

Food production and population in the context of crisis in Mexico and the State of Mexico 1980-2021

Producción alimentaria y población en el contexto de crisis sanitaria: el caso de México y la entidad mexiquense 1980-2021

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Abstract

Objective: to analyze the factors that affect the crisis in food production in Mexico in the last 41 years and the demographic growth which puts pressure on food production, as well as its demand both nationally and in the Mexican entity. The issue of national supply, the characteristics of the production of the rural districts of the Mexican entity, as well as the poverty and nutritional deficiency of the State of Mexico in recent years are also briefly presented. Based on secondary sources, the food imbalance has been verified, as well as the population growth of the country and therefore that of the entity, which has been accompanied by agricultural economic crises, climate change and even the pandemic or insecurity that lead to the lack of food.

Keywords: Food imbalance, population, agricultural crisis, regression, correlation, rates, prices.

Resumen

Objetivo: analizar los factores que inciden en la crisis de la producción de alimentos de México en los últimos 41 años y el crecimiento demográfico, el cual ejerce una presión sobre la producción de alimentos, así como de su demanda tanto nacional y en la entidad mexiquense. También se expone brevemente el tema del abastecimiento nacional, las características de la producción de los distritos rurales de la entidad mexiquense, así como de la pobreza y carencia alimenticia del Estado de México en los años recientes. Con base en fuentes secundarias se ha comprobado el desequilibrio alimentario, así como el crecimiento poblacional del país y por ende el de la entidad, la seguridad que conducen a la carencia de alimentos.

Palabras clave: Desequilibrio alimentario, población, crisis agrícola, regresión, correlación, tasas, precios.

INTRODUCTION

The population, without restriction, increases geometrically. Subsistence only increases in arithmetic proportion. Robert Malthus, 1798.

The study is located in the initial period of the neoliberal model, which precisely begins in the 1980s, which is recognized as the lost decade and “concludes” in 2021, which, for some, is the beginning of another lost decade to the Covid-19 Pandemia. In this period there is a large number of macrosocial events that involve both the population of the world and that of our country in regard to food production.

Today, for example, one of the main objectives in the world towards an immediate future will be to produce more than five billion tons of food until 2050, but is affected by the water crisis, climate change, less land than sow and the vulnerability of biodiversity due to population growth. Therefore, this objective seems complicated. By 2050 the planet will demand 60 percent more food due to the current demographic pressure of eight billion inhabitants and projected, for that same decade, in 9.7 billion inhabitants that in turn will be 12.2 billion for 2100 (UN, 2019). Where it will be sought, through the intensive use of the means of agricultural production, increase the amount of resources obtained in the same land space.

This topic has been one of the objectives for 2030 (Sustainable Development Goals; ODDS) recognized as:

GOAL 2 SDG: By 2030 there is the objective of ensuring the sustainability of food production systems and applying resilient agricultural practices that increase productivity and production, contribute to the maintenance of ecosystems, strengthen the capacity to adapt to climate change, extreme weather events, droughts, floods and other disasters, and progressively improve the quality of soil and land.¹

In the 1970s Mexico contributed 19 percent of world production according to Meadows *et al.* (1972). In 2020 it occupied the place number 11, in regard to food production from the agricultural sector participates with 200 agricultural products (SIAP, 2020) and with it the objective of the mi-

¹ See what are the Sustainable Development Goals? Available in [https://www.undp.org/es/sustainable-development-goals#:~:text=Los%20Objetivos%20de%20Desarrollo%20Sostenible%20\(ODS\)%2C%20tambi%C3%A9n%20conocidos%20como,disfruten%20de%-20paz%20y%20prosperidad.](https://www.undp.org/es/sustainable-development-goals#:~:text=Los%20Objetivos%20de%20Desarrollo%20Sostenible%20(ODS)%2C%20tambi%C3%A9n%20conocidos%20como,disfruten%20de%-20paz%20y%20prosperidad.) (Accessed 04/12/2022)

lennium is contributed to the reduction of the population with hunger, that is, reduce poverty and cushion the food crisis raised in the ODSS 2030.

With this reference in the State Development Plan of the State of Mexico 2017-2023 (pillar 1), it is proposed to “reduce poverty and promote human development”; and in this the sowed life project is inserted, whose description expresses the following:

Program to promote comprehensive rural development. It encourages the establishment of agroforestry production systems, which will help generate jobs, encourage food self-sufficiency and improve the population's income. Financial support will be granted to agricultural subjects of legal age who live in rural localities and who have an income below the rural well-being line, and who own 2.5 hectares available for agroforestry projects. The beneficiaries will receive monthly support of five thousand pesos, as well as in-kind support for agroforestry production (plants, inputs, tools) and technical support for the implementation of agroforestry systems (GEM, 2017: 10).

Bearing in mind the previous arguments, the production of food from the country and the Mexican entity will be analyzed, whose section are divided into the following: the theoretical argument on food production and the population; then the methodology and sources of information and food information are stated. The arguments are based on the simple-multiple linear regression model for the production of food and population in the State of Mexico, covering the period that covers from 1980 to 2021; subsequently, the issue of food distribution and supply, the characteristics of the agricultural districts of the State of Mexico 2003-2020 is addressed; point that is closely linked to production and is one of the main causes of poverty and food lack of the population, and finally, some conclusions about the subject that concerns us here.

THEORETICAL ARGUMENTATION: FOOD PRODUCTION AND POPULATION

In research on this issue, different themes have been addressed closely related to each other, which show the importance of the agricultural sector and its decisive role in the food security of the countries. The individualized analysis of the determining factors in the agricultural production that have been emphasized in time, has been the inappropriate use of the earth and leaving it to produce at its maximum performance within agricultural activities, being the workforce factor as the main motor In the equation of agricultural production, its main characteristics, composition and capital

goods, as well as other decisive factors such as technology, land, climate, among others for the performance of the activities of this sector.

With the combination of production factors, quite a lot of efficiency in the use of material and financial resources to be one of the fundamental premises that must be met in each of the agricultural entities has been written. On the other hand, the demographic pressure, seen from the thesis of the renowned economist Robert Malthus, whose central argument and which is currently valid, was based on the existence of an imbalance between population growth and the increase in food production, which would lead to imbalances or future conflicts. The population is an important factor that has to pay attention if you want to explain (or understand) the standard of living of a society, especially in times of systemic economic crisis, whose responsible was the health crisis that derived from the Covid-19 and the war between Russia and Ukraine, whose global effects are large-scale.

Added to the above is the relationship between the growth of the human population and nature, which has evolved, at the same time it remains controversial and offers some important clues to help us face the challenge of climate change that we face over time, which is expressed today and in the future. Population growth is exceeding the limitations posed by the availability of natural resources and the dynamics of relationships between people (competition, conflicts, inequalities, lack of food and hunger), this is a product of globalization and deglobalization. In this context, we live in a world almost without demographic limits, but with economic limits, which would mean that Malthus's predictions and analyzes have not been forgotten (although some consider that they have).

Given the population growth in the world and in our country, adding millions of new people around 2050 represents a serious challenge for food production for the following issues:

- a. Economic and productive problems or situations that hinder production are: low labor training, infertility of the land, scarcity of raw materials (or high costs), insufficient access to capital and backward technology.
- b. Associated demographic and social aspects: population growth on land size, urbanization processes, migration and growing inequalities between population groups in countries, as well as marginalization, discrimination and social, ethnic exclusion —Cultural and food.
- c. Climate and environmental change that, given the lack of preparation and inappropriate responses, contributes to increasing hunger and degradation of ecosystems as well as the depletion of natural resources.

- d. Inadequate government structures: hinder institutional stability, transparency and accountability that facilitate agricultural financing, guaranteed prices, distribution in the domestic and international market. Which generates dependence from abroad and especially in the issue of imports and exports following the signing of the NAFTA Free Trade Agreement, (today the Treaty between Mexico, the United States and Canada T-MEC).

Additionally, the pandemic and the war injected shortages and imbalance into the global, national and state market, as well as into the production and distribution of food. For example,

Benjamin Whitely went to a Safeway supermarket in Washington DC to buy some things for dinner. But he was disappointed when he found the vegetable shelves empty and a meager supply of turkey, chicken and milk. "It looks like I didn't find anything," said Whitely, 67. "Now I'm going to have to look somewhere else."²

The latter is associated with an abrupt slowdown in the economy and decomposition in the agricultural production base due to the Covid-19 pandemic in conjunction with the war between Russia and Ukraine or the wars that are looming in the future.

It is important to take the above into account because it has implications and challenges for achieving convergence between the economy and population growth. Since Robert Malthus proposed the relationship between the economy (arithmetic growth) and demography (exponential growth) it has been a constant concern to understand population survival and biological-social reproduction. In other words, Malthus argued that the imbalance between population growth and increased food production would lead to conflict and famine (Malthus, 1798).

That is, in the interrelation between economic and demographic variables, a relationship of mutual interdependence can be obtained rather than a unilateral cause; the relationship between given economic and demographic variables can be conditioned by the presence or absence of intervening but unidentified variables; that the effects of changes in demographic variables can be mediated through the production or price system; the short-term effects (such as economic conditions) and demographic (economic) changes may differ from their long-term effects; that variable time in-

² General, food shortages in the US, available at <https://www.jornada.com.mx/no-tas/2022/01/14/economia/general-la-escasez-de-alimentos-en-eu/> (Consulted on 03/01/2022).

tervals can separate a demographic (economic) change from its economic (demographic) effect Hauser and Duncan (1975).

In summary, the demographic variables can be divided into those in which the changes are capable of immediately affecting some of the economic variables, and those in which the changes are not capable of affecting the immediate economic variables (but the pandemic does, achieved) Hauser and Duncan (1975). In this exercise it would be difficult to express the history of interconnections between the economy and demographics, but those who did do so were Hauser and Duncan (1975).

In this work, food production, hectares planted and harvested, prices, as well as their import-export are recognized as economic variables. Demography is the total population, which is fed by births, deaths and internal and international migrations (Hauser and Duncan, 1975).

Since the 1950s, Malthusian ideas have become a source of government policies in many nations of the world, specifically in Latin America and Mexico, and with this the high birth rates (coinciding with the end) have undoubtedly been influenced of the inward development model) that have been presented in most of Mexico and the State of Mexico. Although the possibility of a demographic catastrophe due to population increasing more rapidly (despite its decline in terms of rates) than food production. A situation that could be corroborated with the arguments expressed in the work Limits to Growth Meadows *et al.* (1972) which have been taken up by the Club of Rome.

If industrialization, environmental pollution, food production and resource depletion maintain current global population growth trends, this planet will reach the limits of its growth within the next hundred years. The most likely result would be a sudden and uncontrollable decline in both population and industrial capacity (Meadows *et al.*, 1972: 89).

But the most notable thing is the various international conferences on population, which take up Malthus's concerns, because the central theme has been the effects of population growth on the planet's capacity for sustainability, which is why it is a topic of obligatory reference and of unavoidable validity today that includes the SDGs.³ In the context of the pandemic and the war between Ukraine and Russia, knowing that a high

³ See International Population Conferences, available at <https://apuntesdedemografia.com/pol-pob/maltusianismo/conférences-internacionales-de-poblacion/> (Consulted on 04/14/2022).

percentage of the world's agricultural consumer goods are produced in those places.⁴

Due to this, pressures are growing due to price increases in basic products, as well as the shortage of fertilizers, added to climate change, 1.7 billion people are exposed to more poverty and hunger. Factors that prelude the perfect climate for a global crisis that threatens to devastate many economies in a world that, in the opinions of many, is going through a stage of deglobalization and is becoming increasingly protectionist. To this end, international organizations ask the governments of the world to reinforce food security.⁵ The case of Mexico could not be the exception, thus they have been proposed as axes and guidelines of food policy marked in the objectives of the 2030 Agenda of the Sustainable Development plan, specifically with a view to “ending poverty in all its forms and throughout the world”, put an end to hunger, achieving it through food security along with improved nutrition, thus promoting sustainable agriculture by assuming that the countryside has to be a source of food and a development option for the rural producers, through an effective articulation between productive policy and welfare policy in rural areas.⁶

METHODOLOGY AND SOURCES OF INFORMATION ON POPULATION AND FOOD

The difficulty of having a reliable source that allows estimating, measuring and relating production to food demand at the global, national and state level in the period analyzed is a difficult task. Since on the one hand there are sources that estimate food production and on the other hand those that report a growing population that is becoming more and more complicated to feed with existing resources, which implies methodological difficulties in their articulation.

The available data forces us to use a cross-section of information sources, that is, those derived from the Agro-Food and Fisheries Information Service (SIAP) at the national and state level, those generated by the Geographic Information and Research Institute, Statistics and Cadastral of the State of Mexico (IGECEM), those of the National Institute of Statistics

⁴ Russia and Ukraine: role in production and supply of food and fertilizers, available at https://www.3tres3.com/ultima-hora/rusia-ucrania-produccion-y-el-suministro-de-alimentos-y-fertilizadores_47779/ (Accessed on 03/05/2022).

⁵ See International organizations calling for strengthening food security, available at <https://www.jornada.com.mx/2022/04/14/economia/019n1eco> (Consulted on 04/14/2022).

⁶ Institutional Program 2020-2024 for Mexican Food Safety SEGALMEX, available at https://www.gob.mx/cms/uploads/attachment/file/616119/Programa_Institucional_2020-2024_de_Seguridad_Alimentaria_Mexicana_SEGALMEX.pdf (Consulted on 05/03/2020).

and Geography (INEGI), as well as other secondary sources that will be mentioned throughout the text. These, in turn, support the argument of the imbalance between agricultural food production and that of the population.

The statistical work of the indicators is used absolutely to describe their behavior over time, annual average growth rates, graphic resources and simple and multiple regression models are used, so that the economy converges with the population and the proposals of Hauser and Duncan (1975) are taken as a basis.

Simple regression

The two-variable (national) linear model is used to test hypotheses about the relationship between a dependent variable (Y = food production from 1980-2021) and an independent variable X , that is, for prediction, which is the absolute population between 1980-2021.

The equation being as follows: $Y_i = b_0 + b_1X_i + u_i$.

Y_i = food production in the agricultural sector (or primary sector).

b_0 = constant or ordered to the origin.

b_1 = measures changes in Y /changes in X , marginal trend of food production in the agricultural sector.

u_i = error.

Multiple regression model

Multiple regression analysis is used to test the hypothesis about the relationship between food production in the State of Mexico with four independent variables for prediction (absolute population, planted area, harvested area, price and also its annual accumulated absolute value). The multiple linear regression model is expressed as follows:

$$Y_i = b_0 + b_1X_{1i} + b_2X_{2i} + b_3X_{3i} + b_4X_{4i} + u_i$$

Y_0 = Agricultural production.

X_1 = Total population.

X_2 = Hectares planted.

X_3 = Hectares harvested.

X_4 = Price.

U_i = error.

The assumption is that there is no exact relationship between the x 's (non-collinearity).

Correlation (Sullivan III, 2010)

The Pearson correlation coefficient is used since it is a measure of linear dependence between two quantitative random variables (poverty and food deficiency). Unlike covariance, Pearson correlation is independent of the measurement scale in the variables, and whose reading would be as follows:

- R = 1 means perfect correlation.
- $0.8 < r < 1$ means very high correlation.
- $0.6 < r < 0.8$ means high correlation.
- $0.4 < 0.6$ moderate correlation.
- $0.2 < 0.4$ low correlation.
- $0.0 < 0.2$ very low correlation.
- R = 0 null correlation.

GEOMETRIC GROWTH RATE

Description

Rate of population growth in a given period, expressed as a percentage. The average annual growth rate is based on the hypothesis that the population studied can be considered, during the observation period, as a population that expresses exponential growth that is, it grows according to the exponential law as a function of time. It is also called Geometric Growth:

$$\text{Canculation } r = ((10^{((\log(P_f/P_i))/t))}-1)*100$$

Where:

- R = growth rate.
- Pi = Initial population.
- Pf = Final population.
- T = Time in years.

Each of these calculations will seek to provide an answer or support the arguments of agricultural production depending on the topic and section of this document.

Food production and recurrent economic crisis

The Mexican population between 1980 and 2021 increased by 62.17 million inhabitants in our country, 90 percent from 66.8 million in 1980 to 128.97 million in 2021 (Figure 1). Despite the decrease in fertility, mortality and increasing international emigration in absolute terms, the population

of our country continues to rise after the confinement due to Covid-19. But, at the same time, population growth has been affected by recurrent economic crises, as well as by its determinants such as fertility, mortality and migration (Cabrera, 2005). The millions of people put pressure on the demand for food produced by the country and at the same time, what is needed has to be imported from abroad⁷ and is accompanied by a deficit in the food balance of payment for many years (Table 1). What we can observe is that there is a negative balance between food exports and imports between 1993 and 2021.

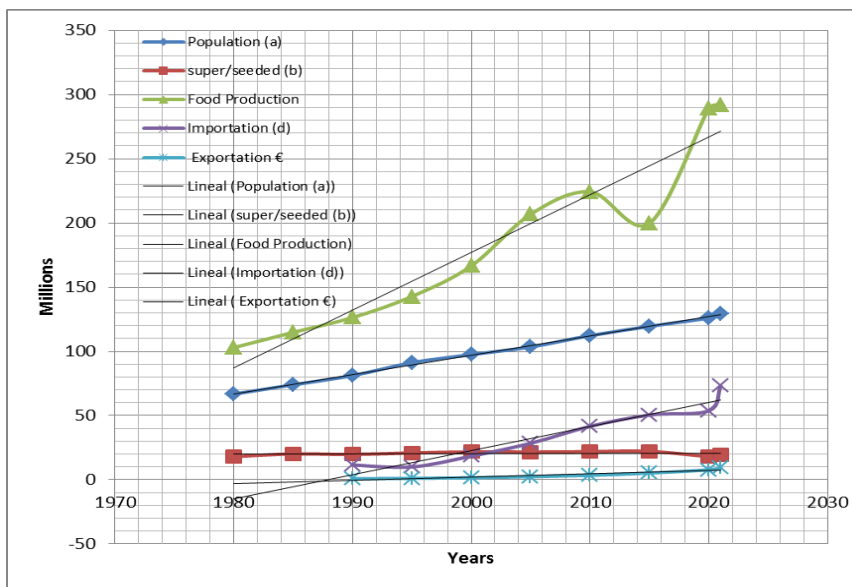
This means that the so -called food self -sufficiency is a myth; A completely different position from that in 2016, when it was announced that Mexico was seven percent of reaching food self-sufficiency because it already produced 68 percent of the foods required by the population (and fell to 64 percent in 2021, affected by Covid-19 pandemic), not very close to 75 percent of the standard raised by the United Nations Food Organization (FAO) to consider a country to generate food self-sufficiency (Cruz *et al.*, 2021).

However, at the national level, food production is linked to consumption and income. This presents a difference in income-food expenditure that affects the diet of Mexicans. Today's Mexican diet is based on processed products that increase depending on one's economic income: the higher the income, the greater the consumption of industrially processed products. At the national level, spending on farm products occurs mainly at home (with consumption of meat, cereals, vegetables, fruits, milk and derivatives), coupled with the increase in spending on food outside the home (drinks and processed foods), through which Mexican households are affected by various downward indicators of the level of well-being, since food consumption also reflects social changes, fashions, and even the way of living (CEDRSSA, 2019).

The population of our country consumes 214 kilos per capita of ultra processed foods every year. Mexico is the country with the greatest intake of these products in Latin America and is "one of the first four to international scale and through which degenerative chronic diseases are derived causing the increase in the mortality of the general population (WHO, 2003).

⁷ For example, Mexico imports half of the grains and oilseeds it consumes, available at <https://www.jornada.com.mx/2022/05/03/politica/002n2pol> (Consulted on 05/03/2022).

Figure 1: Food production in Mexico, population, imports and exports 1980-2021



Note: 1980-1990, lost decade. 1990-2000, Globalization Process and Free Trade Agreement Firm in North America 2001-2010. Technological crisis and economic crisis of 2008-2009. 2011-2019, fall in commodities prices and economic recovery. 2020-2022, systemic crisis, Sars-CoV- 2, wars between Russia and Ukraine.

Sources: <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?accion=-consultarCuadro&idCuadro=CE37&or=1&locale=es>; <https://rppoblacion.uaemex.mx/articulo/view/9111/7653>; and INEGI, Census, Population and Housing Counts, various years and http://www.cedrs-sa.gob.mx/post_la_dependencia_n-alimentaria-n_de_n-mn-xico-n.htm (various dates consultation).

Within the period covered, from 1980 to 2021, the agricultural area grew 22 percent, that is, from the 17.99 million hectares planted in 1980 they increased to reach 18.12 million hectares in 2020, different from the projection of Sosa and Ruíz (2017), which was 22.2 million hectares. Obviously, the systemic crisis derived from the Covid-19 pandemic modified the growth hypothesis of previous years, on which its estimates were based. That is, between 2015 and 2012 there was a reduction contrary to the decrease in hectares planted during this period; Food production, as well as imports and exports, had a significant increase due to the food demand in the world caused by the confinement of the SARS-CoV-2 pandemic (Table 1 and Figure 1).

Table 1: Food production, population, imports and exports of Mexico 1980-2021

Years	Population (a)	Super/seeded (b)	Food Production	Importation (d)	Exportation €	%(c/d)	Saldo=E-D
1980	66.8	17.99	102.96				
1985	74	20.16	114.84				
1990	81.2	19.73	126.35	11.57	0.84	9.15	-10.72
1995	91.2	20.94	142.79	10.03	1.12	7.02	-8.91
2000	97.5	21.78	166.58	18.42	1.54	11.06	-16.87
2005	103.5	21.64	206.83	28.45	2.43	13.76	-26.02
2010	112.3	21.95	224.34	41.65	3.51	18.57	-38.15
2015	119.5	22.2	199.82	50.45	5.22	25.25	-45.23
2020	126.01	18.125	289.30	53.73	7.80	18.57	-45.94
2021	128.97	19.24	292.20	73.22	9.19	25.06	-64.03
2050	148.2	21.95					

Source: Bank of Mexico, <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?accion=consultarCuadro&idCuadro=-CE37§or=1&locale=e>, <https://rppoblacion.uaemex.mx/article/view/9111/7653>

Even though the cultivated area increased, the available land per capita estimated for 1980 (0.27 hectares/inhabitant) only remained unchanged until 1985, subsequently decreasing to 0.18 hectares/inhabitant in 2015 and 0.15 in 2021; this means that, in a period of 41 years, the available agricultural land per capita decreased by -1.43 percent in its average annual growth rate (Table 1). Given the pandemic scenario and the future that is projected for 2050, there will be more than 148 million inhabitants (CONAPO, 2018), the available agricultural land could decrease to 0.15 hectare/inhabitant/year. Considering this projection, the question that arises is: Are we prepared to face this challenge of providing food to the population of Mexico and living with the pandemic or syndemic? Are we facing the possibility of food shortages in the world, in our country and in the State of Mexico? What we can observe graphically is that food production is greater than that of the population at the national level, which would imply being a Malthusian counterargument. However, food production hides the unequal distribution in our country according to the federal entity and its municipalities, and at the same time, it is associated with the food crisis despite the existing government programs to care for the nutrition of the Mexican population (CONEVAL, 2010).

The agricultural crisis and food production has been and will be conditioned by several elements: the internal conditions of agricultural policy,⁸ economic policy and government political transitions, of the recurring internal and external economic crisis; to external factors such as the pandemic-syndemic that triggered a systemic crisis, which caused the abrupt slowdown of the world economy, including the Mexican one, affected production costs,⁹ resulting in the decomposition of the agricultural production base.

This brings with it the insufficiency of agricultural supply to meet domestic food demand, the deterioration of income levels, the concentration of wealth and restricted access to food in various regions of the country and for broad groups of the population; we also have the instrumentalization of manipulation strategies of agricultural markets (monopolies of the food market produced by the Mexican countryside such as import and

⁸ With the 1992 reform of article 27, for the first time the sale of ejidal and communal land is allowed, which would supposedly allow its illegal sale to be gradually replaced by its orderly incorporation into legal urban development. See Guillermo Olivera Lozano, 2005, the reform of constitutional article 27 and the incorporation of ejidal lands into the legal urban land market in Mexico, available at <http://www.ub.edu/geocrit/sn/sn-194-33.htm#:~:text=Con%20la%20reforma%20de%201992,ordenada%20al%20desarrollo%20urba-no%20legal> (Consulted on 04/05/2022).

⁹ See Agri-food surplus fell 40 percent due to increase in inputs: Sader, available at <https://www.jornada.com.mx/2022/04/26/politica/012n1pol> (Consulted on 04/26/2022).

export), which leads to the shortage of local markets and incidents in the generation of exclusion risks Food access, price increase to different strata or population groups, and that above all affects those of lower income. Domestic food insufficiency is structural, conjunctural or due to a pandemic, because the value of food imports exceeds the value limits of total exports as we can see in Table 1, it also generates food insecurity in the food market in the country and in its 32 federal entities.

The health crisis by the Coronavirus, caused the confinement of the population in order to contain its propagation. The deep food and economic implications that led to this phenomenon have already been alluded to. However, it is mentioned that, due to the high index of patients and deaths, a great demographic hole was created in the population difficult to correct. With vaccines the eradication of the Covid-19 pandemic was expected, however, variants resurfaced periodically affecting our way of living, producing and acquiring feed. There are those who claim that the end of economic globalization (we are facing what they have called deglobalization) as we know it is approaching; and only time will tell what the final effects of this food crisis are.

The theses of Robert Malthus, referring to this aforementioned phenomenon, have a latent validity in our time. The expansion and distribution of the population in different habitats, which put increasing pressure on available natural resources, undoubtedly increasingly exposes the health of humanity by coming into contact with viruses and unknown diseases. Is the planet settling scores with the human race in the form of a pandemic or syndemic? In the end... was Malthus right in his proposal of birth control through moral means or through diseases? What future awaits us? Will it be like Bill Gates' five predictions for 2022?¹⁰

We will not respond to these approaches, but we will respond to what we have proposed in this text. To get into our topic, we will start with the simple regression model, in which $Y_i = \beta_0 + \beta X_i + u_i$ is the appropriate functional relationship between Y_i (food production) and X_i (absolute population), u_i = error. The two-variable model, the functional form of the relationship that can often be inferred from the scatter plot. However, in a multiple regression model it is not easy to determine the appropriate functional form, since scatter plots are not displayed graphically in multiple dimensions, so we go straight to simple linear regression in this first part.

¹⁰ The tycoon spoke about the metaverse, the new normal and the evolution of Covid-19, among other topics, available at <https://www.portafolio.co/tendencias/cinco-predicciones-de-bill-gates-para-2022-559929> (Consulted on 05/03/2022).

The high correlation estimated by the regression between total food production and population growth is high, this is reflected in the correlation coefficient, which is 0.953; The coefficient of determination is 0.907 and change in R square = 0.907, which suggests that the increase in agricultural production between 1980-2021 was carried out mainly to satisfy the food demand of the Mexican population (Table 2). However, food availability was and continues to be insufficient, which gives rise to imports, thereby threatening to aggravate the domestic supply, as well as the already poor ecological conditions of the land and with its addition, the pandemic that is here to stay.

The ANOVA model assumes that for each level x_i of factor X , we have $Y = \mu_i + \text{ERROR}$ where ERROR is a NORMAL random variable with mean 0 and unknown variance, the same for all levels.

That is, if $x = x_1$, then $y = \mu_1 + \text{error}$. If $x = x_2$, then $y = \mu_2 + \text{error}$ (serves to determine whether the square r we are estimating is significant or not). Then the value of ANOVA is less than 0.05, which indicates that it is possible to build a regression model with these two variables: food production and population (Table 3).

With Table 4, we have that B_1 is positive, that is, in simple terms, for the estimated model here, for each unit of change in the independent variable ($v_2 = \text{population}$) the production of food does so in 2,979. This means that the Neomalthusian catastrophist arguments are contrary to the results of the model, because in time the production of food is increased at a greater rate to the population. But with important differences between federative entities and municipalities of the country such as the increase in malnutrition and hunger population (FAO, UNDP, UN, s/f).

Student's T allows us to say that in both cases they are less than 0.05, then both the constant and B_1 are significant in our model.

Model equation

$Y = -111.576$ (when x is worth zero) + $2.979x$ (coefficient of the equation as such). Figure 2 indicates that the points are aligned on the diagonal of the graph, which is notifying us to comply with the assumptions of normality because there is very little dispersion of the data or that of the variance.

Table 2: Simple linear regression model: Food production vs total (national) population

Model Summary (b)									
Model	R	R Square	Corrected R squared	Typical estimation error	Change statistics				Durbin-Watson
					Change in R squared	Change in f	gl1	gl2	Sig. change in F
1	.953a	0.907	0.896	21.992	0.907	78.432	1	8	0
									2.076

a. Predictive variables: (constant), v2

b. Dependent variable: V4

INEGI and IGECM (several years).

Source: own elaboration based on SIAP, INEGI and IGECM (several years).

Table 3: ANOVAa

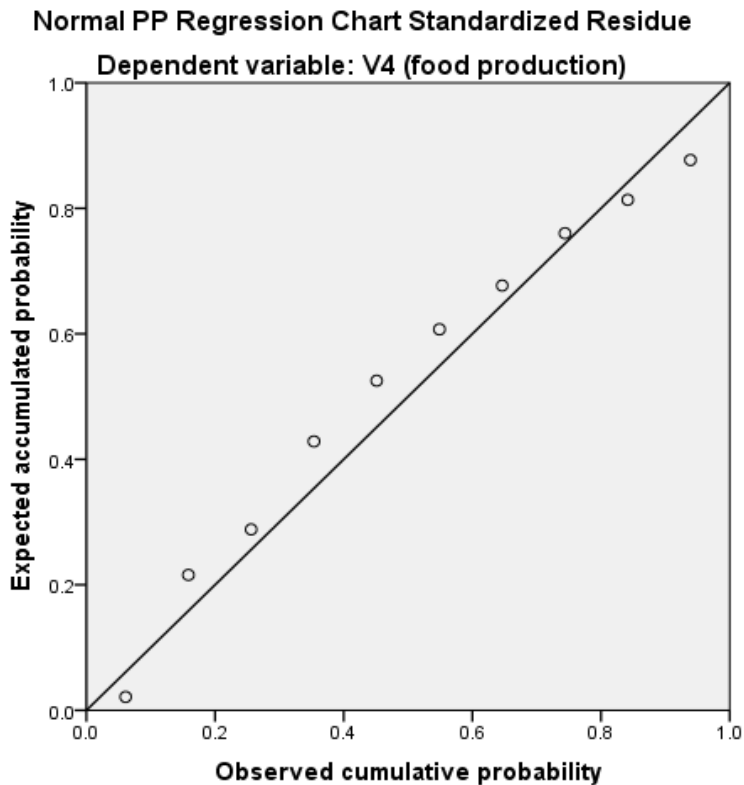
Model		Sum of squares	gl	Mean square	F	Sig.
1	Regresion	37933.153	1	37933.153	78.432	.000b
	Residual	3869.152	8	483.644		
	Total	41802.305	9			

a Dependent variable: V4

b Predictor variables: (constant), v2

Source: Own elaboration based on the SIAP, INEGI and IGCEM (several years).

Figure 2: Food production and typified waste in the country 1980-2020



Source: own elaboration based on the SIAP, INEGI and IGCEM (several years).

Table 4: Coefficients (a)

Model	Non-standardized coefficients	Typical error	Typified coefficients	t	Sig.	95.0% confidence interval for B		Collinearity Statistics	
						Lower limit	Upper limit	Tolerance	FIV
1	(Constant)	34.38		-3.245	0.012	-190.856	-32.297		
	V2	0.336	Beta	8.856	0	2.203	3.754	1.00	1.00

a Variable dependiente: V4
Source: own elaboration based on the SIAP, INEGI and IGECM (several years).

PRODUCTION OF AGRICULTURAL FOOD, POPULATION AND CRISIS IN THE STATE OF MEXICO 1980-2021

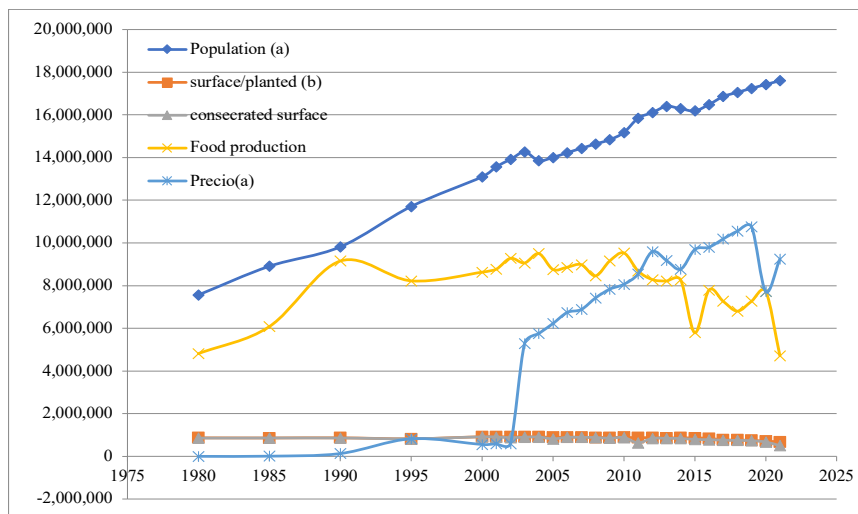
The State of Mexico is the most populous entity in the country since 1980, although some authors maintain that the demographic thrust comes from 1960, which was fed by internal migration recognized as social growth and its own demographic inertia (Jarque, s/f). Simultaneously, the entity, in economic terms, went from being an agricultural economy to a tertiary, which can be expressed in the generation of jobs and its gross domestic product (GDP) (Montoya, 1995).

The personnel occupied in the primary sector (agriculture and extraction) was 16.2 percent of the workforce in the Mexican entity in 1980 (González, 1995), five percent of them in 2010 and 2021 5.4 percent (INEGI, 2021). The primary sector contributed that 20.9 percent of the Gross Domestic Product (GDP) of the entity in 1980, step to 1.5 percent of GDP in 2010¹¹ and in 2020 it represented 1.4 percent of GDP at 2013 prices (INEGI, 2021) with a Fall by 5.76 percent in 2021 (INEGI, 2021). The evolution of employment and agricultural GDP of the our entity keeps coinciding with the fluctuations of the national economy, as well as the urbanization and modernization processes when becoming a tertiary economy. Its proximity to Mexico City has also been one of the determinants of this transformation and relegate the agricultural economy over time.

What we can deduce from the data presented in Figure 3, is that the absolute growth of the population and the production of agricultural food in the entity is positive, even with the fall of the latter, originates in the nineties and that without due to the international competition derived from the North American Free Trade Agreement, but which presents a positive sense in its absolute value. However, here it would be convenient to use the Malthusian argument, which, remember, indicates that population growth is expressed to a geometric measure, while the food only does so on an arithmetic scale. This is understandable by its great population growth from the 1985 earthquake and urban expansion in the municipalities conurbed to Mexico City, and more recently towards the metropolitan area of Toluca and Ocoyoacac, the incessant reduction of the planting and harvesting surface Through time, as well as the constant increase in prices to agricultural consumer goods; they mark the relationship exercised in the entity between population and food.

¹¹ See in Pilar 2. Progressive status, available at https://edomex.gob.mx/sites/edomex.gob.mx/files/files/plandedevelopment11-17_3.pdf (accessed 04/10/2022).

Figure 3: Population, planted area, harvested, food production and prices in the State of Mexico 1980-2021 (absolute values)



Source: IGCEM, INEGI and <http://infosiap.siap.gob.mx/gobmx/datosabiertes.php> fuente: Own elaboration based on the SIAP, INEGI and IGCEM (several years).

... There are regional prices influenced by the interaction of the supply and demand and prices of a national nature linked to the Chicago contributions and the costs called as bases, which refer to the disruptions of transport and management throughout the period of consumption. These national prices were governed by government guarantee prices. However, when the public intervention modalities changed in the markets, the guarantee prices were abandoned, but the participation of the National Company of Popular Substances (CONASUPO) as an important buyer and importer continued for a while, with a great influence on Price training (CEDRSSA, 2014: 8).

Another thing can be said based on the average annual growth rates of corn production, the population, the area planted, harvested and its prices. According to these measurements, the following can be stated (Figure 4):

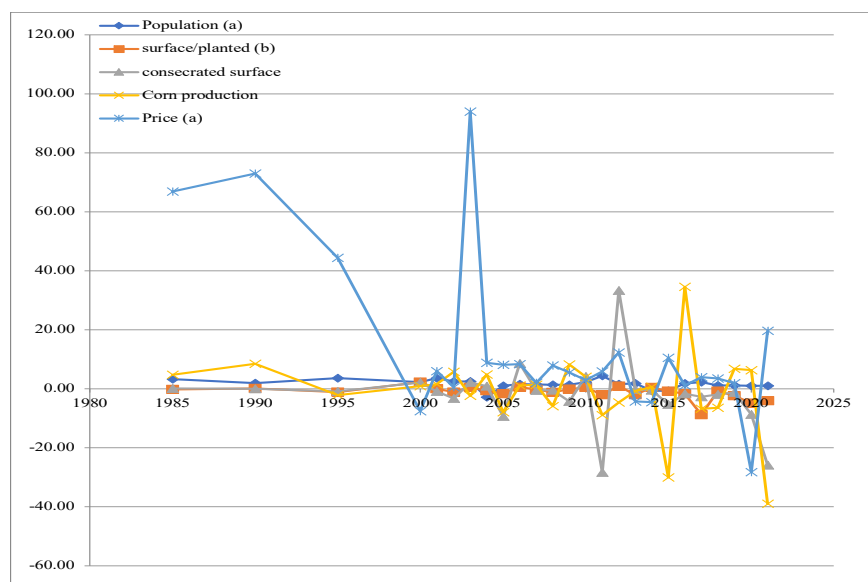
- Food production maintained its irregular rates affected by the national and international context. Which can be corroborated with the great fall in 2015 due to the fall in prices of primary goods and that of 2021 by the Covid-19.
- The relative growth of the population between 1985 and 2021 is descending but does not stop exerting pressure on the demand for agricultural foods in our entity. Its downward trend is due to the reduction of fecundity, mortality and a reorientation of internal migration.

- c. The planted area presented slight variations over time because the territorial extension for this activity in the entity is the same or in any case reduces over time.
- d. The harvested area remained constant between 1985 and 2000. To later present variations, but the most important falls occurred in 2011 and 2021. The first coincides with the beginning of the fall in raw material prices (or what some call the extension of the great crisis that began in 2008 in the United States) and the second due to the SARS-CoV-2 pandemic.
- e. Finally, agricultural prices in the eighties, since there were increases in prices derived from the implementation of the neoliberal model and the economic crisis of 1982, as well as the 1987 financial crack, which put the traditional agriculture model at risk affecting its performance (Gutiérrez and Rabell, 2018). The increase in agricultural prices also happened in the early 1990s due to constitutional reform to article 27 in 1992, which was not resolved with the application of programs from “the Program for the Certification of Ejidal Rights and Degree of Urban Solar (PROCEDE) and Direct support program to the field (ProCampo), which were planned with a long-term vision; starting its real operation at the end of 1993. But its behavior is also explained by Mexico’s entry into NAFTA, the free supply and demand of the market (which assumed that the invisible hand would correct the imbalances) and the recurring economic crises since the eighties.

MULTIPLE LINEAR REGRESSION MODEL OF FOOD PRODUCTION AND POPULATION IN THE STATE OF MEXICO 1980-2021

The simple regression model applied to the State of Mexico to test its relationship with food production is consistent with the Malthusian argument, as is expressed in Figure 3. In this case, the multiple regression model that includes the population variable, hectares planted, hectares harvested and accumulated price of all agricultural products per year presents another situation. Based on this we have the following: an R squared of 0.759 and, however, a change in R of 0.576. With the analysis of the regression, it is desired that the model have significant variables and thus obtain a high R^2 value. This combination, in our exercise for the State of Mexico is low (in relation to the national model of a single variable) (Table 5) P value/high R^2 , but indicates which changes in the predictors are related to changes in the variable of answer and that the model explains a lot of the variability of the response at 0.576.

Figure 4: Average annual growth rate of population, planted and harvested area, food production and prices in the State of Mexico 1980-2021



Source: IGECM, INEGI and <http://infosiap.siap.gob.mx/gobmx/datosabiertes.php> fuente: Own elaboration based on the SIAP, INEGI and IGECM (several years).

Table 6 exposes the values of the regression and the residuals (ANOVA): the model is statistically significant (sig. 0.001), that is, that it does predict the relationship between the dependent and explanatory variable.

The regression equation of “ordinary minimums” (MCO) indicates that the level of Mexican agricultural production, defined in tons, is positively related to the millions of people, directly related to the hectares planted, as well as hectares that hectares harvested and inversely related to accumulated prices of agricultural products (V6, prices) annually between 1980-2021 (Table 5). Specifically, millions of people (b_1), indicate that for each point of increase in the population is associated with an increase of 0.441, while the planted hectares remain constant. An increase in a unit of planted hectares increases agricultural production by 10,920 (b_2) (while harvested hectares remain constant); An increase in a sown hectare is associated with an increase of 4,432 tons of agricultural production (B_3) in the State of Mexico, while before an increase in a unit in the price in agricultural products decreases by -0.160 (B_4) tons in our entity agricultural production (that is, the price acts in reverse to agricultural production) (Table 7).

Table 5: Model summary (b)

Model	R	R square	Corrected R squared	Typical estimation error	Change statistics						D-W
					Change in R squared	Change in F	gl1	gl2	Si. Change in F		
1	.759a	0.576	0.495	967863.717	0.576	7.132	4	21	0.001		1.411

* Durbin-Watson

a. predictor variables: (constant), v6, hectares, hectares, millions.

b. Dependent variable: tons.

Source: own elaboration based on SIAP, INEGI and IGECM (various years).

Table 6: ANOVA^a

Model		Sum of squares	gl	Mean square	F	Sig.
1	Regression	2.6722E+13	4	6.6805E+12	7.132	.001b
	Residual	1.9672E+13	21	9.3676E+11		
	Total	4.6394E+13	25			

a Dependent variable: tons

b Predictor variables: (constant), v6, hectares, hectares, millions

Source: own elaboration based on SIAP, INEGI and IGECM (various years).

This means that producing food in the entity is much more expensive than buying. Because: a) Producing or sowing a hectare of corn in Mexico means investing 27 thousand pesos and to recover it, it would mean waiting for a year,¹² Obviously this also depends on the rural district, where planting is temporary or irrigation.

Figure 5 indicates that the model meets the assumptions of normality. That is, the assumptions of a statistical regression model refer to a series of conditions that must be given to guarantee the validity of the model. These assumptions are of linearity (Figure 6), homocedasticity, normality (asymmetric model), in the average of the waste it could be corroborated by its value of zero and the absence of collinearity (Gujarati, 2010). On the latter we can say that the statistics of colinearity as well as the national model do not have a value of significance, therefore, the interpretation must be done in relation to the value that is being obtained for both models (national and state). To do this, it should be sought that the values are close to one (Cruz and González, 2018).

¹² See how much do we invest in a hectare of corn?, Available at <https://semillas-todoterreno.com/2012/04/cuanto-invertimos-en-una-hectarea-de-maiz#:~:text=Sin%20embargo%2C%20la%20metodolog%C3%ADa%20es,aproximadamente%20%24%2027%2C000.00%20pesos%20de%20inversi%C3%B3n.> (Accessed 05/03/2022).

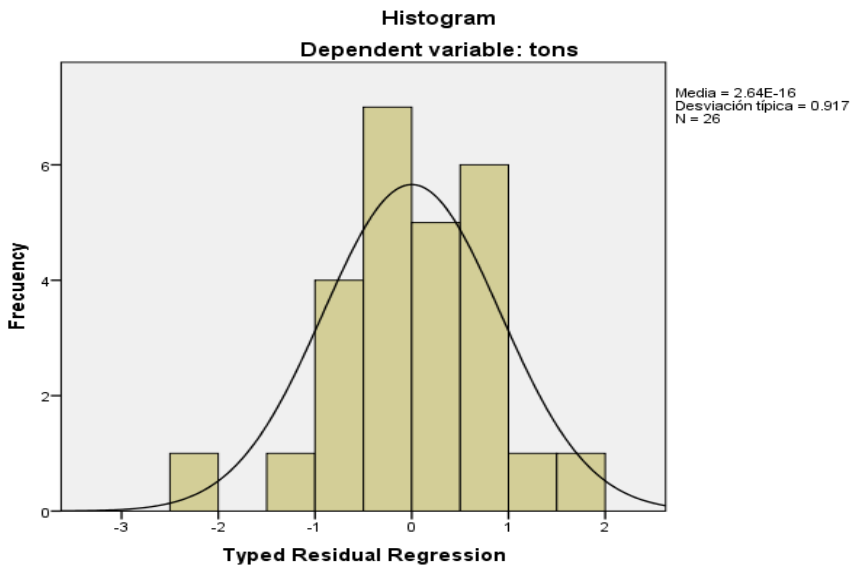
Table 7: Coefficients (a)

Model	Unstandardized coefficients		Error tip.	Typified coefficients		t	Sig.	95.0% trust interval for B		Colinearity statistics	
	B			Beta				Lower limit	Upper limit	Tolerance	FIV
1	(Constante)	-10353171.9	3695082.96			-2.802	0.011	-18037517.6	-2668826.2		
	millions	0.441	0.155	0.843		2.848	0.01	0.119	0.763	0.231	4.335
	hectares	10.92	5.395	0.523		2.024	0.056	-0.301	22.14	0.302	3.309
	hectares	4.432	3.742	0.316		1.184	0.249	-3.35	12.214	0.283	3.536
	V6 (price)	-0.16	0.103	-0.454		-1.559	0.134	-0.374	0.054	0.238	4.194

a Dependent variable: tons

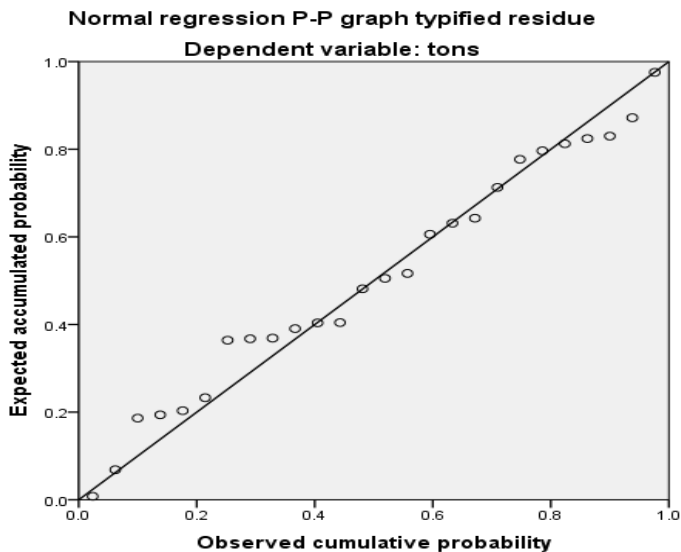
Source: own elaboration based on SIAP, INEGI and IGECEM (various years).

Figure 5: Histogram, dependent variable: tons vs regression of standardized residuals (normal)



Source: own elaboration based on SIAP, INEGI and IGECM (various years).

Figure 6: regression of typified waste (tons vs. accumulated probability observed)



Source: own elaboration based on SIAP, INEGI and IGECM (various years).

What we can see is that the ranges are similar in the inflated variance factor (IVF), this indicates that the assumption of non-multicollinearity between the explanatory variables (values from 1 to 4.3 for both models and their independent variables) is fulfilled). We can say that there is no value above ten and together all values are close to one (tables 4 and 7). In general terms we can affirm that models are good to predict national and state agricultural production (Figures 2, 5 and 6).

Figure 6 of normal waste probability allows to verify the assumption that the waste is normally distributed. The normal waste probability graph follows approximately the straight line (with slight variances or atypical values).

FOOD DISTRIBUTION AND SUPPLY IN THE COUNTRY

The supply and distribution of agricultural foods in the country express the characteristics assumed by polarized development within the national territory and monopolized since it has been considered a globalizing neoliberal development model.¹³

Thus, space patterns have been formed as areas that link in a tangible and intangible way to producers and consumers through trade, which follows, at the same time, the behavior patterns of the consumption patterns of the local, national or demand population external through export-import.

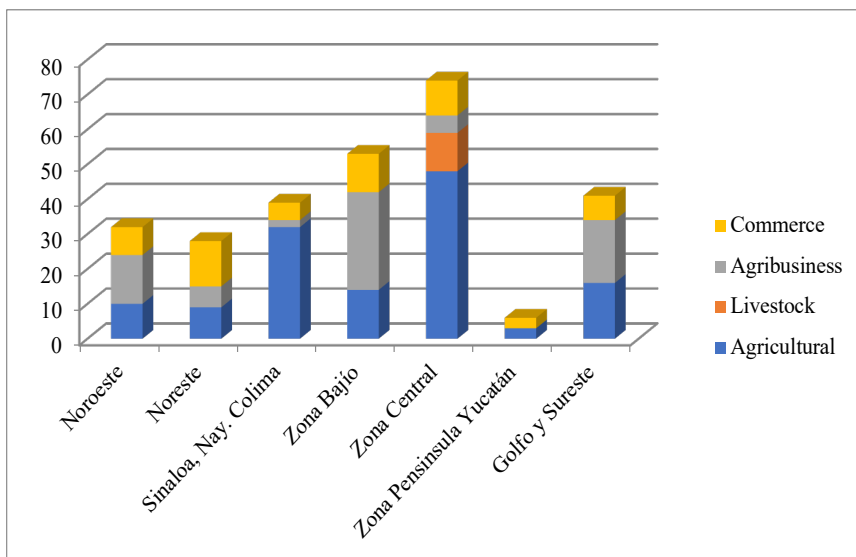
The distribution and supply of food happens under conditions of stability in income, originating a pattern of consumption in the large cities of the country as of the entity. However, the same conditions and transitions of development, together with new conceptions inherent to the outward economic growth models, generated changes in trade (from small trade to transnational shopping centers) and the distribution. The food supply model can form hegemonies by temporary or irrigation agricultural areas, which are presented from an evolution of the relationship between producers and consumers in which both the transformations of the economy and the production regions and of the production regions include commercialization. The varied growth schemes over time that are applied in the national and state economy can impact development processes in various ways; while they are based on competition, they generate unequal situations in sectors and economic agents, as well as for the allocation of benefits.

So that its constant is the asymmetry in national and state production, in the population and the territorial, which is explained by the presence of

¹³ See in Introduction, available at <https://archivos.juridicas.unam.mx/www/bjv/li-bros/9/4334/2.pdf> (Consulted on 05/03/2022).

various types of offers-demands, which lead to the formation of different segments of the consumer market in the that interact, to a different degree, interests and specializations of producers, intermediaries and consumers (Figure 7). This forms a hegemonic food supply pattern that retains for indeterminate times nationwide.

Figure 7: Agricultural areas and marketing in Mexico



Source: <https://www.gob.mx/siap/acciones-y-programas/produccion-agricola-33119>

The agricultural food supply in Mexico is presented as a structuring feature of various spatial relationships that are configured in pattern, system, network or chain in the different phases of primary food production, product collection, conditioning and packaging, storing and storing and transport to its distribution to the final consumer. Around the distribution, in the most visible part in the consumption nucleus, different commercial channels are made up that determine the type and quality of the offer, while generating chains of suppliers and intermediation networks to meet the demand.

These, in turn, respond to a consumption structure typified by diverse ways of social access and territorial configuration that reflect the unequal distribution of income, typical of market economies.

Based on this we have areas specialized in the production and distribution of food: namely (Figure 7).

- a. Northwest zone consisting of Sonora, Baja California and Baja California Sur, which specialize in the distribution of wheat, alfalfa, vine, cotton, sorghum, oatmeal and barley.
- b. Northeast zone composed of Chihuahua, Durango, Zacatecas, San Luis Potosí, Coahuila, Nuevo León and Tamaulipas entities. These entities produce and distribute sorghum, cotton, apple, soybeans, vine, carrum and sugar cane.
- c. The Sinaloa area, Nayarit and Colima distribute vegetables, soybeans, wheat, rice and carrum.
- d. The Bajío area composed of the entities of Jalisco, Guanajuato, Querétaro, Aguascalientes and Michoacán that distributes vegetables, wheat, sorghum, strawberry, beans, corn, vid, cacahuete and alfalfa.
- e. The central zone, where the largest population size consumer of agricultural products (from the country) is concentrated, we have Guerrero, Morelos, Mexico City, Puebla, State of Mexico and Tlaxcala, which distribute corn, beans, sesame, rice, vegetables, alfalfa, peanuts among others for the consumer market.
- f. The Yucatan Peninsula area, composed of Yucatan, Campeche and Quintana Roo, distribute vegetables, citrus, peanuts, sesame, mango, mamey and henequén.
- g. Finally, the Gulf and Southeast area is made up of the Veracruz, Oaxaca, Tabasco and Chiapas entities, which distribute sugar cane, rice, banana, citrus, grasslands, coffee and fine wood.

In this way, in Mexico the monopolies of agricultural, agribusiness, livestock production and especially marketing according to the area are distributed. This defines the food supply spectrum, marking a territorial distribution that, together with the dominant market, establishes an exclusive monopoly in the national economic development model, transforming it into a homogeneous scheme of distribution and consumption, being at the same time more transnational through the agribusiness located in El Bajío, Northeast, and northwest of the country. The spatial configuration of the supply is based on the predominance of consumption in the large metropolises, that of Mexico City, the State of Mexico (which together house more than 21.8 million potential consumers), Guadalajara (5.2 million people), Nuevo León (5.3 million consumers), Toluca (with 2.4 million people) and

the rest of the metropolitan areas of the country (SEDUO, 2021) that model the system through the concentration of food distribution-demand.

Monopolies build a new distribution pattern, eliminate stages of intermediation (excluding new and small producers along with distributors) and expand the borders of supply, or the distance between the cores of the consuming population and the regions of supply becomes irrelevant, supply due to advances in technology and transportation. However, traditional distribution, although with various restrictions generated by competition from large firms, remains at a certain regional and urban-metropolitan scale. The system is distinguished by great complexity, which is explained as the coexistence between tradition and modernity, although marked by the roots to the habits and factors of resistance to change (especially in the information age) between the acceleration of the population consumer encouraged by the media and large transnational shopping centers.¹⁴

These two dimensions (traditional and modern) organizers of the food supply, considering the economic and the territorial, are the result of a prolonged evolutionary process that relegates the adaptation to the requirements of a type of demand-consumption located, regardless of its territorial scale, which must cover the requirement of functionality and efficiency with the relationship between producers and consumers. This forces to structure an intermediation mechanism that forms one or more territorial configurations, with a distribution subject to changes in food (which privileges scrap food that generates a large number of degenerative diseases) and in lifestyles in general.

The pragmatism of social life and the market includes the fact that the supply of agricultural and non-agricultural foods adapts to new needs and meets pre-existing demands (trying to go against the Malthusian approach). This explains the noted coexistence between traditional and modern systems that allow networks to be built to meet a constantly expanding demand at the national level, as is the case in the State of Mexico. This implies having great challenges in the virtual era, essential and non-essential work, since for some they indicate that it is an opportunity for the digital transformation of agricultural SMEs¹⁵ at the national level and for the State of Mexico. Which are accompanied by the traditional system and food distribution.

¹⁴ See in food production, the greatest challenge in the world, available at <https://www.gaceta.unam.mx/la-produccion-de-alimentos-el-mayor-desafio-en-el-mundo/> (consulted on 05/03/2022).

¹⁵ It refers to small and medium-sized companies that have certain occupational and financial limits preset by the States or regions of Mexico.

CHARACTERISTICS OF THE AGRICULTURAL DISTRICTS OF THE STATE OF MEXICO 2003-2020

The agricultural division of the State of Mexico has referenced as a district, regions or zones. For this purpose, INEGI (2001), as well as the SIAP (2020) to describe the data of the year 2003 and that of 2020 to expose statistics under this precept (INEGI, 2001).

For the Rural Development District I,¹⁶ Toluca. With data from 2003 and 2020, the Toluca rural development district decreased the hectares planted and harvested in absolute terms, whose average annual growth rates were -1.78 and -1.22 percent, respectively. Although it is observed that we have an increase in its performance and production value in this period (Table 8). In this District there are two types of agriculture: seasonal and irrigation, distributed in the high valleys and on the gentle slopes of the district. The most important annual crops are: corn, green beans, potatoes, green peas, forage oats, grain oats, cabbage, as well as fruit trees and permanent crops. Their products are marketed locally or sold to large hoarders at the Central de Abasto in Mexico City, Toluca or Texcoco. The development of these crops is carried out in deep, fertile soils, rich in organic matter and nutrients, which are capable of maintaining good yields, such as Feozem (dark and Russian soil) and Vertisol (black and clay soil) (INEGI, 2001).

In the Rural Development District II,¹⁷ Zumpango, the data are similar to the previous one, that is, the hectares planted and harvested decreased between 2003 and 2020 (Table 8). Affected by natural disasters, but above all by the urbanization process that is taking place in this rural district. This district has climatic conditions that are: temperate subhumid and semi-dry temperate with rain in summer. The agriculture practiced in this District is divided into seasonal and irrigation, and is distributed in the flat parts, although there are areas with high erosion rates. This district of the Mexican entity records the greatest spaces to sow wheat, barley, beans, forage corn, nopal nopal and green alfalfa; Other important crops are: grain corn,

¹⁶ This district is made up of the municipalities of Almoloya de Juárez, Almoloya del Río, Ati-zapán, Calimaya, Capulhuac, Chapultepec, Huixquilucan, Joquicingo, Lerma, Metepec, Mexi-caltzingo, Ocoyoacac, Otzolotepec, Rayón, San Antonio la Isla, San Mateo Ateneo, Temoaya, Tenango del Valle, Texcalyacac, Tianguistenco, Toluca, Xalatlaco, Xonacatlán y Zinacantepec.

¹⁷ Rural district composed of the municipalities of Colman, Apaxco, Atizapán de Zaragoza, Axapusco, Coyotepec, Cuautitlán, Cuautitlán Izcalli, Huehuetoca, Hueyoxtlá, Isidro Favela, Jaltenco, Jilotzingo, Melchor Ocampo, Naucalpan de Juárez, Nextlalpan, Nicolás Romero, No-paltepec, Otumba, San Martín de las Pirámides, Tecámac, Temascalapa, Teoloyucan, Teotihuacan, Tepotzotlán, Tequixquiác, Tezoyuca, Tlalnepantla de Baz, Tultepec, Tultitlán, Zumpango.

fodder oatmeal and with a smaller area, represent about 20 percent of the space enabled with the state irrigation (INEGI, 2001).

The Rural Development District III,¹⁸ 18 Texcoco. This district, like the previous ones, decreased the planted and harvested area (Table 8) with increases in its yield and production value, but it is worth mentioning that the urbanization processes, that is, the large infrastructure projects and the concentration of population, have implications in the negative growth rates and their absolute values of the rural sector in this agricultural area or region.

The agricultural activity that takes place in this district is temporary as in irrigation, is sown in flat and soft slopes and there are sites with degraded soils by erosion. The predominant crops of this district are: wheat, fodder corn, shell tomato, green alfalfa and avocado. With lower surface are: barley, bean, fodder beet, corn, cactus, potato, fodder oatmeal, grain oatmeal, peach and al-goggles vegetables. The crops grown in the region are found in Feozem type soils, with a dark surface layer rich in organic matter and soils derived from volcanic ash type Andosol (volcanic soil), deep and rich in nutrients, which allows obtaining good returns. Solonchak (saline sand) is another soil present in the flooded and saline lower parts, whose high concentrations of soluble salts only allow the establishment of grasslands (INEGI, 2001).

Rural Development District,¹⁹ 19 Tejupilco. The decrease expressed in its annual average growth rate is much more pronounced in relation to the other rural districts of the entity in terms of hectares harvested and planted, with negative rates of less five percent in both categories (Table 8), this is due to the fact that it is an area of high internal and international migration, due to the insecurity and agricultural crisis²⁰ (although there is possibly a bias in the type of planting) (unodoc-government of Mexico, 2021).

¹⁸ The municipalities that make up this rural district are: Amecameca, Ateneo, Atlautla, Aya-pango, Coacalco de Berriozábal, Cocotitlán, Chalco, Chiautla, Chicoloapan, Chiconcuac, Chi-malhuacán, Ecatepec, Ecatzingo, Ixtapaluca, Juchitepec, La Paz, Nezahualcóyotl, Ozumba, Pa-palotla, Temamatla, Tenango del Aire, Tepetlaoxtoc, Tepetlaxpa, Texcoco, Tlalmanalco, Valle de Chalco Solidaridad.

¹⁹ The rural district of Tejupilco is made up of the municipalities of Amatepec, San Simón de Guerrero, Tejupilco, Temascaltepec, and Tlatlaya.

²⁰ This journalistic note is a clear example of this, Crime stops road rehabilitation in the south of Edomex, available at <https://www.elsoldetoluca.com.mx/local/delin-cuencia-frena-rehabilitacion-de-carretera-en-el-sur-del-edomex-7206928.html> (Consulted on 05/03/2022).

Table 8: Characteristics of the agricultural sector according to district of the State of Mexico 2003-2020

2003

Agricultural areas	Sown	Harvested	Damaged	Production of volume	Performance	Price	Production of volume
Toluca	152,101.79	137,923.85	14,177.94	1,048,734.16	10,735.85	543,202.00	987,045,010.25
Zumpango	151,930.64	150,852.48	0.00	2,224,279.83	8,932.22	650,190.29	1,578,511,283.40
Texcoco	77,516.11	77,466.11	50.00	1,512,109.84	35,933.74	1,036,807.75	762,667,377.30
Tejupilco	135,770.00	135,760.00	10.00	2,889,995.99	2,254.73	368,541.00	1,190,055,344.00
Atlacomulco	185,186.63	180,686.09	4,498.79	13,222,973.17	2,890,813.07	226,581.00	1,064,793,826.00
Coatepec Harinas	77,858.00	77,752.00	25.00	22,778,307.62	349,252.45	1,458,586.00	3,023,109,229.00
Valle de Bravo	72,926.00	72,894.00	22.00	770,998.41	61,689.33	694,496.00	638,164,694.50
Jilotepec	61,599.00	61,567.00	32.00	664,191.58	1,851.79	308,600.00	488,995,975.00

Source: <https://www.gob.mx/siap>

Table 8: Continued (2020)

Agricultural areas	Sown	Harvested	Damaged	Production of volume	Performance	Price	Production of volume
Toluca	112,009.88	111,939.88	0.00	969,115.99	9,968.11	575,411.86	3,134,614,185.00
Zumpango	125,825.51	93,821.01	32,004.50	1,557,666.03	13,228.57	1,149,433.08	1,631,801,854.81
Texcoco	53,413.55	53,189.55	0.00	1,055,723.06	86,207.38	1,472,752.80	1,302,776,060.57
Tejupilco	54,250.19	54,068.63	0.00	493,968.64	9,483.02	856,488.14	1,282,731,220.79
Atlacomulco	170,157.75	169,962.75	0.00	1,793,396.74	70,313.43	461,489.67	4,019,171,748.76
Coatepec Harinas	61,750.95	60,128.95	0.00	22,349,415.12	224,083.68	1,921,015.19	6,094,643,499.62
Valle de Bravo	70,854.51	66,284.76	4,231.75	1,083,362.67	21,016.22	974,700.49	2,249,061,927.36
Jilotepec	62,460.65	62,455.65	0.00	522,885.52	1,343.63	317,148.65	937,968,145.52

Source: <https://www.gob.mx/siap>

Table 8: Continued

Agricultural areas	Sown	Harvested	Damaged	Production of volume	Performance	Price	Production of volume
Toluca	-1.78	-1.22	-100.00	-0.46	-0.44	0.34	7.03
Zumpango	-1.10	-2.75		-2.07	2.34	3.41	0.20
Texcoco	-2.17	-2.19	-100.00	-2.09	5.28	2.09	3.20
Tejupilco	-5.25	-5.27	-100.00	-9.87	8.82	5.09	0.44
Atlaomulco	-0.50	-0.36	-100.00	-11.09	-19.64	4.27	8.13
Coatepec Harinas	-1.35	-1.50	-100.00	-0.11	-2.58	1.63	4.21
Valle de Bravo	-0.17	-0.56	36.26	2.02	-6.14	2.01	7.69
Jilotepec	0.08	0.08	-100.00	-1.40	-1.87	0.16	3.91

Source: <https://www.gob.mx/siap>

Which can be reflected in its performance and value of production. The agriculture that is practiced in this district is temporary in most valleys and land with soft slopes; The amount of precipitation presented in the area allows to establish crops that have the highest moisture requirements, such as vegetables (potato, pea, onion, haba and tomato), others such as: sugar cane and fruit trees (peach, and avocado) , cultivated grasslands (llanero and African star), and annuals such as beans, oats, corn, barley and wheat, the latter covering a larger surface (INEGI, 2001).

The District of Rural Development V,²¹ Atlacomulco. In this rural area in which mestizos and indigenous people from the entity coexist: Mazahuas and Otomíes, mainly. Whose characteristic of its sowing mostly for self-consumption and the population carries out economic activities in the main cities of the country and in the United States. This affects the planted and harvested surfaces of crops: grain corn, forage oats and forage corn. As for seasonal agriculture, it is distributed in all the municipalities of this District, it has an area dedicated to cultivation that is equivalent to 20 percent of the state; The most important temporary crops are: grain corn and forage oats. It is also the most important producer of seasonal potatoes, after the Toluca Valley. However, the large-scale agricultural crisis in said district stands out (INEGI, 2001).

Rural Development District VI,²² Coatepec flours. Similarly, this district presents a reduction in the planted and harvested area (1.35 and 1.5 percent, respectively), which is affected in terms of its volume of production and performance, but not in the value of production (Table 8). This indicator (production value) is much greater than the rest of the rural districts of the entity. It should be recognized that the population of this area lives in the countryside, but that like district IV they live on internal and international migration. Lately it has also been news in the field of state insecurity which has been national and inter-national news.²³ This district presents the most important surfaces with pea, green, peach and avocado, although they are also important: corn, forage oatmeal, beans, peel and grassland tomato cultivated (llanero and African star); In addition to others such as rice, barley, onion, tomato, potato, fodder sorghum, wheat, grain

²¹ The municipalities belonging to this district are: Acambay, Atlacomulco, El Oro, Ixtlahuaca, Jiquipilco, Jocotitlán, Morelos, San Felipe del Progreso and Temascalcingo.

²² The municipalities belonging to this district are: Almoloya de Alquisiras, Coatepec Harinas, Ixtapan de la Sal, Malinalco, Ocuilán, Sultepec, Tenancingo, Texcaltitlán, Tonalico, Villa Guerrero, Zacualpan y Zumpahuacán.

²³ Killed 13 police officers in an ambush in the State of Mexico. State authorities report that a criminal group attacked the agents during a patrol in Coatepec Harina -a-Emboscada-in-the-state-de-mexico.html (consulted on 05/02/2022).

oatmeal, peach and macadamia. This district also highlights the large number of ornamental crop production units, where many of them are marketed abroad; The municipalities of district VI most important in the production of flowers and ornamental are: Villa Guerrero, Tenancingo, Zumpahuacán, Tonatico, Coatepec flours, Ixtapan de la Sal and Almoloya de Alquisiras, where the best species of ornamental horticulture are found (INEGI, 2001).

Rural Development District VII,²⁴ Valle de Bravo. Recognized by its tourist attractions and very possibly its absolute values in the planted area as the harvested can be affected by tourism in addition to the internal and international migration of its population. Although it should be noted that the value of its production was positive in absolute terms and as a growth rate (Table 8).

The agricultural activity that takes place in the district is mainly temporary and in small areas the irrigation is carried out, they are distributed in the flat parts and on the soft slopes of the slopes. The most important crops in the area are: corn, fodder oatmeal, potato, green pea, green, cultivated pastures (African and llanero star) and others such as: beans, barley, grain oatmeal, onion, tomato, shell tomato and wheat; there are also some fruit trees, mainly avocado, peach and macadamia (INEGI, 2001).

The VIII Rural Development District,²⁵ 25 Jilotepec in the location zone is a district of temporary and small irrigation areas. This is the only rural district of the entity to show absolute data and annual average growth rates of the planted and harvested hectares that presented positive values, as well as the value of their production. But its value for production is among the little ones in relation to the rest of the rural districts of the Mexican entity (Table 8). The data set out in this text allow to argue that the agricultural crisis in our entity is already a fact, which is associated with food insecurity and poverty (Lemos Figueroa *et al.*, 2018).

POVERTY AND FOOD DEFICIENCY IN THE STATE OF MEXICO

Hunger is a ghost that runs through the world after the Covid-19 pandemic, because there are 810 million people suffering from hunger, that is, one in ten people in the world does not have enough food to live (FAO, 2020). Of which 98 percent of people with malnutrition live in developing countries, 83 million people in Latin America and the Caribbean still live in extreme poverty, half of them in Brazil and Mexico according to the World Bank

²⁴ This rural district is made up of Amanalco, Donato Guerra, Ixtapan del Oro, Otzoloapan, Santo Tomás, Valle de Bravo, Villa de Allende, Villa Victoria and Zacazonapan.

²⁵ The municipalities that make it up are: Aculco, Mota Chapa, Jilotepec, Polotitlán, Soyaniquilpan de Juárez, Timilpan and Villa del Coarbón.

in October 2015. Hunger is polarized in the world, for example, hunger is concentrated according to regions: Asia and the Pacific with 418 million people; Sub-Saharan Africa 282 million; Latin America and the Caribbean 60 million people. Hits the most vulnerable such as women and children; 60 percent of hungry people are women and impacts mortality, for example, eight million premature deaths per year occur due Hunger Project Mexico, 2022).

Agriculture is the saving of millions of souls in the world, since it feeds 76 percent of people living in poverty conditions that are located in rural areas and depend on this activity to survive, but, in addition, it also leads to nutrition in Urban areas. 50 percent of hungry people are from families that are located in farming areas and impacts poverty levels.

For example, Mexico has a population of 126,014,024 million people, of which a considerable number of people are in poverty. Recent data indicates that it went from 51.9 million Mexicans in 2018 to 55.7 million Mexicans in 2020 (43.9 percent of the total population). This means that there are 3.8 million more people in poverty since the beginning of the six-year period of the self-proclaimed fourth transformation and within the context of the Covid-19 pandemic (CONEVAL, 2020). On the other hand, the number of people in extreme poverty increased from 8.7 million in 2018 to 10.8 million in 2020 (8.5 percent of the total population) (see The Hunger Project México, 2022).

Our country is considered a country with a growing economy and is part of the G20 as it is the fifteenth economy in the world according to the International Monetary Fund. The Organization for Economic Cooperation and Development (OECD) and the World Trade Organization (WTO) evaluate Mexican workers as those who work the hardest in terms of number of hours worked per year, compared to the rest of the world, according to the OECD, Mexico is the third country with the greatest economic inequality (The Hunger Project México, 2022).

Working more does not mean the absence of hunger. That is, famine and malnutrition require food security in Mexico. Because 23.5 percent of the population lives in food poverty (CONEVAL, 2022) but it hits the most vulnerable sectors of the population (especially in times of pandemic with price increases).²⁶

²⁶ This is where the government comes in with its plans against inflation (today it is called stagflation: Economic situation of the country that is characterized by economic stagnation while rising prices and increasing unemployment persist), Sader: the IP will voluntarily join the anti-inflation plan, available at <https://www.jornada.com.mx/2022/05/04/politica/004n1pol> (Consulted on 05/04/2022).

Table 9. Poverty measurement, 2016-2020: Multidimensional poverty measurement,* Mexico

Indicators	Percentage and number of people by poverty indicator, 2016 - 2020					
	Percent			Thousands of people		
	2016	2018	2020	2016	2018	2020
<i>Poverty</i>						
Population in poverty	46.6	41.8	48.9	7,695.80	7,036.30	8,342.50
Population in moderate poverty	41	37.1	40.7	6,759.20	6,252.70	6,940.60
Population in extreme poverty	5.7	4.7	8.2	936.5	783.6	1,401.90
Vulnerable population due to social deprivation	20.8	26.3	18.1	3,439.00	4,424.50	3,090.00
Vulnerable population due to income	10	9.6	11.8	1,654.40	1,615.90	2,014.80
Non-poor and non-vulnerable population	22.5	22.4	21.2	3,709.20	3,766.80	3,625.40
<i>Social deprivation</i>						
Population with at least one social deprivation	67.5	68	67	11,134.80	11,460.80	11,432.50
Population with at least three social deprivations	16.6	16.9	20.4	2,743.80	2,845.10	3,474.80
<i>Indicators of social deprivation</i>						
Educational lag	14.8	14.7	14.1	2,435.30	2,478.50	2,409.20
Deprivation due to access to health services	15.5	19.8	34.2	2,560.80	3,327.20	5,845.00
Deprivation due to access to social security	53	54.7	52.7	8,740.10	9,208.30	9,005.30
Deprivation due to quality and spaces in housing	12.6	9.6	7.2	2,086.30	1,625.10	1,227.50
Deprivation due to access to basic services in housing	11.7	10.3	9.9	1,930.60	1,740.00	1,686.60
Deprivation due to access to nutritious and quality food	24.2	23.4	24.2	3,989.60	3,943.50	4,131.20
<i>Economic well-being</i>						
Population with income below the extreme income poverty line	13.8	10.8	19.5	2,270.80	1,817.20	3,322.80
Population with income below the income poverty line	56.7	51.4	60.7	9,350.20	8,652.20	10,357.30

According to the general guidelines and criteria for the definition, identification and measurement of poverty (2018) that can be consulted in the Official Gazette of the Federation (https://www.dof.gob.mx/nota_detalle.php?codigo = 5542421*Date = 30/10/2018) and the methodology for the multidimensional measurement of poverty in Mexico, third edition (<https://www.coneval.org.mx/informespublicaciones/informespublicaciones/documents/metodologia-mediton-multidimensional-3er-edition.pdf>).

Source: Estimates of the Coneval based on the ENIGH 2016, 2018 and 2020.

For example, according to the National Food Survey. Health and Nutrition 2018, there are 881,752 children with chronic malnutrition in the country, in which there is no exception in urban and rural areas. In the country, chronic malnutrition in urban areas is 7.7 percent and in rural areas it is 11.2 percent.

This means food insecurity, because according to the 2018 National Health Survey, 55.5 percent of households in Mexico were classified in one of the three categories of food insecurity. 69.1 percent of households living in the rural stratum were classified as having some level of food insecurity.

In a country with high inequality such as Mexico, indigenous peoples are the most vulnerability. One in four indigenous children suffers from chronic malnutrition (ENSANUT 2018). In Mexico, 69.5 percent is, eight million 340 thousand indigenous people live in poverty (CONEVAL). Of that 69.5 percent, 41.6 percent corresponds to indigenous people in moderate poverty and 27.9 percent to indigenous people in extreme poverty. These figures contrast with those of non-indigenous population, for which moderate poverty is 33.7 percent and extreme poverty of 5.3 percent.

For its part, the State of Mexico went from 3.9 million in 2016 to 4.1 million people in extreme poverty. This increase is due to the Covid-19 pandemic, the food production crisis and the immobility in distribution due to confinement.²⁷ In percentage terms it is similar to that of 2016, which was 24.2 percent, but 17.7 percent in 2012, which would mean an increase of 6.5 percent in eight years (between 2012-2020) (Table 9). During 2018, more than 60 percent of the indigenous population of the State of Mexico lived in poverty (mainly Mazahua and Otomi).²⁸

LACK OF ACCESS TO FOOD IN THE MUNICIPALITIES OF THE STATE OF MEXICO

The indicators on national and state lags and lags hide their particularity at a level of greater geographical disaggregation, that is, the municipality. In the tapestone of the largest size they seem to be coincident with the size of its population, for example, the most populous municipality is Ecatepec, Chimalhuacán, Nezahualcóyotl, Tlanepantla, Naucalpan, Valle de Chalco Solidaridad and that also concentrate the largest number of people with

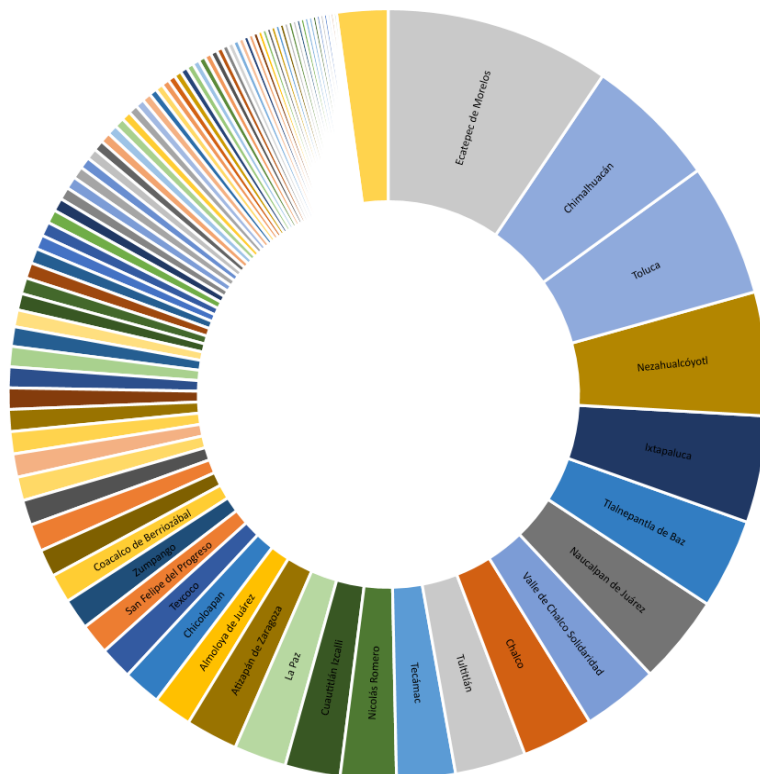
²⁷ State of Mexico, poverty measurement 2020, available at https://www.coneval.org.mx/coordinacion/entidades/estadodemexico/publishingimages/pobreza_2020/pobreza_mi_2018-2020_edo-mex.jpg (accessed on 04/14/2022).

²⁸ CONEVAL, 2019, Poverty in the indigenous population of Mexico, 2008 – 2018, available at https://www.coneval.org.mx/Medicion/MP/Documents/Pobreza_Poblacion_indige-na_2008-2018.pdf (Consulted on 14 /04/2022).

deficiencies for access to food. But, the most important changes are the increases between 2010 and 2020 (Figures 8 and 9).

Figure 8: Deprivation due to access to food, municipalities of the State of Mexico, 2010

Carencia por acceso a la alimentación y municipios del Estado de México, 2010



Source: <https://www.coneval.org.mx/Medicion/Paginas/Pobreza-municipio-2010-2020.aspx>

RELATIONSHIP BETWEEN LACK OF FOOD AND POVERTY

The lack of food is derived from its production while it is caused by poverty and has implications in health, since the quality of the pattern of food consumption can be modified by poverty. Before moving on to the interpretation of the Rho de Spearman coefficient, it is indicated that it agrees in values close to 1; they indicate a strong and positive correlation. Values close to -1 indicate a strong and negative correlation. Securities close to zero indicate that there is no linear correlation.

- c. The greater the number of extreme poor in the municipality (Pobrex) there is a strong correlation (0.897) with the lack of food (Cali-element20).
- d. The greater the number of moderate poor (pobreMod) there is a strong positive correlation (0.969) with the lack of food (Caliment20).
- e. The greater the population with social deprivation (cernsocial) there is a strong positive correlation (0.852) with the lack of food (Cali-ment20).
- f. The greater the number of vulnerable population in terms of their monetary income (VulY), there is a strong positive relationship (0.902) with the lack of food (Caliment20).
- g. The greater the number of population whose income is Below (Yba-joLP) the poverty line there is a strong positive correlation (0.974) with the lack of food (Caliment20).

In simple terms, if you are poor, the possibilities of lacking food increase, even being metropolitan municipalities that have a large spectrum in the labor market to obtain income and with it greater economic possibility to maintain consumption. Amartya Sen's arguments (2006) indicate that the problem of hunger is also the result of the absence of entitlements or food access titles. These titles are made up of employment or land to cultivate (which in turn allows people to have a permanent income), but they suffer discrimination of an ethnic, sexual or religious nature. Without these titles, famine coexists with a full supply of food cited in Vite (1999: 176). The problems of food and poverty are structural that have led to inequality, social and regional polarization, a product of the current economic model and a poor income redistribution policy.

People should not be allowed to become so poor that they offend or cause pain to society. It is not so much the misery or suffering of the poor but the discomfort and cost to the community that is crucial to this conception of poverty. Poverty is a problem to the extent that low income creates problems for those who are not poor (Amartya K. Sen, 1992: 310).

Tabla 10: Correlations

		Calim- ment20	PObT	Pobres	pobrezExt	pobreMod	cernso- cial	VulY	Yba- joLP
Calim- ment20	Correlación de Pearson	1	0.927**	0.985**	0.897**	0.969**	0.902**	0.852**	0.979**
	Sig. (bilateral)		0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N	125	125	125	125	125	125	125	125
PObT	Correlación de Pearson	0.927**	1	0.966**	0.719**	0.980**	0.995**	0.978**	0.890**
	Sig. (bilateral)	0.000		0.000	0.000	0.000	0.000	0.000	0.000
	N	125	125	125	125	125	125	125	125
pobres	Correlación de Pearson	0.985**	0.966**	1	0.850**	0.995**	0.947**	0.904**	0.969**
	Sig. (bilateral)	0.000	0.000		0.000	0.000	0.000	0.000	0.000
	N	125	125	125	125	125	125	125	125
pobrezExt	Correlación de Pearson	0.897**	0.719**	0.850**	1	0.794**	0.672**	0.597**	0.949**
	Sig. (bilateral)	0.000	0.000	0.000		.000	0.000	0.000	0.000
	N	125	125	125	125	125	125	125	125
pobreMod	Correlación de Pearson	0.969**	0.980**	0.995**	0.794**	1	0.967**	0.931**	0.941**
	Sig. (bilateral)	0.000	0.000	0.000	0.000		0.000	0.000	0.000
	N	125	125	125	125	125	125	125	125
cernsocial	Correlación de Pearson	0.902**	0.995**	0.947**	0.672**	0.967**	1	0.975**	0.856**
	Sig. (bilateral)	0.000	0.000	0.000	0.000	0.000		0.000	0.000
	N	125	125	125	125	125	125	125	125
VulY	Correlación de Pearson	0.852**	0.978**	0.904**	0.597**	0.931**	0.975**	1	0.799**
	Sig. (bilateral)	.000	0.000	0.000	0.000	0.000	0.000		0.000
	N	125	125	125	125	125	125	125	125
YbajoLP	Correlación de Pearson	0.979**	0.890**	0.969**	0.949**	0.941**	0.856**	.799**	1
	Sig. (bilateral)	0.000	0.000	0.000	.000	.000	0.000	0.000	
	N	125	125	125	125	125	125	125	125

** The correlation is significant to the 0.01 (bilateral) level.

Source: own elaboration based on https://www.coneval.org.mx/Medicion/paginas/consulta_pobreza_municipal.aspx

CONCLUSIONS

Concern about the imbalance that exists between food production and the population is a problem that is discussed even today, leading it to develop not only in national forums on population, but also in international congresses, reaching different governmental instances both both as transnational. Due to the general problem that recently originated the pandemic in 2020 caused by the SARS-CoV-2 virus, and aggravated by the war conflict

that emerged between Russia and Ukraine in 2022, generated shortage of food, fertilizers and other important supplies related to the Agricultural sector for the world population.

In our analysis we can conclude the following:

Agricultural production between the period analyzed at the national level grows mostly in its absolute value over time and above the country's population. This at first glance means to be a Malthusian counterargument, that is, what can be seen from its position in the quadrant is positive. However, the extension in hectares of the planted and harvested area does not decrease the value of production, but also of imports and exports. With the latter, a deficit is identified in the balance of payments of these two concepts previously explained. Which means that national production does not cover the total demand for food for the total demand of the population over time. Obviously there are elements that play against it, such as the structural crisis, recurring economic crises that impact the agricultural sector, the fall in international prices of raw materials and the most recent, the critical health crisis.

The previous counterargument can be seen more clearly in the simple regression model when beta 1, 2.79 (V2) at the state level is positive. However, behind this indicator are the neoliberal policy of privatization of the ejidos, the little effect that the programs had for the countryside, the economic and agricultural crises, the commercial opening, the fall in international prices of agricultural products and the pandemic crisis that still has no end in sight.

In the case of the State of Mexico, the situation is much worse because the hectares planted and harvested and production are reduced and with a population divided between metropolitan dependents and non-rural producers. But even with this, the results derived from the multiple regression model are shown as a Malthusian counterargument by presenting a positive value of their betas with the exception of prices that act inversely which means that it is more expensive to produce in the entity than to import.

In the middle of all this are the hoarders and those who concentrate the distribution of products derived from the agricultural sector. Those that distribute within the country that are specifically distributed in areas of greater agricultural production. The supply is concentrated in the central area because the main distribution centers are located there, such as the supply center of Mexico City, which includes the State of Mexico. In the north, the shoal and the south there are actors that supply the internal mar-

ket, but also the external market. In general, these suppliers are the ones who have the monopoly on agricultural products and are the ones who control the supply at the national level and obviously the State of Mexico cannot be left out of this.

Agricultural production in the State of Mexico presents a kind of specialization by rural district. That is, they mostly plant and harvest corn. But there are districts like those in the south of the state that plant and harvest fruit, flowers, among other products, whose yields and production value are much higher than those of corn-growing areas whose products are for the market or for self-consumption.

Finally, the correlation between lack of food and poverty would give the reason to the Malthusian argument. That is, the greatest number of poor in the major municipalities are they who suffer from food lack. This could be correlated with the decrease in agricultural production, in the imbalance of food distribution of this sector and to the labor market.

The results presented here can be refuted because, as Karl Popper says, there are no immutable arguments and other studies could reach different results. Thus, our findings are submitted to the scrutiny of experts on the subject and if this happens, this text will have achieved its goal:

a hypothesis is falsifiable if there is an observational statement (or a set of observational statements), logically possible, that are incompatible with it, that is: if established as true, they would refute such proposal (Ibañez, 2007).

In terms of public policy, after the health crisis comes inflation and high food prices, therefore, Adres Manuel López Obrador (AMLO) asked producers to make their homeland and plant more grains to combat inflation.²⁹ This means an internal market policy (protectionist) given that there has been a crisis in the international food market, for example, India has stated that it will stop exporting wheat and for this the government of Mexico has eliminated tariffs on imports of wheat certain food products.³⁰

POSSIBLE SCENARIOS AND OBSTACLES IN THE DEVELOPMENT OF FOOD PRODUCTION OF AGRICULTURAL SECTOR

After the pandemic, the crisis of war between Ukraine and Russia seems difficult to meet the zero hunger objective by 2030. This is because both

²⁹ AMLO asks producers to make homeland and sow more grains to combat inflation, available at <https://www.process.com.mx/nacional/2022/5/16/amlo-pide-product-res-que-hagan-patria-Ste-somas-granos-for-combat-inflation-286003.html> (accessed 05/17/2022)

³⁰ Tariffs are eliminated on 66 goods, available at <https://www.jornada.com.mx/2022/05/17/economia/016n2eco> (Consulted on 05/17/2022).

crises had a systemic effect, especially in the equation of agricultural production. If we start from the idea that the territorial extension does not increase or decrease as we have previously seen, the investment is more expensive by the increase in interest rates and inflation (Figure 10). But FAO (2022) suggests that investment increase and as if the money borrowed was not expensive. Therefore, these are elements that reduce the possibility of increase in production and even complicate the import of food worldwide and therefore to Mexico.

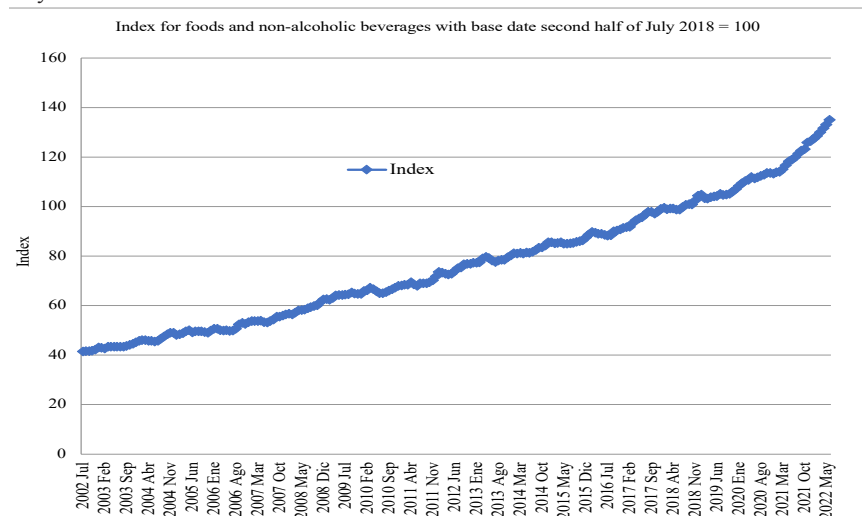
Raw materials have also increased with war, however, FAO suggests guaranteeing the best use of fertilizers, but how does the process of dysbalancing affect import? Which means that it is another element that will affect the equation of agricultural production, as well as the objectives of zero hunger and which is associated with world drought,³¹ national³² and state.³³ But at the same time how to reduce the gap between northern farmers with intensive technology uses and those of the traditional south of the country?

³¹ The number and duration of droughts have increased 29 percent since 2000, available at <https://news.un.org/es/story/2022/05/1508622> (Accessed on 07/14/2022).

³² Mexico Drought Monitor (MSM), available at <https://smn.conagua.gob.mx/es/climatologia/monitor-de-sequia/monitor-de-sequia-en-mexico> (Consulted on 07/14/2022).

³³ In the State of Mexico there are eight municipalities with drought and 72 abnormally dry, available at <https://www.elsoldetoluca.com.mx/local/en-el-estado-de-mexico-hay-ocho-municipios-con-sequia-y-72-abnormally-dry-8583266.html> (Accessed on 07/13/2022).

Figure 10: Food and non -alcoholic beverage price index, Base Date: Second Fortnight of July 2018 = 100



Source: INEGI, Available in <https://www.fao.org/hunger/es/> (07/05/2022).

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