale of maize the final activity in the post-harvest cycle is predominantly handled by men. Grain sales generate additional family income to cover food, medicine, clothing, or agricultural inputs for the next planting season. Typically, maize is sold locally to neighbors or tortilla producers. In San Felipe Cuauhtenco, men view maize as a commercial product starting from its elote stage, while women value it primarily for culinary use. In Guadalupe Tlachco, although few women sell grain directly, they find opportunities through by-products such as tamale leaves or cobs for crafts. Maize in poor condition (discolored, rotten, or broken) is sold as animal feed, though at substantially lower prices. Notably, several women voiced concerns about lacking decision-making autonomy, as men typically control maize sales.

Limitations faced by women and men in the post-harvest process

Peasant strategies involving crop diversification offer ecological, agronomic, and nutritional benefits (Bartra *et al.*, 2014); however, they are constrained by factors such as soil degradation, shifting rainfall patterns, pest and disease pressure, and rising production costs (Guzmán, 2021; Vega, 2022). Yet, post-harvest grain conservation challenges have received limited attention in the literature. Participants in the study communities reported various constraints encountered during native maize post-harvest management. Table 2 summarizes the ten main post-harvest practices, perceived limitations, and their relative importance, differentiated by community and gender. Notably, in several activities both women and men shared similar concerns.

In both communities, labor shortage was identified as the principal constraint during harvest (pizca), driven by rural youth migration to non-agricultural economic sectors significantly reducing available field labor (Vega, 2022). Harvest transport was hindered by high freight costs, affecting both genders equally. For grain drying, limitations varied. In San Felipe Cuauhtenco, both women and men cited lack of physical space for drying. In Guadalupe Tlachco, women highlighted unstable weather especially rainfall that interrupts

Table 2. Constraints faced during the post-harvest process.

Limitations	Community	Sex	order of importance	Activities														
				Harvesting	Transport	Drying	Shelling	Cleaning	Selection	Storage	Transfer to the place of sale	Selling	Processing					
	San Felipe Cuauhtenco	Women	1															
			2															
			3					*				*		*				
		Men	1															
			2															
			3															
	Guadalupe Tlachco	Women	1														*	
			2															
			3					*										
		Men	1															
			2															
			3													*		

Limitations

1. Lack of labor
2. High freight costs
3. Lack of space
4. Climate chance
5. Lack of time
6. Lack of implements / machinery
7. Lack of transportation
8. Lack of buyers
9. Lack of markets
10. Lack of knowledge
11. Lack of training
12. Competition with hybrids
13. Distance
14. Health problems
15. Poor grain quality
16. Not allowed

outdoor drying as the primary barrier, while men prioritized lack of time due to balancing farm work with off-farm income generation.

Regarding shelling, women in both communities identified the lack of mechanical tools as the key obstacle on average, around 40% still shell maize manually. Men again emphasized time constraints as their main barrier. Cleaning and grain selection techniques, storage, transport for sale, commercialization, and grain processing also faced shared limitations across communities and genders. Time scarcity was the most reported issue for cleaning and sorting. Storage was limited by inadequate space. Transport was restricted by high freight costs. Selling maize faced low market demand and few buyers. Finally, grain processing was hindered by lack of time especially for women, who traditionally manage this task. In summary, while limitations vary by post-harvest practice, perceptions between women and men did not differ significantly. Nevertheless, addressing the most frequently cited constraints time scarcity, labor shortages, inadequate storage spaces, and high transport costs is crucial. Native maize production and conservation are threatened by these multiple constraints. Nonetheless, maize remains a central resource not only nutritionally, but also socially and culturally. Its management is closely tied to peasant knowledge, family structure, and community dynamics, all of which help sustain traditional agricultural systems. The use and conservation of native varieties represent a fundamental peasant strategy for securing food supply and preserving local genetic diversity (Guzmán, 2021).

CONCLUSIONS

Post-harvest practices carried out by women and men in the communities of Guadalupe Tlachco and San Felipe Cuauhtenco follow a similar structure, organized into two phases: the first, conducted in the field, and the second, in the domestic sphere. While both genders actively participate in both stages, greater female involvement was observed in the second phase, which includes activities such as shelling, cleaning, storage, and maize processing for household consumption.

The differences in levels of involvement between women and men are closely linked to the structural limitations that women face in their daily lives. Among these are the work overload resulting from their multiple roles, unequal access to productive resources, information and technical training, as well as limitations regarding community organization and the physical capacities required for certain tasks. Addressing these barriers could serve as a strategic starting point to strengthen local food security by improving post-harvest conservation processes of native maize and recognizing the key role of women in this work.

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