Food Security, Self-Sufficiency, and the Availability of Amaranth in Mexico

Laura Martínez Salvador[1]

[1]Doctoral student in economics at UNAM, Mexico. E-mail address: lauramtz.sa@hotmail.com

Abstract:
In Mexico, obesity and malnutrition have become a severe public health problem. As a result, a return to nutritional surplus crops, such as amaranth, has emerged as an alternative to improve the population's diet and mitigate malnutrition-related problems in Mexico. Amaranth, considered to be a crop with wide-ranging nutritional potential, has seen a statistical reduction in production, entailing a clear example of untapped agricultural potential and diversity resulting from the food strategy. It will be important to revive local amaranth production, ensuring that the actors involved in growing this crop have the capacity to boost its production and consumption to better deal with the problems of malnutrition and food security.
Key Words: Amaranth, agricultural crop, food security, nutrition, malnutrition

Date received: November 24, 2015
Date accepted: April 13, 2016

INTRODUCTION

In the mid-twentieth century, starting in the 1980s, one of the major and unfortunate transformations in the context of a new globalized and liberalized economy was the dismantling of government support for the agricultural and livestock productive sector.

In the so-called "lost decade," a series of structural economic reforms were undertaken, leading to significant consequences for productive sectors throughout all of Latin America. In the specific case of Mexico, the state promoted an export policy for the agriculture and livestock sector, delegating to the whims of the market the supply of such basic elements of agricultural productivity as inputs and machinery, credit and funding, and technical training.

In this time period, the elimination of price guarantees and policies related to technological changes, which gambled on technology transfers instead of collaborative technology development, ended up weakening the Mexican agricultural sector. In the wake of Mexico's disastrous decision to join the General Agreement on Tariffs and Trade (GATT) and the North American Free Trade Agreement (NAFTA), the dynamics of the agriculture and livestock sector in Mexico diverged markedly. In the two decades following, the agriculture and livestock sector saw a reduced growth rate of 1.7% on average annually as compared to the rising volume of agriculture and livestock exports and imports, which quadrupled and

quintupled, respectively (Flores, 2013: 9). In the context of these transformations, the agriculture and livestock sector was thrown severely out of balance, reflecting alarming levels of food dependency and a diversification of the food supply, which although broader, was to a certain point harmful.[2]

In Mexico, obesity and malnutrition are now severe public health problems[3], on which policies meant to reduce food poverty have had little impact and have produced barely visible results. That is why reviving nutritional and surplus crops, such as amaranth, is an alternative that could help improve the Mexican diet and mitigate malnutrition-related problems.

Incentivizing the production, transformation, and distribution of crops such as amaranth is an option in the pursuit of national food security, which would simultaneously improve the economic circumstances of amaranth-producing towns and help people in vulnerable communities to achieve minimum nutritional and dietary requirements. In light of the foregoing, any food security strategy must include the production of native crops with both availability and self-sufficiency, and which, like amaranth, have a broad nutritional, agronomic, and productive profile.

The goal of this paper is to analyze the nutritional, agronomic, and productive characteristics of the native amaranth crop in Mexico and its potential, which will include an analysis of the dimension of "availability" in food security, to contribute as an alternative in food strategies. To do so, I will conduct a document review and analyze case studies and statistics related to the amaranth crop in Mexico in its most recent stage, and identify the nutritional, agronomic, and productive potentialities of the crop based on its essential condition of availability.

FOOD SECURITY AND ITS DIMENSIONS

Food security is understood as the condition by which everyone in a given country has "at all times physical and economic access to sufficient healthy and nutritious food to satisfy food needs and preferences when it comes to food [with the purpose of] living a healthy and active life" (FAO, 1996). This condition of food security is defined by the agronomic, biological, economic, and social conditions in a region and can be affected by various elements, such as: i) the rise in food prices; ii) population growth in a region beyond proportional growth; iii) environmental pollution and degradation, which makes agricultural soil and ecosystems hostile; iv) deficient forms of production and food distribution; v) the presence of segregated and oligopolistic agrifood markets; vi) the poor use or diversion of agriculture and livestock products for non-food purposes, such a producing fuels, plastics, or fertilizers; and even vii) financial and energy crises.

Food security applies at different levels of aggregation (national, regional, household, and individual), different timeframes (chronic or temporary), and is grounded in four main dimensions: i) food availability; ii) access; iii) utilization; and iv) stability (FAO, 2006).

There is a causal relationship between the aforementioned dimensions of food security. Availability refers primarily to the physical existence of food, obtained from overall national production, trade in food products by way of imports, and even theft from exported food, food aid, and food stores (FAO, 2006).

The dimension of food availability is a necessary but insufficient condition to achieve food security for a region or population. However, this physical availability of food can be considered a prerequisite for access to food, which depends primarily on the financial resources of individuals (individually or aggregated) and the price of food on the market (FAO, 2006).

To Amartya Sen (1982, in Aguirre, 2004: 1-2), the pillars or dimensions of food security to not all enjoy the same importance. The availability and presence of multiple physical and human resources that give rise to food production is just a basic condition for food security, as the rise in the food supply, in some cases more than proportional to the demographic explosion, has not always meant a consequent decrease in starvation. Hunger is a function both of access to food as well as its distribution, and even the vision of food as a right (Sen,1982: 7). As such, it can be inferred that it is not the population in general which, strictly speaking, suffers some degree of malnutrition, but rather that those who do have malnutrition are part of the population suffering from asymmetric food distribution, insufficient real income, and conditions that violate fundamental rights, such as access to food.

Based on the foregoing, the dimension of availability becomes less relevant in relation to access, although it is still considered an essential requirement for food security. On the other hand, access to food (with the economic capacity of individuals to acquire it), is not a sufficient condition either, although it is necessary to guarantee food security. In light of this, the other dimension of utilization of food becomes important.

The dimension of utilization refers to the nutritional welfare accessible to an individual and encompasses: i) the quantity and way in which food nutrients are used and harnessed by the organism in the search for improving the quality of life of individuals (biological utilization) and ii) the way the food is used, which is a function of food habits in the region, where culture, uses, customs, and habits are elements that play an essential role in establishing optimal food security levels (FAO, 2006). Food utilization is tied not only to availability and access but also to the way in which people obtain, prepare, and consume food.

The stability of a region or population, as a dimension of food security, refers to the capacity to guarantee the aforementioned three conditions (availability, access, and good utilization of food) at all times and in the long term, as well as to minimize the impact of potential natural and biological disasters, climate change, food price volatility in the international market, and even the effects of internal social conflicts (FAO, 2006 and Chung et al., 1997).

Preventing seasonal variations that compromise the provision of health and adequately nutritional food in a region or population entails finding sustainability and resilience in agrifood systems, especially those that, as in the case of amaranth, are primarily family-based small-scale farming endeavors, with limited productive capacities, and are generally spearheaded by rural families. This type of family farming, which in Latin American countries can account for up to 80% of agriculture, creates sources of rural and farming jobs, and provides foods for urban areas, as well, contributing to territorial and community development (FAO, 2014), when crops such as amaranth are produced.

AVAILABILITY AND SELF-SUFFICIENCY IN FOOD SECURITY

An analysis of the dimensions that comprise food security, given their nature, would suggest, initially, that food availability is an essential condition to overcoming hunger. The physical availability of food, as mentioned earlier, is focused on the food supply and depends on: i) natural resources (precipitation, soil quality, agronomic and climate stability, access to forestry resources); ii) physical resources (access to farming infrastructure, livestock and land ownership rights); iii) human resources (education, gender, and age of heads of households, as well as the size of family groups and levels of dependency of the economically active population) (Chung et al., 1997: 6).

In addition, food availability depends on such elements as areas dedicated to cultivating agrifood, water resources, the capacity to access and make optimal use of inputs, the frequency of harvest seasons, the diversity and yields of crops, production levels, trade inventory, and exchange of food (Chung et al., 1997: 6).

In food security strategies, the food availability or supply must be:

i. Sufficient: with enough energy content in the food for each and every inhabitant in the region.
ii. Stable: meaning that food availability levels are maintained constant over time.
iii. Autonomous: referring to food self-sufficiency, which is an indicator of the capacity to satisfy effective demand and provide the population with food in sufficient quantities without depending on an external supply (Chateauneuf, 1995, in Aguirre, 2004: 2 and Morón and Schejman, 1997: 33).
iv. Sustainable: agrifood systems must seek to protect the natural resources used without compromising the food security of future generations (Morón and Schejtman, 1997: 33-34).
v. Safe: the condition in which the health of individuals is not compromised by eating food (Morón and Schejtman, 1997: 34-35).

A more comprehensive analysis of the dimension of availability raises a critique of the attainment and physical availability of food, because even in the very definition of food security, it establishes that food supply and availability should be "via local production, imports, or by way of food aid" (FAO, 2006), which gives rise to ambiguity in strategies directed towards achieving food security and leaves out an extremely important element in this regard: food self-sufficiency. To the FAO (2002), food self-sufficiency is the condition under which the food needs of a population, country, or region are covered and satisfied by way of local agrifood production. This condition brings with it the main advantages of protecting the food supply and insuring against fluctuations in price, availability, and the conditions of the international agricultural products market. Likewise, self-sufficiency oriented policies tend to lower dependence on imported foods.

However, in spite of the agrifood virtues of the self-sufficiency approach, there is also good reason to critique this practice, because although it does entail currency savings that would have otherwise been destined to purchasing imported foods (FAO, 2002: 4), in the absence of imported food, these financial funds are not necessarily channeled to productive agricultural sectors, and therefore the effect of these savings can be practically imperceptible. In addition, for nations with unfavorable agronomic conditions,

insufficient water infrastructure, or underdeveloped farming systems, food self-sufficiency strategies can lead to a string of political fumbles, rather than successes.

Partial dependency on imported foods could be an alternative strategy to the problem of local productive insufficiency and how to safeguard the food stability of a region. However, even though it may not be feasible to withdraw from the international food trade altogether, and even though importing from the international market may run counter to efforts to achieve full food self-sufficiency, it is a major risk to food insecurity that more than 25% (Curiel, 2013: 9) of the food components of the basic diet needed to satisfy the population comes from imports, and this figure is rising.

Security and self-sufficiency find their common denominator in food availability, because both approaches seek to achieve individual development by emphasizing the food supply. As such, in the search for alternatives to strengthen food security strategies in Mexico, the production, transformation, and commercialization of native crops with ample potential, such as amaranth, which is a surplus crop and self-sufficient, is certainly a contribution to the field.

Although availability alone does not guarantee food security, it is the first of the four dimensions, which, broadly speaking, makes it eligible to help achieve food security.

THE POTENTIAL OF THE AMARANTH CROP TO CONTRIBUTE TO SELF-SUFFICIENCY IN PURSUIT OF FOOD SECURITY

Amaranth, a word rooted in the Greek, means “that which does not wilt, the unwilting” (Porr, 2012: 2). It has gained ground in global food dynamics in recent years. However, its cultivation history is summarily ancient. Based on its origin and use, amaranth could be considered a native crop of Mesoamerica. Cultivated since 5,000 B.C., amaranth (huahtli) was long considered a grain imbued with significant social, religious, and economic worth, before the Conquest, and was held in the same regard as such crops as corn and beans.

Amaranth, considered a pseudo-grain, grows intensively and undergoes extremely fast and effective photosynthesis with little regard for the quality of the soil in which it grows. It can also survive in extreme climate conditions, ranging “from arid to humid environments, regions far above sea level, and is able to develop in soil of all types of qualities” (SIAP, 2013b: 17). This resistance and adaptability to adverse agronomic conditions constitutes a production opportunity for small-scale rural growers, as amaranth is lower risk than the more common crops grown in Mexico. One example of this is that, in an analysis from 1987 to 2014, an average of merely 3.3% of the surface area planted with amaranth suffered some type of loss, while in the case of other fundamental crops to the Mexican diet, such as rice and corn, these figures were as high as 8.7% and 11.4%, respectively. Comparatively, rice has a 38% higher chance of losses, and corn 29% higher, than amaranth (SIACON, 2014).

Nutritional Characteristics and Ways to Use Amaranth

Amaranth has great agrifood potential, because its seeds, plants, and leaves all possess nutritional value that surpasses that of some of the more commonly used grains, so it is highly recommended for both human and animal consumption.

In addition, the amaranth grain does not contain gluten in its chemical composition, so people with gluten intolerances are able to eat it. Gluten is generally found in wheat, barley, and oats. The amaranth seed, in a comparative analysis with the most common grains in the Mexican diet (corn, rice, wheat), came up with the following values:

Table 1. Nutritional Value of the Amaranth Seed in Comparison with Other Grains (maximum content in 100 g)

	Amaranth	*Corn*	*Rice*	*Wheat*
Protein (g)	18.0	11.0	8.0	15.0
Iron (mg)	9.0	1.0	3.0	4.5
Calcium (mg)	200.0	20.0	25.0	50.0
Fiber (g)	15.0	7.2	4.0	12.0
Fat (g)	9.0	4.9	2.0	2.0

Source: Created by the author based on Porr (2012), Puente a la Salud Comunitaria (2006), and Kent, N.L. (1998).

The above table reveals how the nutritional content of amaranth is superior to that of the other grains analyzed in all of the categories, which means that amaranth-based products are highly nutritiously fortifying.

The agroindustrial process for amaranth can transform it into a broad variety of products for boosting nutrition and reducing malnutrition, but it can also be transformed into basic consumer products such as cereals and granola bars, flour for bread, tortillas, and crackers, starches, oils, vegetable colorings, nutritional drinks, snacks, food supplements, milk and powdered milk, and even food for babies, such as formula and baby food. The amaranth plant can also be used for human or animal consumption and its leaves contain high levels of calcium, phosphorus, and vitamins, with nutritional values even comparable to those of spinach (Porr, 2012, Velasco and Villela, 2016).

According to Porr (2012), amaranth has antioxidant effects and can also contribute to treating chronic degenerative diseases, such as: osteoporosis, hypertension, constipation, renal and liver failure, and celiac disease for those who are allergic to gluten, or even glucose levels, making it recommended for people with diabetes.

Advances in the use of amaranth in medicine are so ample that an anti-depressant has actually been developed based on the amaranth protein, whose use and application is similar to that of Prozac, with minimal side effects and at an accessible cost (DGCS-UNAM, 2014).

Although amaranth has wide-ranging potential in various realms, such as medicine and even the industrial fabrication of biodegradable utensils (Vélez et al., 2014), perhaps its greatest potential resides in what it

can do for food and nutrition, contributing to help mitigate infant malnutrition in rural and marginalized areas.

One example of this can be found in studies conducted in the state of San Luis Potosí in 2006 by the Society of Rural Producers, known as "San Miguel de Proyectos Agropecuarios." Based on the information provided by this group (2006), the organization studied nearly 1,000 infants in varying states of malnutrition, whose families were asked to include in the infants' daily diet for a time period of one year 400 grams of amaranth concentrate mixed into 13 grams of their normal daily food. The result of this experimental study at the end of the time period was as follows: more than 70% of the infants with "slight malnutrition" recovered considerable weight, while the percentage of improvement or recovery among infants with "moderate and severe malnutrition" at the end of the year came to 37% and 28%, respectively (San Miguel Proyectos Agropecuarios, 2006).

This study reflects how amaranth, as a supplement to the individual diet, particularly in children, can have positive effects at all levels of malnutrition, although the degree of improvement depends on the extent and intensity of the original malnutrition.

It is also useful to consider actions carried out in other latitudes with regard to strengthening traditional crops, which, like amaranth, play a major role in rural economies and the welfare of farmers. Amaranth, known as kiwicha in some countries in Central and South America, has gained renown and marked interest alongside other grains considered to be "super grains," such as quinoa, chia, millet and sorghum, as an alternative in overcoming food security and rural development challenges. Amaranth, cultivated in the Andean zone ranging from Colombia to Argentina, has been added into projects[4] seeking to boost the production and value of farming crops that have fallen into disuse or been neglected, in order to contribute to achieving food security in the Andean region (Rojas et al., 2010).

Amaranth Production in Mexico

Eleven amaranth species grow in Mexico, of which the species Amaranthus hypochondriacus L. and Amaranthus cruentus are endemic to the national territory (Velasco and Villela, 2016). Amaranth production is mainly concentrated in the states located in the central highlands: Tlaxcala, Puebla, State of Mexico, Morelos, Mexico City, Oaxaca, San Luis Potosí, Durango and Querétaro.

Figure 1 provides an overview of the productive dynamics of amaranth in Mexico, showing its distribution by state in 2014:

Source: Created by the author based on data from SIAP (2015).

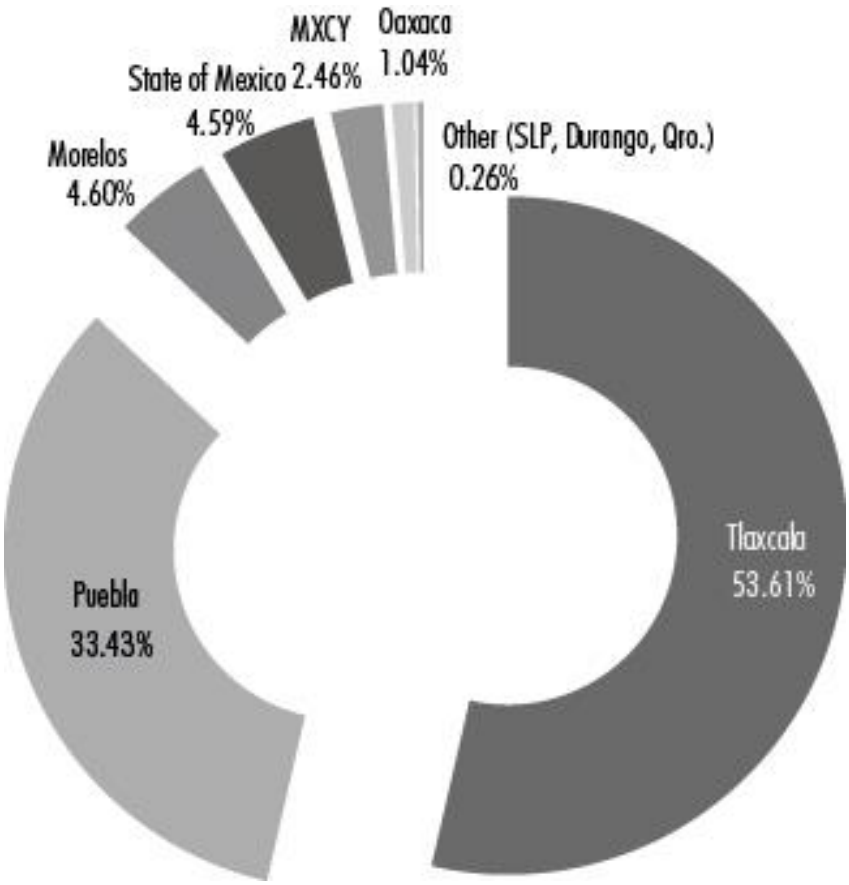

Figure 1. Mexico: Amaranth Production Volume (Percentage by State), 2014

In 2014, a little over 5,000 hectares of amaranth were planted and 6,547 tons were cultivated, which at an average rural price (ARP) of over 11,000 pesos per ton nationwide, represents more than 75 million pesos in value in the production of this grain (SIACON, 2014). It is also useful to note the ARP paid per ton of amaranth, as this can serve as an incentive for production. In the farm year of 2014, it reached as high as 23,000 pesos per ton in Mexico City (SIACON, 2014). Rural prices paid per ton by state are shown below (see Figure 2).

Source: Created by the author based on SIACON (2014).

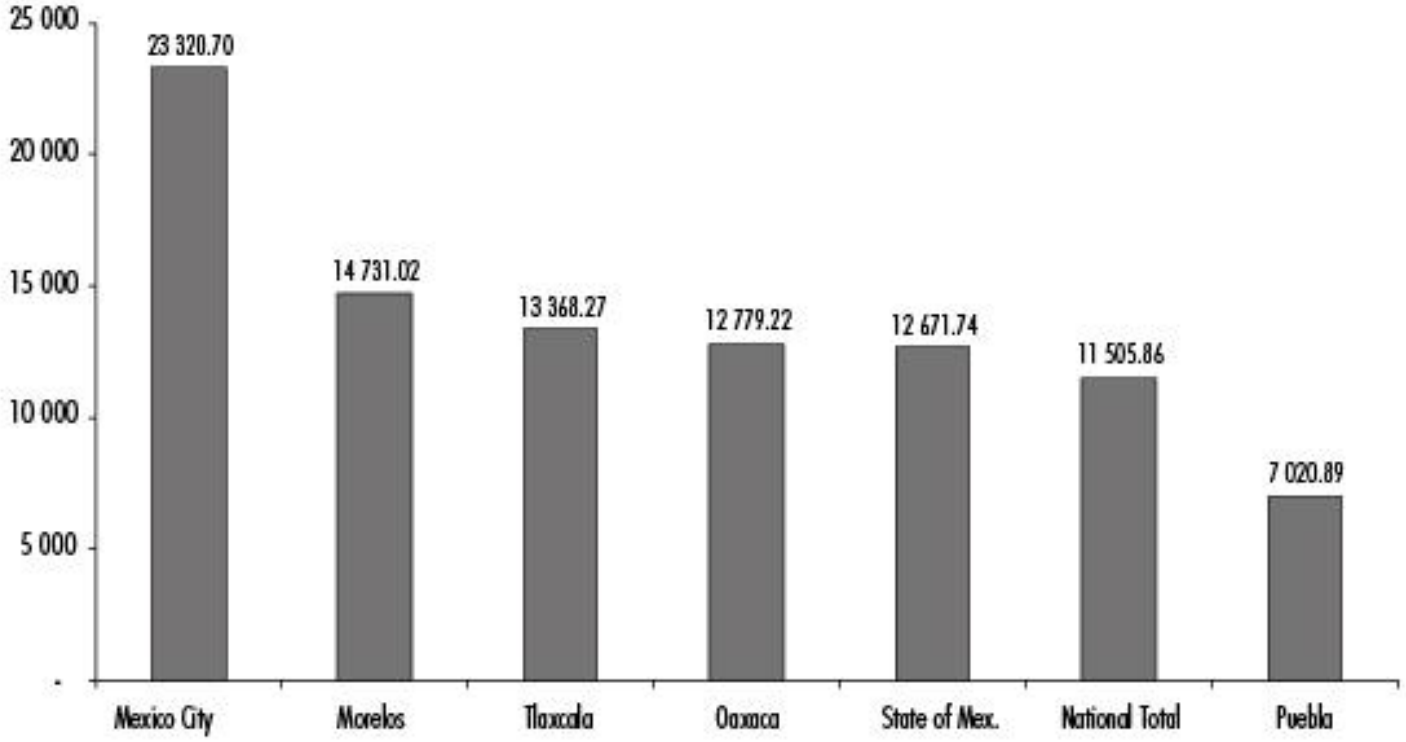

Figure 2. Mexico: Average Rural Price of Amaranth in Mexico by State (pesos paid per ton), 2014

Moreover, the ARP for those involved in planting amaranth is an incentive in large part because it is higher than the ARP per ton of more commonly produced crops nationwide. It is in fact 2.9 times higher than the ARP of rice, 3.7 times higher than that of corn, and 3.4 times higher than that of wheat (SIACON, 2014). Another important piece of information to look at in the productive dynamics of amaranth in Mexico is the annual average growth rate (AAGR), which can be calculated for different indicators, as shown in Table 2.

Table 2. Amaranth Production Indicators (Annual Average Growth Rate, AAGR), Various Years

Years	*Planted Surface*	*Production Volume (Vol. P)*	*Production Value (PV)*	*Average Rural Price (ARP)*	*Yield per Hectare*
1994-2014	9.3%	9.8%	17.4%	7.0%	0.5%

Source: Created by the author based on SIACON (2014).

Based on the above data and an analysis of the past 20 years of amaranth production, it can be inferred that the AAGR of the production volume of 9.8% reflects a type of "extensive" amaranth agriculture due to the rise in sown area (9.3%) and not in the yield per hectare at the national level, which achieved a nascent average of 0.5%. Based on SIAP (2013a), only 46% of amaranth hectares nationwide have been planted with improved seeds, while 98% of these same hectares lack irrigation systems and depend on unstable weather systems. This absence of efficient technology packages for the cultivation of amaranth nationwide indicates that this extensive agriculture lacks the basic technical elements needed to improve

yields of the amaranth crop. On the one hand, the AAGR of the production value is the result both of the production volume, as well as the average rural price, areas in which there is an AAGR of 17% in the period of analysis for production value and 7% for the ARP.

The Contribution of Amaranth to Food Self-Sufficiency

Paradoxically, Mexico is ranked twelfth on the list of top food exporters and yet (in agricultural period 2013), produced only 16% of the rice, 45% of the wheat, 77% of the corn, and 6% of the soy consumed in the country, according to national Apparent Consumption figures (SIAP, 2014). According to Curiel (2013), who asserted that a country must produce 75% of the food it consumes in order to have achieved food security, Mexico has not yet done so.

In light of this situation, the amaranth trade balance in Mexico is also extremely interesting, because unlike the overall situation (as of 2014, the National Agricultural and Livestock and Agroindustrial Trade Balance was –107,403.3 thousand dollars (Banxico, 2015)), amaranth has a clear surplus, as is evident in Figure 3.

Source: Created by the authors based on SIAP (2014).

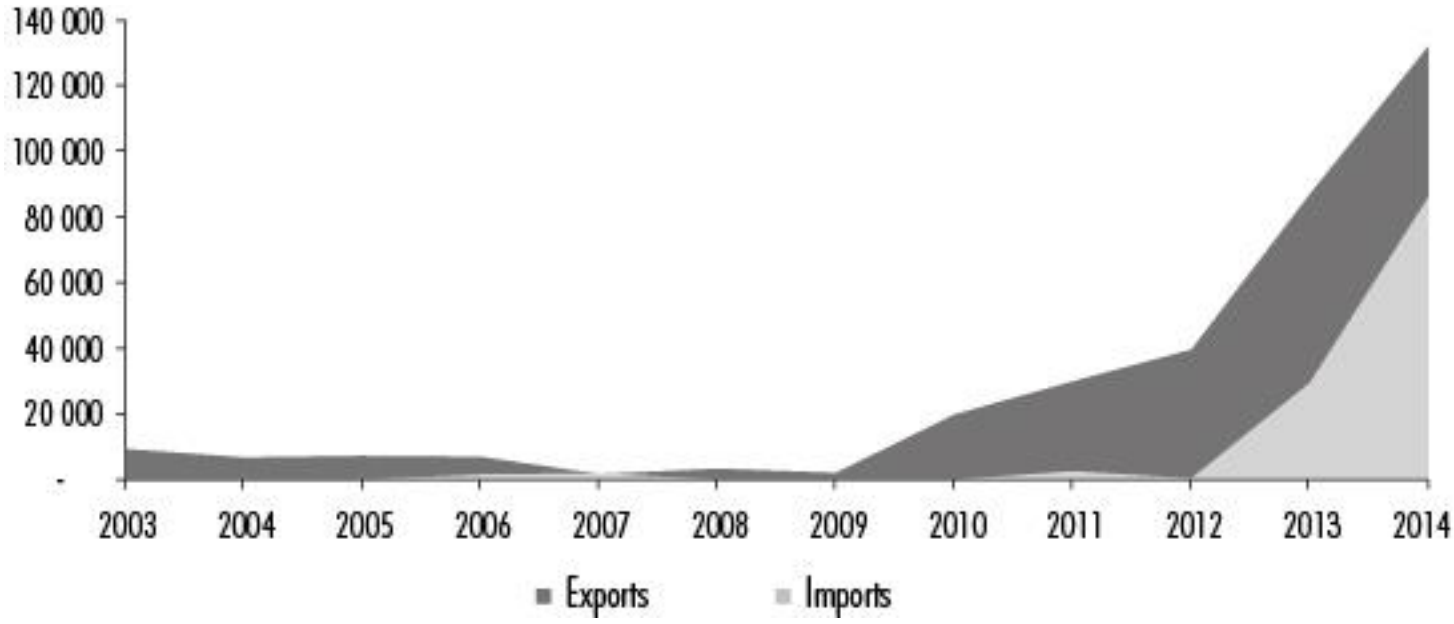

Figure 3. Mexico: Foreign Trade in Amaranth (dollars), 2003-2014

As can be observed in the figure, amaranth exports, and therefore the positive trade balance of this crop, have seen a clear and marked ascent, although this positive trend saw its largest spike in 2010.

Abroad, health food markets such as North America or Europe are the top export destinations for amaranth from Mexico, which exceeded 87,000 dollars in 2013 (SIAP, 2014). Ayala et al. (2012) wrote that, based on an average of the period from 2006 to 2010, the top Mexican amaranth export destinations were Italy,

with 42% of the total; the United States with 37%; Colombia with 12%; Canada with 5%; and Cuba with 1% (Ayala et al., 2012: 321). However, the export landscape of amaranth by 2012 was already vastly different, with 53% of total exports sent to the United States (amounting to 21,216 dollars), over 8,925 dollars worth sent to Chile (for a total of 22.48%), and 8,384 dollars exported to Italy (21.12%) (SIAP, 2014), making the United States Mexico's top amaranth foreign trade partner.

To analyze levels of amaranth availability in Mexico over the past decade, it is useful to look at a series of indicators that define levels of the self-sufficiency and food dependency of a country with respect to a certain food or food group. In this case, we will look at amaranth data from 2003 to 2014 (see Table 3).

The Food Self-Sufficiency Ratio (SSR) shown in Table 2 elucidates to what extent the degree of food availability can be met with national production. This SSR index is obtained by dividing national production by the national apparent consumption (AC). When the AC indicator is equal to or greater than 1, as is the case for amaranth in Mexico, for all of the analysis years except 2014, the country is understood to be highly sufficient in the cultivation of that crop, in this case, amaranth. In addition, the Food Dependency Ratio (FDR) measures the degree to which the food supply is satisfied by imports, and is obtained by dividing imports by national production. If the FDR indicator is close to or equal to 1, this reflects total dependency on imports. On the contrary, as is the case in Mexico, if the indicator is less than or close to zero, it means that the country is highly self-sufficient in supplying that food (López, 2012). This analysis helps us establish production levels and reveals that national apparent consumption of amaranth is on the rise. It also points to a status of food self-sufficiency for amaranth and zero dependency on imports for this crop, and this behavior has moreover remained constant over the past decade.

Table 3. Mexico: Indicators for Calculating the Availability of Amaranth, 2003-2014

Year	*National Production (dollars)*	*National Apparent Consumption (dollars)*	*Food Self-Sufficiency Ratio*	*Food Dependency Ratio*
2003	1 209 056	1 199 656	1.01	0.000
2004	1 933 092	1 926 392	1.00	0.000
2005	1 382 116	1 374 816	1.01	0.000
2006	2 103 858	2 098 458	1.00	0.001
2007	2 729 066	2 729 366	1.00	0.001
2008	2 520 367	2 516 987	1.00	0.000
2009	2 674 218	2 672 118	1.00	0.000
2010	1 991 439	1 971 539	1.01	0.000
2011	1 749 561	1 722 161	1.02	0.001
2012	2 085 569	2 046 269	1.02	0.000
2013	4 084 060	4 026 560	1.01	0.007
2014	5 659 646	5 613 546	1.01	0.015

Note: The original data on production values were in Mexican pesos and have been converted to dollars using an annual average peso/dollar exchange rate from 2003 to 2013 (Banxico, 2015).

Source: Created by the author based on SIAP (2015).

Rising amaranth production, especially for exporting, in recent years, can be explained in part by recent interest seen in first-world economies in finding more nutritious foods and economies such as Mexico in finding nutritional alternatives that are agriculturally and economically profitable. In the beginning of the 1980s, this dynamic favored amaranth, which began to be widely included in research and nutrition agendas at various national and international institutions (Mendoza, 1998), ushering in a new export wave for the amaranth sector.

Food trends in Mexico have reflected a marked interest in researching and producing healthy foods that can contribute to reducing national malnutrition problems, so foods based on products with highly nutritional properties, such as amaranth, and which support healthcare, the environment, and even territorial development, are increasingly in demand. The data and indicators shown here position amaranth as a crop with great food potential, not only due to its nutritional benefits, favorable agronomic conditions, and productive diversification, but also because it is already a surplus crop, self-sufficient and not at all dependent on imports. Likewise, local amaranth production has the potential to partially reduce the importation of other agricultural inputs used in food products, as it can supplement or in some cases supplant altogether other grains or flours. The supply and availability of amaranth, according to these indicators, can be guaranteed, making it plausible to include this pseudo-grain in strategies to overcome food poverty.

However, despite the clear statistical self-sufficiency of amaranth production in Mexico, its real consumption and demand are not yet solidified. An example of this is that amaranth has the lowest per capita annual consumption of the country's most representative agricultural products, with 0.03 kg and an average of 0.03 dollars of consumption per capita in 2013 (SIAP, 2014). Options for how to use it have received little attention. Amaranth is typically negatively associated with a regional treat known as an "alegría," and is therefore tied to the food habits of people considered to be from the lower classes. Even so, recently, there have been efforts to showcase the broad gastronomical diversity of amaranth, such as the 2016 publication of the *Recetario de Santiago Tulyehualco. El Amaranto Como Patrimonio Gastronómico (Santiago Tulyehualco's Recipe Collection. Amaranth as Gastronomical Heritage)*, released by the Secretary of Rural Development and Equity for Communities in partnership with the Civil Association Amaranth Product System Mexico City and the Mexico City local government. This book is a testament to the culinary diversity of amaranth and its potential to transform and enrich Mexican cuisine.

THE AMARANTH AGROINDUSTRY IN FOOD STRATEGIES IN MEXICO

In Mexico, the organization of the amaranth food supply translates into multiple agroindustrial units that produce, transform, and commercialize the seed as their main economic activity. In terms of the rural productive force, it is important to note, given that I was unable to find any nationwide registry of amaranth producers, that the best estimate is that there are around 8,000 producers[5] in Mexico, of whom less than 3.6% (287 amaranth producers) are believed to be located in Mexico City (OEIDRUS-DF, 2009). Based

on the National Statistics Directorate of Economic Units (DENUE-INEGI, 2015), just under approximately one hundred amaranth agroindustrial producer units have been identified, of which 50% are located in the territory of Mexico City. These agroindustrial amaranth units must both confront and join a highly concentrated food market dominated by food competition with superior technology and productive capacities.

The amaranth agroindustrial units in Mexico have evolved, going from individual production to organized economic units, which, unlike subsistence farming and farming used to maximize profits, are reviving and returning value to amaranth and are finding this sufficient incentive to undertake productive activities. The efforts of these stakeholders have been aimed at restoring value to the amaranth crop, by fostering and strengthening the productive chain. This is done through technology transfer and agroindustrial innovation activities, forging relationships and strategic partnerships among rungs of the productive chain and implementing conservation and care practices for protected green areas dedicated to amaranth cultivation (Escalante, 2010).

Despite the boom of the pseudo-grain, and the fact that amaranth has seen production and demand for the crop rise nationwide in recent years, these agroindustrial organizations are facing not only disadvantages in terms of competing in the food market, but also in having to join a consumption dynamic that gives little value to traditional, specialized, non-mass, and small-scale production. Amaranth production also suffers from a series of productive, technological, organizational, and commercialization-related obstacles. Getting amaranth onto the food market has been especially difficult, in part also because of the absence of adequate channels to commercialize it, as well as the dearth of promotion strategies to raise awareness about the nutritional benefits of and ways to use amaranth.

As such, despite the evident benefits of amaranth in terms of nutrition and welfare, the crop has not made full inroads into food-related strategies and public policy. One of the most far-reaching policy efforts made in recent years in Mexico is the National Crusade Against Hunger (CNCH), which is an inclusion tactic and social benefit launched in 2013, whose principal objective is to "reduce the number of people living with extreme food poverty, transforming the social and economic environment, improving inclusion and social participation, and supporting community development (Sedesol, 2014: 20). However, despite these efforts, the results of this strategy are still in their early stage, because many of the programs are still operating in pilot mode.

In these efforts to combat malnutrition, amaranth and the amaranth agroindustry in Mexico have received little consideration, because it appears that the amaranth crop belongs only to the range of products offered by Diconsa and potentially acquirable with the SIN-Hambre card (Diconsa, 2015). There is little awareness of amaranth, and the status of amaranth in the National Crusade Against Hunger (CNCH) strategy is unclear. However[6], it can be inferred that there is preliminary interest in including this crop in the effort to fight hunger, thanks to a mention by the Diconsa Development director, José Luis Espinoza, at the "Forum for Small-Scale Producers to Consumers. Diversity and Nutrition" in 2015, where he noted that some working tables related to growing and using amaranth have already been launched and that work has been done with authorities from the agricultural and farming sector in the states of San Luis Potosí, Hidalgo, Mexico City, and the State of Mexico. This is part of an effort to draw up plans to increase production and productivity in amaranth-producing regions, raise knowledge among diverse stakeholders

(consumers, companies, food policy strategic groups) as to the nutritional and agronomic benefits of amaranth, adding it to the food habits of the Mexican people, and improve commercialization channels by harnessing the agroindustrial transformation potential of the native crop amaranth. Unfortunately, as of the publication of this journal, these efforts to more comprehensively incorporate amaranth to the benefit not only of consumers but also national producers are still in the early stages, so this crop is still not considered to be a strategic element in fighting malnutrition problems.

Some practices related to promoting and encouraging amaranth production have started to emerge. Of special note are those carried out by the interdisciplinary organization the Liaison Group for the Promotion of Amaranth in Mexico (*Grupo de Enlace para la Promoción del Amaranto en México*), including the First National Meeting of Amaranth Producers in Mexico, held at the Graduate School of the Puebla campus in 2015. This first encounter brought together nearly 400 growers from around the country for networking and the chance to share and exchange knowledge and information about growing amaranth in all of its productive stages.

Some of the proposals that emerged from this meeting include: setting up a fixed price to pay to producers nationwide; strengthening regional and national organization by way of legal figures; defining training programs to properly handle the grains, water, soil, and better transformation of amaranth, as well as efficient strategies for the commercialization and insertion of amaranth into the food market; creating savings cooperatives to inject low-cost financial liquidity; defining strategies to protect native seeds, setting up collective purchasing of inputs, equipment, and seeds; desiging strategies oriented towards promoting amaranth in the mass and non-traditional media; fostering amaranth consumption from productive households and distributing, in turn, manuals, guides, or recipe books to help introduce amaranth into the Mexican diet (Grupo Enlace para la Promoción del Amaranto en México, 2015: 4).

FINAL REFLECTIONS

Mexico's food problem has multifaceted origins, but in the framework of the current changes agricultural policy is undergoing in the country, it requires critical analysis and a series of alternatives to contribute to knowledge in pursuit of reducing malnutrition problems. Likewise, the status of food security in Mexico is a tremendously important objective to pursue and, of course, a goal that cannot be swept aside. Achieving food security requires actions that reflect enhanced integration among stakeholders, sectors, policies, and programs designed to combat malnutrition. These systemic efforts must aim not only to increase the financial, technological, and productive resources available to the agriculture sector, but also to have spillover effects in terms of social welfare and inclusiveness for the most vulnerable people with the highest levels of food insecurity.

Self-sufficiency as a strategy to achieve food security is in many cases an inviable and counterproductive strategy for regions with food deficiencies. However, restoring the social, productive, and nutritional value to crops that are highly beneficial to health and have broad productive development potential, such as amaranth, and which are available and self-sufficient, could indeed be a more affordable alternative for

nations with malnutrition problems such as Mexico. The foregoing, without leaving out the trade and partial exchange of foods that represent benefits for both consumers and agricultural producers.

Despite the fact that amaranth is part of the Mexican diet and is considered to be a crop with broad nutritional potential and the capacity to reduce malnutrition when added to the current diet, because it is so underrepresented in production, and is ailed by stunted demand and a minimal degree of acceptance and consumption among the Mexican population, its statistical importance continues to be low, making this crop a clear example of untapped agricultural potential and diversity in food strategies.

It is important to revive local production of amaranth, and ensure that stakeholders growing this crop have the fundamental capacities to produce, promote, and commercialize it, and above all, ensure its consumption, for the sake of tackling the problem of malnutrition and food security in Mexico.

Public policies related to agrifood matters must identify those endogenous farm crops and natural resources that are at surplus levels, as well as maintain a focus on forging ties between local production and, in many cases, family farming and efficient and targeted institutional programs designed to achieve a better structured and more equitable and fair food market for consumers and growers. This is the way to boost production, transformation, and especially consumption of native, nutritional products that have reached self-sufficient levels in Mexico, through ground-up strategies to match our realities.

[1]Trade exchange processes have favored the incorporation of food products low in nutritional value and of questionable quality into local diets.

[2]In Mexico, 18% of the population suffers from food poverty due to income, while 30% of the national adult population suffers from some degree of obesity, leading to the "double burden" of malnutrition facing Mexico (Urquía, 2014: S92).

[3]A project to boost the production of crops such as amaranth was carried out in Bolivia from 2001 to 2010, funded by the International Fund for Agricultural Development (IFAD), called "Strengthening Income Opportunities and Nutritional Security of the Rural Poor through the Use and Marketing of Neglected and Underutilized Species" and "Programme For Empowering The Rural Poor By Strengthening Their Identity, Income Opportunities And Nutritional Security Through The Improved Use And Marketing Of Neglected And Underutilized Species" (Rojas et al., 2010: iv).

[4]It is useful to note that in the absence of a centralized registry of amaranth producers, this is a figure estimated by the author of this paper based on a review of various journalistic sources, attendance at multiple events dedicated to amaranth promotion in Mexico, and information exchanged with the Liaison Group for the Promotion of Amaranth in Mexico (an association consisting of researchers, producers, organizations of producers, students, and the general public). For more information about this group, see: <https://grupoamarantomexicano.wordpress.com/> (viewed in March 2016).

[5]This information was obtained at the round of questions and answers held at the "Forum for Small-Scale Producers to Consumers. Diversity and Nutrition" in May 2015. For more information, see: <http://alianzasalud.org.mx/foro-del-pequeno-productor-al-consumidor-diversidad-y-nutricion/#sthash.ojVsqX7G.dpuf> (viewed May 2015).

Bibliografía y fuentes consultadas

Aguirre, Patricia (2004), *Seguridad alimentaria. Una visión desde la antropología alimentaria*, Córdoba, Argentina, Fundación CLACyD (consultado en abril de 2015), disponible en <http://www.suteba.org.ar/download/ trabajo-de-investigacin-sobre-seguridad-alimentaria-13648.pdf>

Ayala Garay, Alma Velia, Diana Escobedo López y Lorena Cortés Espinosa (2012), "El cultivo de amaranto en México, descripción de la cadena, implicaciones y retos. Situación Actual, rentabilidad y comercialización", en Eduardo Espitia Rangel (ed.), *Amaranto: Ciencia y Tecnología*, México, INIFAP, pp. 315-330.

Banco de México (Banxico) (2015), "Balanza de Productos Agropecuarios y Agroindustriales" (consultado en marzo de 2015), disponible en <http://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction. do?accion=consultarSeries>

Chateauneuf, R. (1995), "Elementos de seguridad alimentaria", en Patricia Aguirre (2004), *Seguridad alimentaria. Una visión desde la antropología alimentaria, Córdoba, Argentina, Fundación CLACyD (consultado en abril de 2015), disponible en <http://www.suteba.org.ar/download/trabajo-de-investigacin-sobre-seguridad-alimentaria-13648.pdf>*

Chung, Kimberly, Lawrence Haddad, Jayashree Ramakrishna y Frank Riely (1997), *Identifying the Food Insecure: the Application of Mixed-method Approaches in India*, Washington D.C., United States, International Food Policy Research Institute, pp. 70.

Curiel, Ricardo (2013), "MasAgro por la seguridad alimentaria y el desarrollo agrícola sustentable de México", *Revista Claridades Agropecuarias*, núm. 237, México, mayo, pp. 9-18.

Diconsa (2015), "Diconsa suministra 19 productos nutritivo a beneficiarios de la tarjeta SINHambre" (consultado en abril de 2016), disponible en <http://www.diconsa.gob.mx/index.php/landingpage/768-diconsa-suministra-19-productos-nutritivos-a-beneficiarios-de-la-tarjeta-sinhambre-.html>

Directorio Estadístico Nacional de Unidades Económicas (DENUE-INEGI), (2015) (consultado en marzo de 2016), disponible en <http://www3.inegi.org.mx/sistemas/mapa/denue/>

Dirección General de Comunicación Social (DGCS-UNAM) (2014), "Desarrollan antidepresivo a partir de proteína del amaranto" (consultado en mayo de 2016), disponible en <http://www.dgcs.unam.mx/boletin/bdboletin/2014_743.html>

Escalante Escoffié, Martha Cristina (2010), *Rescate y revalorización del cultivo del amaranto*, México, Fundación Grupo Produce Ciudad de México A.C., Instituto Interamericano de Cooperación para la Agricultura (IICA), pp. 89.

Flores, Margarita (2013), "Producción agrícola, seguridad alimentaria y desarrollo rural en México", *Cuadernos de Investigación en Desarrollo*, México, UNAM

Grupo Enlace para la Promoción del Amaranto en México (2015), "Nuestras voces: mujeres y hombres productores, transformadores y consumidores del amaranto". Documento electrónico (no disponible en línea).

Kent, Norman Leslie (1998), "Tecnología de los cereales. Introducción para estudiantes de ciencia de los alimentos y agricultura" (consultado en marzo de 2015), disponible en <http://datateca.unad.edu.co/contenidos/232016/ contLinea/index.html>

López Hernández, Diego (2012), "Disponibilidad de alimentos básicos en Colombia 2000-2010: ¿producción nacional o importaciones" (consultado en mayo de 2015), disponible en <http://www.bdigital.unal.edu.co/5897/1/diegolopezhernandez.2012.pdf>

Mendoza Zazueta, José Antonio (coord.) (1998), *Pequeños productores. Grandes negocios: el potencial económico de los productores agropecuarios comercialmente no tradicionales. De México al Mundo*,

Memoria de la Primera Exposición Nacional, México, Secretaría de Agricultura, Ganadería y Desarrollo Rural (SAGAR), pp. 364.
Morón, Cecilio y Alejandro Schejtman (1997), "Situación de la seguridad alimentaria en América Latina" en Organización de las Naciones Unidas para la Agricultura y la Alimentación, FAO (1997), *Producción y manejo de datos de composición química de alimentos en nutrición*, Santiago, Chile, Universidad de Chile-Instituto de Nutrición y Tecnología de los Alimentos, pp. 29-42.
Oficina Estatal de Información para el Desarrollo Rural Sustentable (OEIDRUS-DF) (2009), "Padrón georreferenciado de Productores de Amaranto del Distrito Federal" (consultado en marzo de 2015), disponible en <http://www.sifupro.org.mx/agendas/-001360-doc00418220100330155320.pdf>.
Organización de las Naciones Unidas para la Agricultura y la Alimentación (FAO) (1996), "Declaración de Roma sobre la Seguridad Alimentaria", en *Cumbre Mundial sobre la Alimentación*, 13-17 de noviembre, 1996. Roma, Italia (consultado en marzo de 2015), disponible en <http://www.fao.org/docrep/003/w3613s/w3613s00.HTM>
——— (2002), "Agua y cultivos. Logrando el uso óptimo del agua en la agricultura" (consultado en julio de 2015), disponible en <ftp://ftp.fao.org/docrep/fao/005/y3918S/Y3918S00.pdf>
——— (2006), "Informe de políticas: Seguridad Alimentaria" (consultado en marzo, 2015), disponible en <ftp://ftp.fao.org/es/ESA/policybriefs/pb_02_es.pdf >
——— (2014), "Agricultura familiar en América Latina y el Caribe. Recomendaciones de política", Santiago, Chile (consultado en abril de 2016), disponible en <http://www.fao.org/docrep/019/i3788s/i3788s.pdf>
Porr, Madeleine (2012), "El amaranto- pequeñas semillas con fuerzas colosales" (consultado en mayo de 2014), disponible en <http://www.el-pan-alegre.org/Guia_Amaranto.pdf>
Puente a la Salud Comunitaria (2006), "¿Por qué amaranto: valor nutricional?" (consultado en marzo de 2015), disponible en <http://www.puentemexico.org/index.php?option=com_content&view=article&id=165&Itemid=383&lang=es&as_qdr=y15>
Rojas, Wilfredo, José Luis Soto, Milton Pinto, Matthlas Jäger, Stefano Padulosl (2010), "Granos Andinos. Avances, logros y experiencias desarrolladas en quinua, cañahua y amaranto en Bolivia", Bioversity International y Fondo Internacional de Desarrollo Agrícola. Roma, Italia (consultado en abril de 2016), disponible en <http://www.bioversityinternational.org/uploads/tx_news/Granos_andinos__avances__logros_y_experiencias_desarrolladas_en_quinua__ca%C3%B1ahua_y_amaranto_en_Bolivia_1413.pdf>
San Miguel Proyectos Agropecuarios (2006), "Servicios de Salud de San Luis Potosí. San Miguel es Amaranto" (consultado en marzo de 2015), disponible en <http://www.sanmiguel.com.mx/>
Secretaría de Desarrollo Social (SEDESOL) (2014), "Elementos Técnicos de Diseño, Planeación e Instrumentación del Programa Nacional México sin Hambre" (consultado en junio de 2015), disponible en <http://www.sedesol.gob.mx/work/models/SEDESOL/Cruzada/Programa_Nacional_Mexico_Sin_Hambre_Elementos_Metodologicos.pdf>
Sen, Amartya (1982), *Poverty and Famines: An Essay on Entitlement and Deprivation*, Reino Unido, Oxford University Press, pp. 272.
Sistema de Información Agroalimentaria de Consulta (SIACON) (2014), Programa informático (consultado en marzo de 2015), disponible en <http://www.siap.gob.mx/optestadisticasiacon2012parcialsiacon-zip/>

Servicio de Información Agroalimentaria y Pesquera (SIAP) (2013a), “Uso de tecnología y servicios en el campo. Cuadros tabulares 2013” (consultado en marzo de 2016), disponible en <http://www.siap.gob.mx/wp-content/uploads/2013/PDF/TECNIFICACION/tecnifica_2014.pdf>
—— (2013b), “Atlas Agroalimentario 2013” (consultado en marzo de 2015), disponible en <http://www.siap.gob.mx/atlas2013/index.html>
—— (2014), “Atlas Agroalimentario 2014” (consultado en marzo de 2015), disponible en <http://www.siap.sagarpa.gob.mx/atlas2014/index.html>
—— (2015), Atlas Agroalimentario 2015” (consultado en marzo de 2015), disponible en <http://nube.siap.gob.mx/publicaciones_siap/pag/2015/Atlas-Agroalimentario-2015>
Urquía Fernández, Nuria (2014), “La seguridad alimentaria en México”, en *Salud Pública de México*, vol. 56, Suplemento 1 (consultado en marzo de 2015), disponible en <http://www.scielosp.org/pdf/spm/v56s1/v56s1a14.pdf>
Velasco L. Ana Ma. y Samuel L. Villela F. (2016), “El amaranto”, en *Revista Arqueología Mexicana*, vol. XXIII-núm. 138, mayo, México.
Vélez Jiménez, Elier, Klaus Tenbergen, Priscila Santiago y María Anarberta Cardador Martínez (2014), “Functional Attributes of Amaranth”, en *Austin Journal of Nutrition and Food Sciences*, vol. 2(1), febrero, pp. 1-6.