The Biocultural System of the Native Corn Zapalote chico in the Tehuantepec Isthmus (Mexico)

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Abstract. In this work, we characterized the food-processing system used by the population of the Tehuantepec Isthmus (Mexico), largely of zapotec origin. Also, we examined the relationship of the system to the native corn zapalote chico, and assessed its potential for retaining its food sovereignty. For this purpose, we performed extensive empirical fieldwork involving peasant and consumer surveys, and also on interviews with key local informants. Based on the results, the native cereal, which accounts for more than one half of the food intake for the locals, is cropped by a high proportion of peasants in the region. As confirmed here, this native variety is used to produce a wide variety of highly complex and diverse foods that remain the dietary basis for the isthmian population as a legacy of the pre-Hispanic Mesoamerican counterfoil. Available empirical evidence suggests that this food system, linked to the cereal’s biocultural model, has allowed the population to retain a high level of food sovereignty or autonomy.

Introduction

Mexico is one of the twelve megadiverse countries in the world. In fact, it houses 60–70% of the global biodiversity, and is the origin of the domestication and genetic diversification of 15.4% of the species comprising the world’s food system [13]. One such species is maize (Zea mays L.). A total of 59 native maize races among the 346 assumed to exist on a global level have been identified in Mexico [11]. Also, 35 of those 59 races (58.0%) occur in the Oaxaca state, which accounts for 4.8% of Mexico’s land area and includes the Tehuantepec Isthmus. Archaeological evidence dating from 4000 yr B.C. found in the Guilá Naquitz caves, Oaxaca, suggests that this country was the origin and principal domestication site for maize [15]. Also, that region houses five living populations of teocintle, a wild ancestor of maize. The origin and domestication sites for maize are located in places currently inhabited by indigenous populations [7].

In this work, we studied the native maize variety zapalote chico (xuba huini in the local dialect) to characterize the agrifood system based on it and assess the degree of food sovereignty it confers to the population of the Tehuantepec Isthmus, which is largely of zapotec origin. The starting hypothesis was that most peasants in the region crop zapalote chico as a result of their adaptation to the environment (supply factor) and the age-old cooking system around this cereal (demand factor), which is closely linked to Mesoamerican maize-growing tradition and has aroused strong cultural resistance to change among peasants and consumers in the region. The interest of this study is enhanced by the scarcity of research into zapalote chico in the Tehuantepec Isthmus.
with the exception of work by the López Romero and co-workers [16-19], and Regalado López and co-workers [23]. These authors have investigated the properties, cropping and production methods, and sales of the cereal in relation to the zapotec population of the region.

This research is especially important if one considers the unending price rise of food since 2007 largely resulting from speculative marketing investments. Also, Mexico, which is one of the greatest maize producers and consumers in the world, has been under a growing oligopoly of global agrifood companies, especially since the North American Free Trade Agreement, signed in 1994, undermined small and mid-sized family farming systems [10]. As shown here, there are effective alternatives to these national and global trends. In some places where the indigenous population prevails, agrifood diversity and autonomy are protected under the umbrella of family and community agriculture [1].

Material and Methods

Study Area

The Tehuantepec Isthmus is one of Mexico’s largest areas in wood, forest and aquifer biodiversity.


The isthmus is located in the southwest of the Oaxaca state and spans an area of 798 900 ha (1% of the national figure). The area has a population of 340 883 that encompasses five ethnic groups in addition to a national mixed-race group and a small African mixed-race group. The zapotecs account for 30.5% of the overall regional population [8].
Zapalote chico is exclusively grown in a well-defined geographic area of the isthmus [24], [14], [15], [2-4].

**Genetic Material**

Wellhausen [24] and Ortega-Paczka [21-22] classified the 59 native races of maize present in Mexico into six large groups, namely: indigenous, exotic Pre-Colombian, pre-historic mixed, incipient modern, ill-defined and unclassifiable. Zapalote chico, which was included in the pre-historic mixed race group, is a highly precocious variety (85 days) producing short plants with also short, thick cylindrical cobs slightly thinner at the apex. Cobs are typically 44–49 mm wide, stalks 29–34 mm long and grains 10–13 mm long. Grains are short and wide, the endosperm is white and the pericarp colorless. This maize variety is highly resistant to strong winds —a result of its small size —, attack by the African armyworm —thanks to its effective cob coating— and drought. Also, it contains very nutritious starch, which makes it highly suitable for making foods such as totopo, elote quesadillas and tamales [24], [2], [19].

According to [20] and [7], zapalote chico differentiation started some 2500 years ago. This maize variety encompasses 22 favorable genetic complexes not present in any other race, which makes it the most perfect plant on earth. Also, according to [19], natural selection and adverse environmental conditions such as heat, drought, wind and pests in the Tehuantepec Isthmus have compounded with artificial selection to drive it through an evolution pathway considerably departing from those of other populations for 5000 years [19].

**Experimental Design and Treatment**

As noted earlier, the primary aim of this work was to characterize the agrifood system revolving around zapalote chico in the Tehuantepec Isthmus on the basis of available literature and extensive fieldwork conducted over the period 2010–2014. The agri-food system is made up of a set of socio-economic activities that make it possible to meet the demand for food by society in sufficient time, quantity and quality, through the use of traditional practices and knowledge, which
has allowed conservation of the biological diversity and the sustainable use of its components [25], [7]. The degree of food sovereignty, in this case, has been measured through three variables: Corn self-sufficiency; Self-sufficiency of basic consumer goods and degree of satisfaction in the consumption of corn and its derivatives [25], [10], [5].

The type of information to be obtained led us to adopt a mix-method approach involving quantitative processing of the responses to peasant and consumer questionnaires (the data was processed using the SPSS Inc Statistic 17 program), and assessing qualitative information from in-depth interviews with key informants [9], [12]. Also, an exhaustive compilation of the typical dishes made with the cereal in the study area was produced. The information thus gathered was supplemented with direct observations during fieldwork.

The peasants and consumers to be administered the questionnaires were selected by using a non-probabilistic intentional or convenience sampling method instead of the invariably expensive probabilistic sampling method. Because no official or unofficial peasant census was available, their numbers had to be calculated from the cultivated land area and average farm size. The number of maize-cropping peasants in the Isthmus was thus estimated to be around 36 000, 195 of whom were given a questionnaire. Most selected peasants were from the so-called “maize corridor”, which comprises the following municipalities: Juchitán, Xadani, Tehuantepec, Comitancillo, Ixtaltepec, San Blas Atempa and Matías Romero. As regards consumers, the sampling method was applied in 20 randomly chosen municipalities among the 41 in the isthmus. Their population amounts to 340 000 and the number of inhabitants receiving the questionnaires was 161. The following box summarizes the fieldwork performed.

<table>
<thead>
<tr>
<th>Research techniques used</th>
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<td>– 195 questionnaires for maize peasants.</td>
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<td>– 161 questionnaires for consumer families in the area</td>
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<td>– 29 sheets of zapalote chico-based foods</td>
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<td>– 13 interviews with women producing and selling maize-based foods at local markets</td>
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<td>– 2 interviews with representatives and members of peasant associations</td>
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<td>– 1 interview with a municipal civil servant in the agricultural sector</td>
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<td>– 1 interview with a tortilla seller</td>
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<td>– 1 interview with a maize miller</td>
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While the small size of the sample and the method used to select it may have detracted from statistical representativeness in the results, these did allow us to estimate the reality and opinion of peasants and consumers in the area. Fieldwork was adapted to the peculiarities of the target families. Thus, in maize-producing families, transformation processes are essentially conducted by the women, who play an active role in marketing the products and contribute substantially to the family’s income. For these reasons, the research techniques used were aimed at specific groups, namely: males for peasants, association representatives and civil servants; and females for family heads and maize product sellers.

**Results and Discussion**

Based on the sociological results, the target peasants are largely males aged 31–50 yr speaking the indigenous zapotec language and having no studies or primary education only, with farming as their exclusive occupation and a monthly income of less than 2,000 pesos (about $106 USA)—less than one-half the guaranteed minimum wage in Mexico— (see Fig. 1).
Figure 1. Prevailing sociological profile among the surveyed peasants.

Also worth noting is the tight binding of the families to zapalote chico, which is their main produce and also the essential ingredient of their diet. In fact, 85.1% of all surveyed peasants were growing the cereal, against 5.5% cropping zapalote grande and 4% other types of maize. Their main argument to prefer this native cereal was its precociousness, followed by its resistance to pests and strong local winds, the ability to obtain a variety of foods and their special taste.

More of 30% of the peasants, reported having 1.2-2 ha of cropped land of was used to grow maize and, largely, zapote chico. Individual farms were mostly small: two-thirds used 1–5 ha to grow the cereal, 11% more than 5 ha and 16% less than 1 ha (see Fig. 2). These land fractions are similar to overall figures for the country, where 85.1% of all maize producers use 5 ha or less for maize cropping.

Figure 2. Percent distribution of peasants according to zapalote chico-cropped land area.

Maize in the Tehuantepec Isthmus is managed either as an associate crop (milpa) or as a monoculture. Based on peasants’ responses, the latter prevails, albeit with differences among municipalities in the region. This is also the case with the irrigation method used (seasonal irrigation or dry farming). This factor strongly influences productivity; in fact, zapalote chico production under irrigation 2–3 times higher than with dry farming (2–3 vs 1 ton). Overall, crop yields are rather low, but this disadvantage is partly offset by the ability to harvest this maize race two—or, occasionally, three—times a year.

As far as crop outlets are concerned, most peasants use zapalote chico for self-consumption and, to a variable extent, also for selling at local markets. Only one-fifth reported using their whole produce for family self-consumption (see Fig. 3). Therefore, the rationale behind the farms essentially continues to be fulfilling the family’s nutritional requirements, albeit with provision for marketing to a variable degree at the local or regional level.
One out of five surveyed consumers reported that more than 80% of their diet consisted of zapalote chico, one-third that the cereal accounted for 40–80% of their diet, and another third for 10–40%, with only a small minority (14%) having a diet comprising less than 10% of the cereal and its products (see Fig. 4). These results testify to the strong reliance of the Isthmus population on this natural maize variety and hence of a feeding pattern revolving around it.

A substantial fraction of the population (almost one-third) cooks their own zapalote-based foods, but an even larger one buys them at local markets (one-fourth) or from neighbors and travelling sellers (one-sixth), and only about one-fifth obtain them from other sources. These results confirm the nutritional self-sufficiency of the isthmian population by effect of cropping, processing and marketing of zapalote chico all occurring at the local or regional level. The zapalote-based foods used for marketing or self-consumption fall in the following food families: tortillas, tamales, atoles, bread, esquites and molitos. The individual products most widely consumed in the Isthmus are totopos, tortillas, tamales, guetazee, gueta-badxi, quesadillas and elote bread (see Fig. 5 and Table 1).

**Figure 3.** Percent distribution of peasants according to production for self-consumption and marketing.

**Figure 4.** Percent contribution of zapalote chico to the diet of the isthmian population. [% consumers/% diet • Maize/Zapalote chico]
Table 1. Food families of zapalote chico products.

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<th>FAMILY</th>
<th>FOODS</th>
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<td>Tortillas</td>
<td>New corn totopo (Gueta xhuba cubi), traditional unsalted totopo (Gueta yacchi), bean totopo (Gueta bizaa), pumpkin seed totopo (Gueta vidxi guitu), brown-sugar totopo (Gueta dxiña), butter totopo (Gueta mantequita), salted butter totopo (Gueta mantequita siidi), sweet butter totopo (Gueta mantequita dxiña), salted totopo (Gueta siidi), totopo and goosefoot (Gueta vitiaa), coconut totopo (Gueta coco), peanut totopo (Gueta cacahuat). Round tortilla (Gueta naalaga), cow tongue tortilla (Gueta ludxi vaca), ball tortilla (Gueta bicuuni bola), three-corner tortilla (Gueta chona esquina), oblong tortilla (Gueta bicuuni yu'la'), oval tortilla (Gueta bicuuni bata), butter tortilla (Gueta mantequilla) and butter and sugar tortilla.</td>
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<td>Tamales</td>
<td>Small elote tamale (Gueta zee), small boiled elote tamale (Guetab baa dxi ‘zee), iguana and egg tamale (Gueta guu guchachi’ dxiúta), chicken and black mole tamale, beef tamale (Gueta guu beela za), small cambray tamale (Gueta guu cambray), green sauce tamale (Gueta nniu salsa verde), bean tamale (Gueta baadxi’ bizaa).</td>
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<tr>
<td>Atoles (drinks)</td>
<td>White atole (Nisiiaba), champurrado (Nisiiaba’ ne dxiúlad), novena atole (Nisiiaba’ ladxi), milk and sugar atole, foam atole, pozole (Cuba), milk pozole, brown-sugar pozole, tamarind pozole, coconut cake pozole, sour pozole and Bupu.</td>
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<tr>
<td>Bread</td>
<td>Elote quesadilla, corn bread (Pan zee), pimpo (Pimpu), shrimp or fish tortilla (Gueta’ bi’ngui’).</td>
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<tr>
<td>Esquites</td>
<td>Esquite and soft elote.</td>
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<tr>
<td>Molitos</td>
<td>Shrimp molito (Güiña dò benda boaa), beef molito (Cheguiña), pork molito (Zeé beela bihu or Zee belá bihu), iguana molito.</td>
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</table>

Overall, the results confirm that zapalote chico has played an essential role in consolidating the food sovereignty of the regional population and, especially, that of peasants. The fact that its production is shared between self-consumption and selling at local or regional markets has ensured nutritional subsistence based on a balanced diet; thus, the local markets in the Isthmus provide an abundant, diverse choice of all types of foods that are exchanged by maize-based products (the staple foods for the region’s gastronomy). Some of these foods are prepared and consumed in specific celebrations and festivities: Gueta guu guchachi’ dxiúta are prepared at Easter; nisiiaba’ ladxi and tamals, in the novenarios; the bupu in the Labrada de Cera of the Velas (celebrations) and the pozol is the food of the peasants when they go to the cornfield. There are thus no impoverished,
undernourished peasants, but rather a population of individuals enjoying a balanced, rich diet despite their modest income.

According to the interviewed experts, the region has a subsistence economy relying on a redistribution, reciprocity logic that has so far resisted capitalist dynamics. In their opinion, the peasants continue to grow *zapalote chico* for reasons of cultural resistance despite the many government-sponsored programs subsidizing sorghum, sesame, rice and sugarcane plantations. These informants confirmed that preferring this native cereal over others is a result of its taste, gastronomic diversity, nutritional value, precociouslyness, easy adaptation to the environment and color —some of the attributes that have led the regional population to deem this cereal the best in the world. However, the strength of this crop is somehow threatened by its low profitability and the lack of farming subsidies.

The results of this work therefore confirm that a vast majority of peasants in the Tehuantepec Isthmus grow *zapalote chico* and use their produce partly for self-consumption and partly for selling at local or regional markets. As a result, this maize race is an essential ingredient of the isthmian population’s diet.

**Conclusions**

The results of this study picture a unique region with an agrifood and biocultural heritage of its own with a high food sovereignty as a result of the population using a local maize race as staple food. This has allowed the Tehuantepec Isthmus to withstand the ever oscillating and erratic dynamics of prices at international markets, a stance strengthened by the population’s resistance to adopting commercial and transgenic hybrids of the cereal.

Our results confirm previous hypotheses and provides new information about the share of *zapalote chico* and its derivatives in the regional diet. Also, these results provide empirical evidence that confirms our starting hypothesis: this region retains a nutritional pattern of its own revolving around a farming system and nutritional model based on single maize race. Also, the largely indigenous population possesses a deeply rooted ethnic (zapotec) culture, and has produced a highly complex, diverse, sophisticated and well-balanced nutritional cooking system dating back to pre-Hispanic times.

The Meso-American region, where the Tehuantepec Isthmus lies, is one of so-called “sites of origin”, where the wild plants present in the food systems of many peoples were first domesticated, transformed and diversified. These sites play a major role in the countries concerned and also, probably, in the rest of the world, namely: preserving the original germplasm and helping it adapt to the ever-changing environmental and socio-cultural conditions. The germplasm has been domesticated, diversified and maintained through indigenous and rural agricultural practices in a process that continues today.

Although *zapalote chico* is less productive than other maize races, official attempts at introducing alternative crops such as rice, sugarcane, sorghum or sesame, and establishing high-yield hybrid or even transgenic varieties, have failed as peasants in the region continue to prefer their own cereal, mainly on the grounds of its precocity, its resistance to strong winds and the African armyworm, and its containing highly nutritious starch that is especially well suited to the regional gastronomy. In summary, the prevalence of *zapalote chico* in farmers’ and consumers’ diets is a result of its easy adaption to the environmental conditions and the gastronomic culture of the region.

The territorial, social and nutritional consequences of this agrifood system have made the Tehuantepec Isthmus a region with a safe, nutritious, autonomous and singular nutritional pattern. Such a pattern has successfully resisted the industrialization and globalization processes that are fostering dependence, eroding biological diversity, and endangering rural, indigenous, family and community farming, around the globe. Finally, as confirmed here, some biocultural regions still remain in the world where the population leads an autonomous life. The maize-based zapotec agrifood pattern of the population in the Tehuantepec Isthmus is a clear example. In fact, the isthmian population has resisted external social and cultural pressure because the original zapotec
civilization has successfully faced history with great strength and vitality. At present, the zapotecs boast an economic and community consumption system that singles out the “best contributors” from those who are simply materially rich. In fact, their traditional feasts and celebrations favor confidence, redistribution and reciprocity over mercantilist logic. Their high regard of their customs, traditions and knowledge have made the zapotecs culturally resistant to foreign agrifood models. Also, the historic strength of the indigenous population has propitiated a policy of resistance and rebellion among people who refuse to yield. This strength has made the people even more inclined to retain their autonomous agricultural practices despite much external pressure. The regional peasants and natives, and the population at large, have committed themselves to their maize race and resisted financial, technological and commercial subsidizing, which are increasingly compromising native maize races and the biocultural heritage of Mexico.

References


