Article

# Localized agri-food system: revaluation in a context of poverty and climate change in the Huasteca Hidalguense

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## Abstract

This research aimed to characterize the localized agri-food system that still persists in three municipalities inhabited by Nahuatl population in the Huasteca Hidalguense in Mexico, characterized by its poverty, marginalization and vulnerability to climate change. The methodological tools were a survey on producers (n= 68) and consumers (n= 68) and a documentary review. The data obtained were analyzed with descriptive statistics. The results indicate that, in the Huasteca Hidalguense, there is a localized agri-food system in critical conditions, in whose operation the participation of small producers with limited resources and affected in their productive work by drought conditions in the last five years is essential. It is considered that the recovery and strengthening of the localized agri-food system in the region will strengthen the food and nutritional security of the population.

**Keywords:** food security, small producers, sustainability.

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# Introduction

In Mexico, during the last three decades, the right to access to food, as well as the promotion of local food production were two issues that, due to lack of actions and omissions, led the country to a serious state of food dependence (López and Gallardo, 2015; Díaz-Carreño *et al*., 2016). Today, 60% of the food in our country is imported (Levario, 2018), including corn, a staple crop in the Mexican diet (Moreno-Sáenz *et al*., 2016). The main effect of these agricultural policies resulted in the impoverishment of small producers, who, in order to continue with their economic activity, replaced most of their traditional species with those required by the market, whose purpose was not precisely to satisfy the demand for foods based on the nutritional and culinary requirements of the local population (Moreno-Sáenz *et al*., 2016; FAO, 2016).

Parallel to this process, long marketing chains were developed and strengthened, which today make up the most important supply network in the Mexican territory (Hernández and Villaseñor, 2014), where the losers have been both small agricultural producers and consumers, as it is the largest spatiotemporal gap between who produces foods and who consumes them (Sacco *et al*., 2019). In contrast to this globalizing process, in local contexts, there are still proximity markets that allow interaction between producer and consumer with the multiple benefits that this means, an experience that must be revalued and strengthened by both, in addition to decision makers and makers of public policy in our country.

Consequently, the present research aimed to characterize the localized agri-food system that still persists in the Huasteca Hidalguense, a system that could be strengthened to reconfigure it in a synergistic point to empower both the producer and the consumer, all under sustainable production and solidarity consumption (Bianchi *et al*., 2013; Donovan, 2018).

# Materials and methods

## Study area

The study area includes the municipalities of Huejutla, Atlapexco and San Felipe Orizatlán, Hidalgo, Mexico, belonging to the Huasteca Hidalguense region (Figure 1). Huejutla, Atlapexco and San Felipe Orizatlán have been classified as municipalities of medium and high marginalization (CONEVAL, 2018), with more than 76% of the population belonging to the Nahuatl indigenous people (CDI, 2010) and where food poverty affects 55.5% of the population (INEGI, 2010).

## Theoretical-conceptual approach

The methodological design of this research was based on the theoretical-conceptual approach 'agri-food system', which is composed of three elements that act as entry and exit points of nutrition: 1) food supply chains; 2) food environments; and 3) consumer behavior (FAO 2016). Likewise, this was contextualized based on what is referred to in the Law of Sustainable Rural Development, section XXVII of Article 3º, which defines food security as the timely, sufficient and inclusive supply of foods to the population (LDRS, 2019).

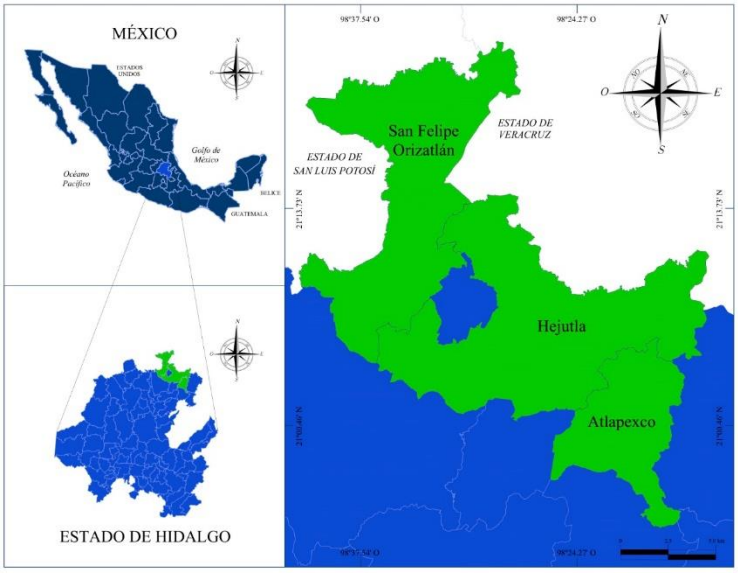



**Figure 1. Location of the municipalities that make up the study area**. Made with data from INEGI (2010).

## Methodological tools

During the period January-April 2018, a survey was conducted on producers (n= 68) and consumers (n= 68) in the municipal markets of Atlapexco, Huejutla and San Felipe Orizatlán, Hidalgo (Table 1).

**Table 1. Producers and consumers surveyed by municipality.**

| Municipality | Municipal market | |
|---|---|---|
| | Producers | Consumers |
| Huejutla | 28 | 28 |
| Atlapexco | 20 | 20 |
| San Felipe Orizatlán | 20 | 20 |
| Total | 68 | 68 |

The questionnaire to producers consisted of four sections: consumer characterization, origin, agricultural knowledge, type of production, destination of production and crop pattern. Similarly, the questionnaire to consumers was made up of four sections: consumer characterization, origin, consumption habits and food consumption pattern. Sampling was non-probabilistic by quotas (Pimienta, 2000). The quantitative variables were systematized and analyzed using descriptive statistics through Statistics V25.

Likewise, a documentary review was carried out on the digital platforms of the National Institute of Statistics, Geography and Informatics (INEGI), the National Council for the Evaluation of Social Development Policy (CONEVAL), the State Program for Action against Climate Change of Hidalgo (PEACCH) and the National Water Commission-Drought Monitor (CNA-MS).

## Characterization of the study area

Atlapexco, San Felipe Orizatlán and Huejutla occupy a rugged territory to the northeast of the state of Hidalgo. In the higher altitude gradient, there is a temperate climate with pine-oak forested areas, while the lower altitude gradient is dominated by medium evergreen forest that gives rise to the variety of flora and fauna that characterizes the region (Madueño, 2000).

The study area is identified by its indigenous population component belonging to the Nahuatl ethnic group, Table 2, with an eminently rural population in Table 3, it was observed that the percentage of the population in poverty is greater than 60% (Table 4), information consistent with the income levels reported by CONEVAL in 2016 (Table 5).

**Table 2. Percentage of indigenous population (Nahuatl) in the study area.**

| Municipality | Population | | |
|---|---|---|---|
| | Total | Indigenous | (%) |
| Atlapexco | 19 902 | 15 776 | 79 |
| Huejutla | 129 919 | 77 899 | 60 |
| San Felipe Orizatlán | 38 952 | 23 971 | 62 |

Made with data from INEGI (2015).

**Table 3. Urban and rural population present in the municipalities that make up the study area.**

| Municipality | Population | | |
|---|---|---|---|
| | Total | Urban (%) | Rural (%) |
| Atlapexco | 19 462 | 0 | 100 |
| Huejutla | 122 905 | 41 | 59 |
| San Felipe Orizatlán | 39 181 | 36 | 64 |

Made with data from INEGI (2010).

**Table 4. Poverty at the municipal level in the state of Hidalgo**.

| Municipality | Total population 2015 | Total in poverty | (%) | | | | |
|---|---|---|---|---|---|---|---|
| | | | In moderate poverty | In extreme poverty | Vulnerable due to social deprivations | Vulnerable due to income | Not poor and not vulnerable |
| Atlapexco | 17 957 | 78 | 48 | 30 | 17 | 1 | 4 |
| Huejutla | 123 763 | 63 | 40 | 22 | 21 | 3 | 13 |
| San Felipe Orizatlán | 34 746 | 78 | 52 | 27 | 16 | 1 | 5 |

Made with data from CONEVAL (2016).

**Table 5. Population that obtained an income of up to 2 minimum wages in the study area in 2015.**

| Municipality | Total | EAP | Income up to 2 minimum wages (%) |
|---|---|---|---|
| Atlapexco | 17 957 | 5 148 | 71 |
| Huejutla | 123 763 | 40 702 | 62 |
| San Felipe Orizatlán | 34 746 | 10 349 | 68 |

Trejo-Benítez *et al*. (2017).

### Globalized *versus* localized agri-food systems

Currently, in the Huasteca Hidalguense, access to foods is between two systems: the globalized agri-food system and the localized agri-food system made up of those small producers who move from their localities to sell their crops first-hand. The first dominates through the long chains of marketing and mass commercial distribution, the second is based on the production of quality foods in short value chains also called short marketing or proximity circuits (Ranaboldo and Arosio, 2016; Rodríguez and Rivero, 2016).

In the area of study, the progressive predominance of these globalized agri-food systems has had an impact on the pattern of agricultural production, since the supply of staple foods, such as corn and beans, now comes from distant regions, gradually displacing local production. In a parallel process, the inhabitants have stopped consuming cultivated or gathered native species. These plants are considered species that respond more to the nutritional and culinary needs of the population. An indirect effect is the abandonment of the dynamic domestication that the producer and their family carried out each cycle in the milpa and the family yard, places considered as *in situ* genetic reservoirs (Salazar and Magaña, 2015).

This is essential in a country whose major challenge is to be able to produce at least 75% of the foods for its population in the coming years (FAO, 2015). For now, Mexico is far from meeting the food security of its entire population (Moreno-Sáenz *et al*., 2016). This achievement will depend, among other things, on the recognition of the need to strengthen localized agri-food systems and their short marketing chains through the definition and operationalization of public policies aimed at local agricultural development, with the poorest producers in this country as beneficiaries.

## Results

Climate change is a global phenomenon with differentiated local effects, as observed in the study area where, although the three municipalities that make it up will be affected by the reduction of precipitation and the increase in temperature, Atlapexco will be the one that receives the greatest impact due to the decrease in precipitation estimated for 2080 (PEACCH, 2013) (Table 6).

**Table 6. Degree of impact in the study area due to changes in precipitation and temperature patterns estimated for 2080.**

| Municipality | Precipitation | Temperature |
|---|---|---|
| Atlapexco | 4 | 2 |
| Huejutla | 2 | 1 |
| San Felipe Orizatlán | 3 | 1 |

Degree of impact: 4= very high, 3= high, 2= medium high, 1= low. Made with data from PEACCH (2013).

In the study area, the drought period went from occurring in a couple of months to almost the whole year, as it happened in 2019. In this regard, the CNA-SM (2020) indicates that, when this drought occurs for more than six months a year, in addition to affecting the agricultural and livestock

activity of the region, the hydrological system and ecology of the place are impacted. These droughts have been classified by the CNA-MS (2020) as: D0 (abnormally dry), D1 (moderate drought), D2 (severe drought), D3 (extreme drought) and D4 (exceptional drought). The incidence of drought and its intensity in the study area for 16 years are shown below (Figures 2, 3 and 4).

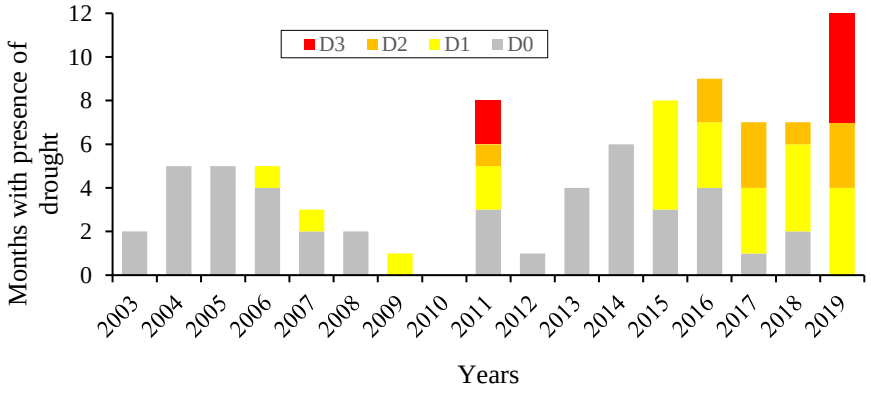



**Figure 2. Presence of drought in Atlapexco, Hidalgo 2003-2019.** Made with data from CNA-MS (2020).

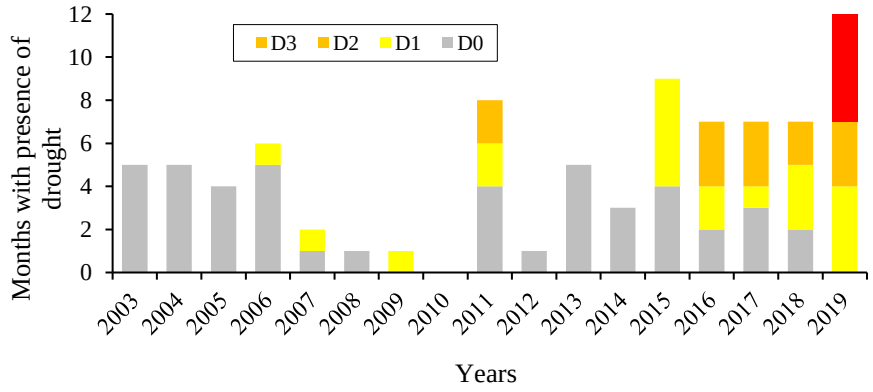



**Figure 3. Presence of drought in Huejutla, Hidalgo 2003-2019.** Made with data from CNA-MS (2020).

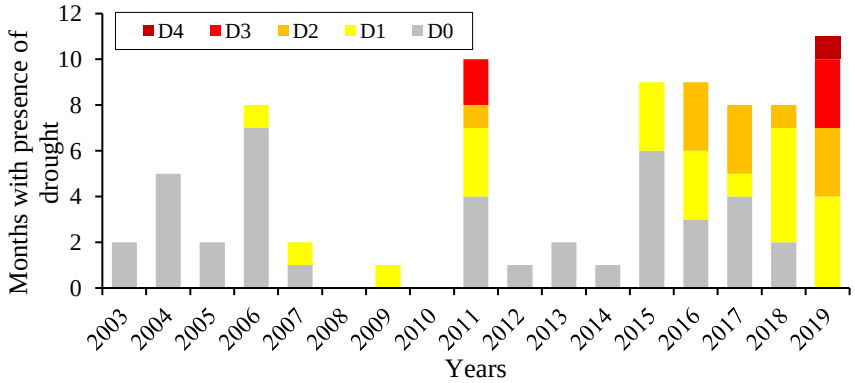
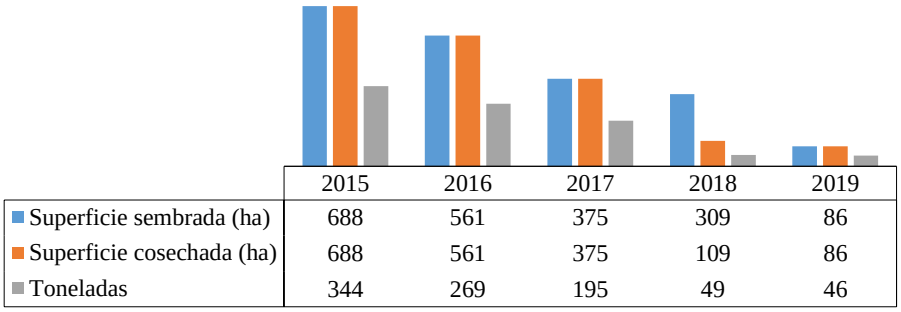



**Figure 4. Presence of drought in San Felipe Orizatlán, Hidalgo 2003-2019.** Made with data from CNA-MS (2020).

The effects of these years of drought have particularly affected the production of beans, a C3 crop that requires higher moisture conditions than corn and that, due to higher temperatures, is more exposed to the presence of diseases (Figure 5).



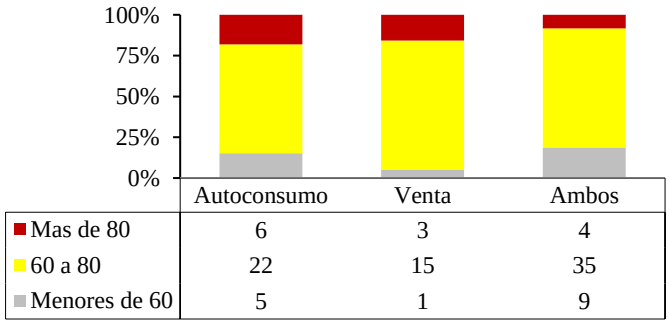
| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Superficie sembrada (ha) | 688 | 561 | 375 | 309 | 86 |
| Superficie cosechada (ha) | 688 | 561 | 375 | 109 | 86 |
| Toneladas | 344 | 269 | 195 | 49 | 46 |

**Figure 5. Decreasing behavior of the area and the harvested volume of beans in Huejutla, Hidalgo.** Made with data from (SIAP, 2020).

It is important to mention that, although PEACH (2013) indicates that Atlapexco will be the municipality that will have the highest degree of impact in terms of changes in precipitation and temperature in an estimate made for 2080, in contrast, the data indicated by the CNA-MS (2020), during the period studied, indicate San Felipe Orizatlán as the most vulnerable municipality. This finding shows the need for studies on the impact of climate change at the local level, useful information in the definition of agriculture adaptation strategies, particularly in the medium and long term.

Regarding the characterization of producers and consumers in the study area, the participants were 76% men and 24% women; of the total of interviewees, 75% assumed themselves as indigenous, with an average of 69 years, finding that, the older, the greater the number of crops in their milpa and lot (mean positive Spearman's correlation coefficient of 0.34), but on average each producer grows 5 species.

The data obtained indicate that 33% of the interviewees produce foods to satisfy their self-supply, 19% of the producers take all their production to local markets, while 48% of the participants consume and market their crops. This variable, in relation to age groups, offers a particular perspective where it can be seen that, regardless of the aforementioned purposes, the older producers are the ones in charge of local food production in the study area (Figure 6).




| | Autoconsumo | Venta | Ambos |
|---|---|---|---|
| Mas de 80 | 6 | 3 | 4 |
| 60 a 80 | 22 | 15 | 35 |
| Menores de 60 | 5 | 1 | 9 |

**Figure 6. Age of producers involved in food production/supply.** Made with field data.

Forty-five percent of the products sold come from the milpa, 18% from the family yard and the rest from both. Eighty percent of the participants indicated that their products are characterized by being freshly cut and produced without the use of agrochemicals, particularly those from the family yard. Eighty percent of producers mention that they use at least 60 min to move from their localities to the municipal markets and the localities where producers/consumers come from are in a surrounding area of 50 km.

The food production identified in the study area consisted of 37% fruits, 33% vegetables, 6% grains, 6% aromatic herbs and 2% tubers. Except for corn and beans, species such as purslane (*Portulaca oleracea* L.), izote (*Yuca filifera* Chabaud 1976), chiltepin (*Capsicum annuum* variety *glabriusculum* (Dunal) Heiser and Pickersgill) and wild tomato (*Lycopersicon esculentum* L. variety *Cerasiforme*), are species that exist within the milpa or the family yard but do not receive any management (i.e., fertilization or pest and disease control).

The participants stated that some of these species are consumed only by the family and particularly by the older members, for example, seeds of guaje (*Leucaena leucocephala*) or the fruit of wild papaya (*Carica papaya* L.), food species little consumed or disused, which are no longer part of the crop-gathering pattern of families and nor of the culinary pattern (CONABIO, 2020). Other species are still marketed in municipal markets, although their demand is minimal because younger people have stopped consuming them, such as anona (*Annona squamosa*) and atomales (*Allium neapolitanum, Sabal mexicana* Mart). Also, the producers mention that there are species such as yellow mombin (*Spondias mombin* L.) and huitlacoche (*Ustilagus maydis*) that, although still consumed, their sale is still basically local because they are highly perishable and that limits their fresh sale in other regions (CONAFOR, 2020).

Of the consumers interviewed, 40% were men and 60% women, with an average schooling of 8 years, that is, more than double that of the producers. Of these, 23% purchase plant-based foods once a week, 32% twice a week, 37% three times a week and 8% of people purchase four times a week. People who make their purchases once a week live in the municipal seats and based on the interviews, this behavior is associated with greater schooling and better paid job, while those who buy their foods up to four times a week inhabit peripheral areas of the municipal seats, with a lower schooling. Twenty-five percent of consumers indicated that their consumption is based on the acquisition of fruits, vegetables and grains from people who sell from house to house, while 75% said they buy these products in improvised stands located in the areas surrounding the municipal markets of Atlapexco, Huejutla and San Felipe Orizatlán.

Forty-seven percent of consumers said they purchase these foods due to their lower cost, 35% for their taste, 2% for custom, 5% because these products are healthy and 11% mentioned that they do it because of the quality of the products because of the way they are grown. It should be noted that the consumers interviewed, when assessing the foods generated by local production, only 5% indicate them as healthy foods. Given this data, it is necessary to provide the consumer with information about the nutritional properties of these products.

## Discussion

The globalized agri-food system has not guaranteed society access to foods in quantity and quality, for this reason and considering the findings found in the study area, the strengthening of the local agri-food system based on the meeting between producers and consumers in a more democratic and fair space is proposed (Rodríguez *et al*., 2017). Fortunately, in the Huasteca Hidalguense, this type of system still persists, but it is in the process of disarticulation, so it is necessary to strengthen the links between producers and intermediate or final consumers, favoring the existence of agreements prior to sale and the proximity relationships that underlie them (Rodríguez and Riveros, 2016).

It is also important to work with the impacts caused by the gradual imposition of processed and ultra-processed foods provided by the globalized agri-food system and that is causing public health problems such as malnutrition and obesity (Monteiro *et al*., 2013). In this sense, data on obesity place Hidalgo as one of the states with the highest incidence, with 490.75 cases per 100 thousand inhabitants (Anuario de Morbilidad, 2014). In Mexico, as in China and South Africa, nutritious foods have become relatively more expensive than those high in fats, sugars or salt (Rodríguez and Riveros, 2016).

This has negatively impacted people's nutritional status, increasing their vulnerability to noncommunicable diseases (CEPAL, 2017). The most severe effects of this process occur in infants in rural areas where chronic malnutrition has been found to be a common problem that has negative effects on infants' motor and cognitive development (Lacroix *et al*., 2013). In the Huasteca Hidalguense, a response to the above could be the promotion of an offer of fresh, nutritious foods, linked to the local, the artisanal, also having their own identity as it happens in other regions of the country and Latin America (Ortega and Morales, 2013; Rodríguez and Riveros, 2016).

That is, fruits, seeds, tubers, produced locally and that must be progressively included in the diet and therefore, reintroduced to the culinary pattern of the region, to be consumed particularly by the younger generations. The above according to the idea of what is not consumed is not preserved. Another important argument for the strengthening of localized agri-food systems in the Huasteca Hidalguense is its role in the conservation of the biocultural heritage of this territory, because these are based mainly on a production of native species (Muchnik *et al*., 2011; Altieri and Nicholls, 2019).

The reasons for the choice of these edible species and their domestication are the result of the historical interaction between society and nature, this genetic wealth is part of their biocultural heritage (Hernández and Villaseñor, 2014; Zuluaga and Ramírez, 2015; Méndez and Hernández, 2019). Finally, it is necessary to rebalance the power relationships between production and consumption (García and Sanz, 2016), redefine and strengthen the links between poor producers and consumers, recognizing their inherent needs and establishing close communication between the two (Lacroix *et al*., 2013; Hernández and Villaseñor, 2014; López-García, 2015; Altieri and Nicholls, 2019).

In this sense, it is important to compare the valuation made by the producer and the consumer of locally produced foods, so consumers value their price while producers think that the preference for their products is due to their better taste; however, these perceptions are never shared and much less reflected upon (Table 7).

**Table 7. Perception of why foods are purchased by consumers *versus* perception of the producer (%).**

| Participant | Price | Taste | Quality | Custom | Healthy |
|---|---|---|---|---|---|
| Consumer | 47 | 35 | 11 | 2 | 5 |
| Producer | 34 | 47 | 12 | 7 | 0 |

As for climate change, it is suggested that this phenomenon is creating conditions of greater uncertainty for those who carry out agricultural work. Those affected will continue to be, as in other regions of the world, small producers who carry out their agricultural activity in marginal productive areas such as rainfed lands, slopes, thin soils prone to erosion (Altieri and Nicholls, 2009; PEACCH, 2013; Murray and Jaramillo, 2018) and whose adaptation strategies are minimal or none (Medina-García *et al*., 2016; Morales, 2016), this will deepen poverty, hunger and with it, migration flows to urban centers, where rural poverty will increase existing urban poverty (Morales, 2016).

Given this context, it is necessary to reconsider the importance of the genetic diversity of local varieties that make up localized agri-food systems as a strategy to reduce variability in yields, which acts as an insurance to sustain production and face environmental and climate change, as well as to meet their sociocultural and economic needs. That is, small producers obtain multiple nutritional uses from this genetic wealth and at the same time exploit the various production environments based on empirical knowledge of the different characteristics such as: soil quality, altitude, slope, moisture availability, etc. (Torres-Salcido *et al*., 2015; Altieri and Nicholls, 2019).

In this sense, it is important to mention that agricultural production in the study area is still characterized by management practices underlain by ecological knowledge and environmental values compatible with sustainability approaches (Torres-Salcido *et al*., 2015). However, practices such as polyculture in the milpa, hoeing, recycling of organic matter are disappearing, as well as practices that support genetic diversity, soil and moisture conservation, so important in an area of rainfed agriculture (Donovan, 2018; Altieri and Nicholls, 2019).

As for consumers, they must assume the importance of healthy and environmentally friendly food consumption, the recovery of production and consumption habits consistent with sustainability, the recognition of family farming (Gliessman *et al*., 2007; Hernández and Villaseñor, 2014; López-García *et al*., 2015). In other words, the localized agri-food system, in addition to producing food, must strengthen the social fabric (López-García, 2015) and local economic development (Rosset and Martínez, 2014).

With this, the transport needs of products decrease considerably, productive diversification is promoted so that food needs are covered primarily by local agriculture, thus promoting food security (Sanz, 2014; Altieri and Nicholls, 2019). Finally, one of the most recurrent arguments is

that, in localized agri-food systems, not only security is promoted, but also food sovereignty (Donovan, 2018) since these incorporate species that do not reach the short marketing circuits, such as those subject to gathering.

It is also important for food producers and consumers to question the mercantile logic of the prevailing agri-food system that excludes producers and standardizes consumption patterns. Any action by decision-makers should consider that poverty, the lack of access to foods for most of the population, are essential elements in their design (Montan, 2017). These actions should consider the political and social relationships that occur in the municipalities, which are sometimes difficult and often contradictory, as happens in the study area (Madueño, 2000).

In addition, it is necessary to be aware that the quality of foods has been defined based on intrinsic characteristics such as taste, freshness, texture and hygiene; this as a response to the specifications that each actor participating in the different stages of production and distribution gives to food products (Montan, 2017). It is important that, in the case of locally produced food, other attributes related to health, safety and care of the environment are considered (Altieri and Nicholls, 2019).

In addition, it is necessary to consider the fact that producers are carrying out their agricultural activity in conditions of greater uncertainty due to changes in the behavior of the main agroclimatic variables (Madueño, 2000). No less important is the consideration that these small producers are aging and that there is no generational replacement that can produce foods in the coming years, this should be worrying since the average age of the producers interviewed is almost a decade older in relation to the national average, which is 60 years (Vázquez-Palacios, 2007).

The strengthening of the local agri-food system also requires the existence and maintenance of communication routes that communicate to proximity markets. A factor that helps producers in the study area to be regularly subject to the presence of intermediaries who travel through localities and properties on dirt roads imposing excessively low prices on products and that small producers have no choice but to accept (Madueño, 2000).

## Conclusions

The recovery and strengthening of the localized agri-food system such as the one that still persists in the Huasteca Hidalguense will allow the continuation of the way of life of the producers, the conservation of their cultivated and associated agrobiodiversity and in the case of consumers, access to cheaper foods, valued for their freshness and flavor, which are also part of their cultural identity. However, it is necessary to implement strategies so that there is a real link between the two, recognizing their needs and expectations, thus being able to establish more democratic relationships and recognition of the importance and interdependence between the two, a process that will also contribute to the recovery of the social fabric.

All this requires the committed participation of decision makers so that there are decent spaces for their interaction and mutual recognition. Strengthening localized agri-food systems is not only talking about food production and supply, but also about the means to do so (infrastructure, means of transport, training and technical assistance). The achievement of this objective will bring additional benefits such as recognizing the importance of the relationship between rural and urban, the reduction of food poverty and nutritional deprivations in a framework of search towards rural sustainability and the care of common goods fundamental to life such as water, soil and climate.

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