Article

Food vulnerability index for the development of the Mazahua community in the state of Mexico

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Abstract: The native peoples of the State of Mexico, especially the Mazahua community, present a high degree of marginality and food vulnerability, causing their inhabitants to be classified within the poor and extremely poor population. The objective of the research is to propose a food vulnerability index for the Mazahua community of the State of Mexico through the induction-deduction method, contrasting the existing literature with a semi-structured exploratory interview to identify the main factors that affect the native peoples. The study population was selected taking into account the number of inhabitants and poverty levels. The sources of information, in addition to documentary sources, were key informants and visits to Mazahua families that facilitated information about the different variables: natural, economic, social, cultural component, degree of adaptability and resilience for the creation and better understanding of the food vulnerability index in the communities under study.

Keywords: extreme poverty; marginality; food security; native peoples

1. Introduction

In the 1970s, as a result of the food crisis, interest in the availability of and access to food was evident, and the first concept of food security was presented in 1974 by the United Nations at the World Food Conference (Espinosa, 2022); in 1980, vulnerability became an important part of food security analyses; it applies to families, groups or populations that are susceptible to food insecurity, i.e. not being able to meet their food needs (Haro and Marceleño, 2019), food security is a high priority issue for developing countries. Most underdeveloped countries made structural changes in the agricultural sector based on supposed comparative advantages, causing increased food dependence and vulnerability, under the assumption, that it would be cheaper to import food than to produce it, not taking into account the dissimilar unfavorable consequences that these actions would bring to the agricultural sector and how they would affect the socioeconomic conditions of the population in general (Morett-Sánchez and Cosío-Ruíz, 2023).

Food vulnerability is a priority issue and, due to its complexity, it constitutes one of the fundamental bases for decision making when proposing public policies to help reduce poverty levels. FAO's concept of food security is the state in which all people at all times have physical and economic access to the basic foods they need for adequate nutrition (FAO, 2022).

The food recipient countries avoided hunger among their poor population with humanitarian aid, it also served to open new markets for U.S. basic grains and

weakened traditional agriculture in recipient countries, where farmers could not compete with the prices of donated food (Espinosa, 2022). Currently, the Mexican population has high levels of poverty, which is reflected in 56.1 million people, making it more vulnerable in terms of food and agriculture. The percentage of people with an income below the income poverty line has decreased from 49.9% to 43.5%, which is equivalent to a decrease from 61.8 to 56.1 million people affected (CONEVAL, 2022).

The conditions of deprivation are similar among the urban and rural poor, but we must take into account that geographic location is a key component in understanding the structure, causes and trends of poverty, vulnerability and hunger (Castro and Camberos, 2017). Within the rural population, we must highlight the presence of native peoples, in Mexico, according to Article 2 of the Constitution, are those who descend from populations that inhabited the current territory of the country at the beginning of colonization and who preserve their own social, economic, cultural and political institutions or part of them. The National Institute of Statistics and Geography (INEGI), states that of the 126 million 14 thousand 24 people living in the country in 2020, about 7 million 812 thousand 488 people are indigenous, representing 6.2% of the total population of Mexico (INEGI, 2024). In the State of Mexico, the Mazahua community has the largest presence with 112,000 speakers of the language. Self-consumption agriculture is the economic base of the Mazahua people, along with backyard livestock, and the collection of vegetables, fruits and mushrooms from the plains and the forest. Unfortunately, this way of life suffered a drastic change due to new forms of production, the mercantilism of the countryside and better job opportunities in other sectors, which led to migration to nearby cities such as Mexico City and Toluca (Figueroa, 2020).

The objective of the research is to propose a food vulnerability index for the Mazahua community of the State of Mexico through the induction-deduction method, contrasting the existing literature with a semi-structured exploratory interview to identify the main factors that affect the native peoples. The hypothesis of the research assumes that by contrasting the existing literature with the information obtained in the field, it will be possible to obtain the factors that affect the food vulnerability of the native peoples of the State of Mexico.

2. Literature review

Food vulnerability is understood as the situation suffered by countries, social groups and families in particular that are susceptible or exposed to hunger, malnutrition or disease because they do not have physical and economic access to sufficient, nutritious and culturally acceptable food (FAO, 2011). In the world, around 258 million people in 58 countries and territories are in crisis contexts with acute food insecurity or worse (phases 3 to 5) of the Integrated Food Security Phase Classification (FAO, 2023).

Vulnerability and poverty are closely related; not all vulnerable people are in a state of poverty, but all poor people are vulnerable, because poverty is a multidimensional phenomenon that includes aspects related to living conditions that violate people's dignity, limit their fundamental rights and freedoms, prevent the

satisfaction of their basic needs and make their full social integration impossible CONEVAL (2022). Extreme poverty refers to people who have three or more of the social deprivations described above and do not have sufficient income to purchase a food basket, and are below the extreme poverty line based on income. The latter means that if they used all of their household's available income, they would not be able to purchase the food basket CONEVAL (2022).

Food security must integrate this multifactorial territorial perspective that serves to generate comprehensive diagnoses and responds to territorial particularities, in addition to integrating a methodology that measures regional magnitudes as a structural problem of inequality (Huerta, 2020). Mexico suffered a series of structural changes and commercial openness that brought with it the increase in food prices and generated greater food insecurity (López, 2018); five decades ago, the term food security began to be used with all its mutations over the years until today where we continue to observe an increase in food vulnerability with public policies that lack objectivity for rural communities and native peoples in the State of Mexico.

Food imports represent one of the main problems for food security because their growth reflects the negative orientation of domestic production policies and the effect of international food price fluctuations. The increase in imports implies transferring demand abroad and constitutes a brake on the growth of the economy as a whole (Torres and Rojas, 2020). It can be affirmed that Mexico is experiencing a complex situation, where family production units in rural areas have gradually abandoned their agricultural activities and even their identity in search of better opportunities for their members (Marcial et al., 2020). Food vulnerability in the Mexican female population has an increasing social incidence, reflected in the multiple existing structural inequalities, placing them at a disadvantage with respect to the male population, who are less economically dependent. Women suffer from low salaries and precarious employment, making them and their children more vulnerable in their role as heads of household (Longhi et al., 2022).

Rural communities and our native peoples have seen their social development frustrated due largely to the new rules of the game that adopted a pattern of free trade and little state intervention, betting on a global market that offers a wide range of products with stable prices with an apparent economic growth, but not developing the country. This causes the lower and middle social classes to suffer more and more vulnerability and exposure to risk not only in terms of food but also socially, being exposed to low wages and job insecurity. In Mexico, the unemployment rate for these social groups has been increasing, forcing citizens to assume more risks and insecurities, forming part of a vulnerable population with great possibilities of suffering poverty and sometimes extreme poverty, substantially limiting their social development (Pizarro, 2001).

The Latin American and Caribbean Food Security Scale (ELCSA) created by the Food and Agriculture Organization of the United Nations (FAO) is part of the family of food insecurity measurement scales based on the experience of household censuses. The application of this scale was a great challenge, since it had to be agreed upon by all the countries in the region, making ELCSA very solid in terms of its results (ELCSA, 2012).

In Argentina, the Food Vulnerability Index (IVAL) was created. The construction of this index was carried out in two consecutive stages. On the one hand, it was necessary to select those dimensions which, based on the analysis of the previous literature, best expressed food vulnerability and which allowed the proposed definition to be operationalized.

Later, the variables that would make up the index were carefully defined. At this point, we found ourselves on more than one occasion in tension between what we considered to be the optimal variables for analyzing and detecting territories with food vulnerability and the possibilities provided by the data source (Longhi et al., 2022).

To measure food vulnerability in the Andes region of Peru, descriptive and explanatory methods were used within the general framework of the scientific research method. Initially, a situational diagnosis of the food security context in the district was carried out, following the rapid participatory diagnosis methodology. To establish the perception of food security, a nine-question questionnaire with a modified Likert scale was used, considering four response alternatives for each question. The effects of climate change on each of the food security components were then assessed (Zarate and Miranda, 2016).

For the construction of the Municipal and Regional Food Security Index in Mexico, indicators were selected that measure food security, more specific than national or state scales, since they should be approached according to the different levels of human development and in the context of their economic development, bearing in mind the four dimensions proposed by the Food and Agriculture Organization of the United Nations (FAO).

The analysis of food security must also be placed in a multifactorial-territorial perspective, where multiple internal and external factors converge to make it vulnerable and cause disparities in the territory; it is not possible to measure it with a single variable, especially when it is analyzed spatially. Therefore, 13 indicators were selected for which disaggregated information is available. This makes it possible to analyze changes in the food security situation through the behavior of the index over time; another selection criterion was that this period is located at the apex of trade liberalization and the consolidation of the current development model, where food security shows a different dynamic compared to past decades (Torres and Rojas, 2020). The need to carry out an index for the study area is very important, increasingly imperative, due to the fact that there are various indexes and methodologies proposed to measure food vulnerability as we have been able to appreciate, but none meet the precise indicators for this study area and many of the proposals are not applied.

3. Materials and methods

3.1. Study area

To carry out the fieldwork, the Mazahua community was chosen as the area to be studied because it has the largest presence in the State of Mexico (**Figure 1**), has 112,000 speakers of the language and its economic activities include subsistence agriculture, backyard livestock, gathering of vegetables, fruits and mushrooms from the plains and the forest (Figueroa, 2020).

Figure 1. Communities with the largest population of Mazahua origin.
Source: Extracted from Figueroa, 2020.

3.2. Collection and documentation of information

The information that made it possible to extract the data that made up the indicators that gave rise to the creation of the index was obtained through semi-structured interviews, which were aimed at identifying the factors that affect the food vulnerability of the Mazahua community and the remaining data were obtained through websites of reliable institutions and organizations such as the National Institute of Statistics, Geography and Informatics (INEGI), the National Council for the Evaluation of Social Development Policy (CONEVAL) and the World Organization for Food and Agriculture Organization of the United Nations (FAO).

3.3. Semi-structured interview

This type of interview facilitates the collection and analysis of social knowledge crystallized in discourses, which have been constructed by the direct and unmediated practice of the protagonists. It also makes it possible for this analysis to take place through the experience of a certain number of people who are both part and product of the action studied (De Toscano, 2009). In semi-structured interviews, interviewers can comfortably obtain information on a specific topic and informants will be free to express their points of view, providing us with more reliable data.

4. Method

The method used was the induction-deduction method, through semi-structured interviews with key informants and the paramount chief of the Mazahua community, which when contrasted with the information obtained in the field allowed visualizing the factors that make up the objective achievement of the study. The method and the participants were specified.

An index is an incorporation of a set of individual indicators that show a multifactorial problem using mathematical methods, its main objective is to quantify and simplify the information of the set of indicators in a way that is understandable to the general public (Marceleño et al., 2019).

The indexes are created gradually, in a first stage we investigate and propose the different individual indicators that have to do with our object of research, then in our second stage we group and organize the individual indicators which bring together a certain number of factors according to their nature, forming the composite indicators and finally we make the composite indicators interact through mathematical algorithms (Freudenberg, 2003).

5. Results and discussion

According to the information found through field work and the bibliographic review, the following indicators and variables must be taken into account in order to create a food vulnerability index in the Mazahua Community of the State of Mexico (**Table 1**).

Table 1. Indicators and variables for the creation of the Vulnerability Index.

Indicators	Variables	Measurement/Interpretation (the degree of incidence will be measured on a scale of (0 to 1) ascending
Natural	Climate change	Inclement weather stability in terms of temperature, drought or rainfall. The higher the temperature, drought or rainfall, the scale approaches 1.
	Genetic plurality	Variety of genetically modified species available for planting and production. The greater the variety, the closer to 0 and the smaller the variety, the scale tends to 1.
	Forest food	Quantity of food products collected from the forest. The greater the variety collected, the scale approaches 0 and the smaller it approaches 1.
	Natural Resources	Availability of natural resources in their territories. The higher the availability of resources the scale tends to 0 and the lower the availability tends to 1.
	Spirituality	It brings together the way of life and the close relationship with their ancestors and nature from daily actions. Higher degree of spirituality tends to 0 and lower degree to 1.
Economic	Income level	Amount of money received by the family nucleus in the period of one month, taking into account the poverty line. The higher the income the scale tends to 0 and the lower it tends to 1.
	Financial shortfalls	Access to credit, bank cards. The higher the accessibility to credit, the scale tends to 0 and the lower the accessibility, the scale tends to 1.
	Sources of Income	Main sources that facilitate the acquisition of resources. More than three sources, scale tends to 0, 1 source or less approaches 1.
	Government Cash Transfers	Number of money transfers that the household has. If it is greater than 1, the scale tends to 0 and if it is 1 or less than 1 the scale tends to 1.
	Self-consumption level	Capacity to satisfy their food needs from their harvests. The longer the time of consumption the scale tends to 0 and the shorter the time the scale tends to 1.
Social	Mobility	Roads and trucks available to move safely and efficiently. The higher the mobility the scale approaches 0 and the lower the mobility the scale approaches 1.
	Educational level	Primary, Secondary, High School and University. If you have elementary and high school the scale is close to 1, Bachelor and University the scale tends to 0.
	Access to Health	They have medical insurance or a nearby medical center to which they can go. If they have it, the scale approaches 0 and if they do not have it, it approaches 1.
	Discrimination	They suffer physical or verbal aggression, they are denied opportunities for development, they are not recognized as members of society. If it exists, it is close to 1 and if it does not, it is close to 0.
	Enjoyment and Recreation	They spend time getting to know new places, going on family outings, community parties, playing sports. If they do, the scale tends to 0, otherwise it tends to 1.

Table 1. (*Continued*).

Indicators	Variables	Measurement/Interpretation (the degree of incidence will be measured on a scale of (0 to 1) ascending
Cultural	Language	They master their indigenous language and practice it daily. If this is the case, the scale tends to 1, otherwise it tends to 0.
	Community Acquired Skills	Mastery of weaving, pottery, seed preservation. Knowledge of the climate. The higher the skills the scale tends to zero, the lower the skills the scale tends to 1.
	Allegorical festivities, sacred dates, sacred dates, etc.	Allegorical celebrations endure, new generations maintain their traditions. If traditions are maintained, the scale is close to 0, otherwise it tends to 1.
	Clothing	Most people keep their traditional dress both women and men. If they do, the scale tends to zero. If not, the scale tends to 1.
	Ancestral knowledge	They have mastered traditional medicine, knowledge of nature, myths, and culinary knowledge. If they possess it, the scale tends to 0. If not, it tends to 1
Adaptive Capacity	New cultivation techniques	They master new techniques for planting, knowledge of the land and knowledge of plants in the territory. If they have it, the scale tends to 0. If not, it tends to 1
	People who cannot read or write.	Number of people who cannot read or write. If the number is higher than the national average the scale tends to 0 otherwise it tends to 1.
	Access to agricultural machinery	They have machinery for sowing and dominate its use. If they have machines the scale tends to 0 and if not tends to 1.
	Timeliness	At all times of the year they have safe and nutritious food for the whole family. If they have food most of the year the scale tends to 0 and if not counted tends to 1.
	Access to Community Resources	There are resources in the community that we can make use of. If we have resources to scale it is close to o and if we do not, it is close to 1.
Resilience	Problem-solving skills	They face adversities and solve them effectively, there is organization and cohesion in the community. If they exist, the scale tends to 0; if they do not exist, it tends to 1.
	Tolerance to frustration	They assume with discipline and optimism the unfavorable situations of life. If it is fulfilled, the scale tends to 0. If they do not have tolerance, the scale tends to 1.
	Acceptance of reality	Actions you take to improve your environment. If actions are taken, the scale tends to 0. If there are no actions the scale tends to 1.
	Communicating Concerns Assertively	Ability to speak to the public, convince and express own and collective difficulties in an adequate manner. If it is fulfilled the scale tends to 0 if not fulfilled tends to 1.
	Emotional Intelligence	Mastery of my emotions and knowledge of the emotions of others. If this is achieved the scale tends to 0, if not the scale tends to 1.

Creation of the index

A food vulnerability index is proposed for the Mazahua community in which each variable has a weighting of 1 and each indicator of 5 units, the index is reflected in the following formula: VA = N + E + S − (CC + Ad + R) where: VA: Food Vulnerability, N: Natural = 5, E: Economic = 5, S: Social = 5, CC: Cultural Component = 5, Ad: Adaptability = 5, and R: Resilience = 5. If the formula adopts the following expression VA = 5 + 5 + 5 − (0 + 0 + 0) = 15 considering that all the positive factors would reach the maximum value and the negative ones their minimum value, the VA would be 100%. The weighting factor is 0.06667 = 100/15/100 where 15 = 100%. At the time of capturing the information, the number of variables that do not have natural,

economic and social indicators should be entered. For the variables of the resilience, adaptive capacity and native component indicators, the variables that do exist are counted, causing the inverse effect.

VA between 0 and 1 presents vulnerability VA less than 0 no Vulnerability.

6. Conclusions

It is feasible to propose the food vulnerability index for the Mazahua community, after the literature review and field work. The methodology of food vulnerability indexes already existing for Latin America and Mexico in particular do not meet the relevant requirements for this particular case study and our proposal adopts variables such as culture, ancestral knowledge and spirituality, which offer the index a holistic character for these territories under study. Therefore, an index with these characteristics can be applied to provide accurate data for the development of these communities.

Schools in the study area should encourage the learning of the native language, uses and customs of the Mazahua community.

Social benefit programs should be focused on the production of goods and services that generate jobs for the community.

The public health system must be more present in the Mazahua communities of the native peoples.

Improve infrastructure to ensure better viability for residents and visitors.

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