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Review

Food Security, Environmental Health, and the Economy in Mexico: Lessons Learned with the COVID-19

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Abstract: In Mexico, it is estimated that due to the economic system the overexploitation of natural resources, environmental impacts and health have been generated, with high rates of overweight and obesity. This review analyzes the impacts on food safety, environmental health, and the economy in Mexico before and during the COVID-19 contingency. Derived from the analysis, among the lessons learned we can include: the health contingency due to COVID-19 had negative repercussions on food security, environmental health and the economy, which require the promotion of public policies (health, environment and economy) and migrate to a health prevention system and an agroecological model, which includes multidisciplinary and intersectoral interventions (government, academia, researchers, civil society organizations, business groups and citizens themselves) to reform and enforce the right to enjoy adequate food and a healthy environment. The contingency due to COVID19 has shown us that this must go from an ideology to being a reality and the lessons learned will have to focus on promoting an innovative and ethical culture of generating an economy, with a gender balance, resilience to climate change, management transparent technology and a priority in health and this will lead to progress in the food security of the population.

Keywords: Food security; environmental health; Economical system; COVID-19.

1. Introduction

In December 2019, SARS-COV-2, of still uncertain origin, causing the COVID-19 disease, was detected for the first time in Wuhan China [1]. On March 11, 2020, the World Health Organization (WHO) declares the pandemic and by December more than one million deaths worldwide have been caused by COVID-19, mainly with economic and health impacts.

Mexico, one of the largest countries in terms of territory and population in the Latin American continent, presented 209,000 confirmed deaths and 2,028,000 infections by April 10, 2021 [2]. According to the 2018 National Health and Nutrition Survey (ENSANUT) (table 1), compared to the 2012 survey, there was an increase in the figures for diabetes (10.3%), hypertension (18.4%), dyslipidemias (19.5%), obesity and overweight (35.6%). In 2012, 70% of households had presented food insecurity while for 2018 food security increased from 30% to 44.5%. This increase in food security is not attributed to access to healthy or nutritious food, but to processed foods with high energy density, saturated fats

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and added sugars [3]. The health panorama in Mexico with these figures are evidence of the public health problem that the Mexican population presents and therefore the vulnerability to the presence of a new virus.

Table 1. Comparison of the percentages of some of the main results of the National Health and Nutrition Surveys (ENSANUT) of 2012 vs 2018.

Indicator	Survey- 2012	Survey- 2018
Food security	30%	48.9%
Diarrheal disease in infants of 0 to 4 years	11%	11.8%
Diabetes in population of 20 years and more*	9.2%	10.3%
Hypertension in population of 20 years and more*	16.6%	18.4%
Cholesterol and triglycerides in the population of 20 years and more*	13%	19.5%
Tobacco consumption in the population of 10 to 19 years	Rank of 1.5 to 9.5%**	5.1 %
Exclusive breastfeeding	14.4%	28.6%

* Women have the highest percentages [3].

Poor nutrition affects productivity and general well-being of people. Malnutrition and nutritional deficiencies are the cause of neurocognitive deterioration, emaciation, anemia, decrease and weaken the response of the immune system, increasing vulnerability to infectious diseases. On the contrary, overweight and obesity increase the risk of chronic non-communicable diseases, such as diabetes, heart disease, osteoarthritis, cancer, and the immune system is also affected by the inflammatory processes that obesity generates [4,5].

With this introduction it was that the objective, design and criteria of this review of the literature was structured according to figure 1.

Objective: We conducted a literature review of the main scientific evidence for Food Security, Environmental Health, and the Economy and to derive proposals derived from the lessons learned with the contingency by COVID-19.

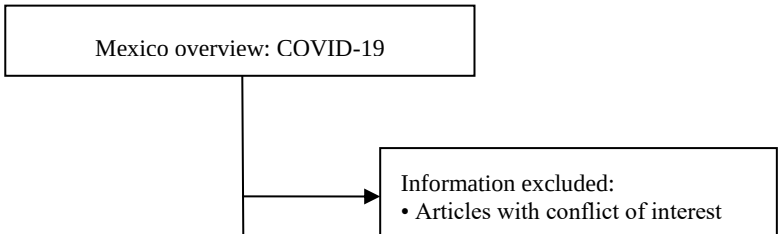
2. Materials and Methods

Design: Literature review

Data sources: MEDLINE, Embase, CINAHL Plus, Web of Science, CAB Abstracts and PAIS Index

Selection criteria: Articles with quality criteria of the journals and integrate the lesson learned with the COVID-19 for the Food Security, Environmental Health, and the Economy.

Data analysis: Relevance and quality of the results regarding Food Security, Environmental Health, and the Economy.



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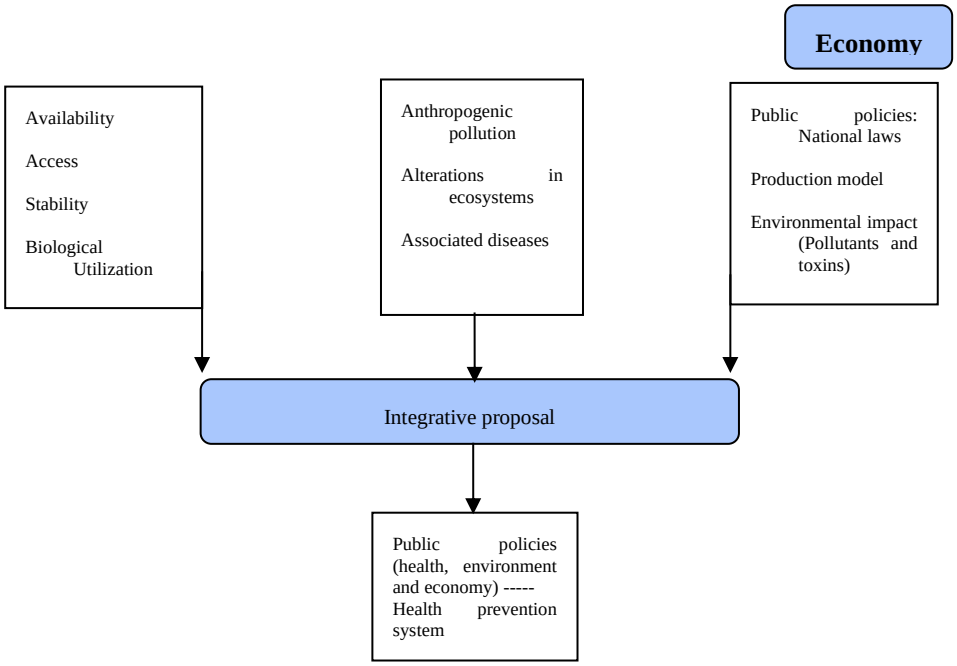

Figure 1. Article selection criteria and review structure with main teams food security, environmental health and economy.

3. Literature Review

3.1 Food Security

Food security is when everyone, at all times, has constant and permanent access to a nutritious and culturally acceptable diet, which provides essential nutrients for proper development and growth [6]. More than 820 million people suffer from hunger in the world and approximately 2 billion people suffer from some type of food insecurity. Food insecurity in Latin America and the Caribbean went from 4.7% to 6.4% in three years [7]. Lack of access to food, mainly nutritious, increases the risk of presenting poor nutrition (due to deficiency or excess) [8]. In addition to this, households headed by women present a greater risk of having some degree of food insecurity, this being associated with the presence of obesity and overweight (RR = 1.28 to 2.97; 95% CI: 1.08-1,44 to 1.52-6.14) [9].

In Mexico, since 2012 the levels of food insecurity have increased, where from 2012 to 2014 it was from 21.6% to 23.4% respectively. In 2018, 44.5% of households presented food security; of the levels of food insecurity, 22.6% reported having moderate and severe food insecurity while 32.9% mild insecurity [3, 9]. Stability, availability, accessibility, consumption and biological incorporation are part of the dimensions of food security.

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Availability, physical and economic, is the result of domestic food production (primary and industrialized), reserves in a country, imports and exports, food supports and the capacity for storage and transportation. The fact that a food is healthy, nutritious and economical allows the other dimensions of food security to be achieved, but it will depend on the supply and demand of consumers and the food policies of the countries [10]. The distance between the centers of production, distribution and the infrastructure available to carry out the internal agri-food trade influences the availability for food to be purchased at home [11]. In 2012, 70.1% of the food consumed in Mexican households came from grocery stores (24.9%), specific brand stores (22.3%), supermarkets (13.7%) and open markets (9.2%). However, this behavior is different for each region of the country [12], which generates a greater concentration and accessibility of processed and fresh products only in certain regions of the country. An important point of availability is the destination dynamics of agricultural production, where 49% of the country's agricultural production units, 51.5% sell their harvest to intermediaries, 25.5% direct to the consumer, 11% to the industry and the rest corresponds to food markets, supermarkets or warehouses [8]. In the case of fresh food, its highest concentration is in supply centers, where 95% of the food in the basic basket can be accessed. This concentration of markets, which is migrating to become increasingly urban, generates a situation of vulnerability and informality for producers who cannot sell their products in these spaces due to the difficulty of marketing, transportation or storage, lack of fair prices, competitive and a lack of organization among local producers. This explains why a greater number of intermediaries that are part of the food production and distribution chain are registered and all of this is part of the current economic system and model [13]. The biological use of food will depend on physiological aspects, the nutritional, emotional, cultural, health, type of food and its origin, access to basic services (drinking water, sewerage, housing, health services and housing) [14].

An adequate nutritional state is achieved with a balance between consumption (nutrient intake and energy) and energy expenditure. Genetic, biological, cultural, psychological and environmental factors influence and determine sufficient, excessive or insufficient energy intake according to the requirement and type and variety of foods that are acquired by people and the distribution in the members of a household or family [15,16]. Hygiene in food preparation (safety) is important to access food that does not pose a health risk [17,18]. Foodborne illnesses continue to be a public health problem and contribute to the prevalence of diarrheal diseases with impacts on morbidity and mortality of up to 2.2 million people per year and mostly children under 5 years of age [19]. Food safety, in addition to the population sector, is part of the production and distribution systems, that is, part of the economic dynamics [20]. Data from the World Health Organization (WHO) estimate that each year more than 400,000 people die from infectious foodborne diseases [21, 22]. More than 9 million cases of infections associated with the consumption of contaminated food are reported each year in the United States [23]. At the end of the last century it was estimated that meat was the main food followed by dairy products, cereals and vegetables [24]. In addition to the effects on people's health, it has an impact on the economy of households and the food industry itself, on their reputation and therefore on trust [25].

Having these dimensions of food security, from access to basic housing, water and sewerage services that influence and impact food hygiene, lack of access to drinking water is usually present in households that suffer from poverty. which complicates the achievement of a food right known as the 6 "P" as the analysis of the dimensions that generate poor nutrition (Figure 2).

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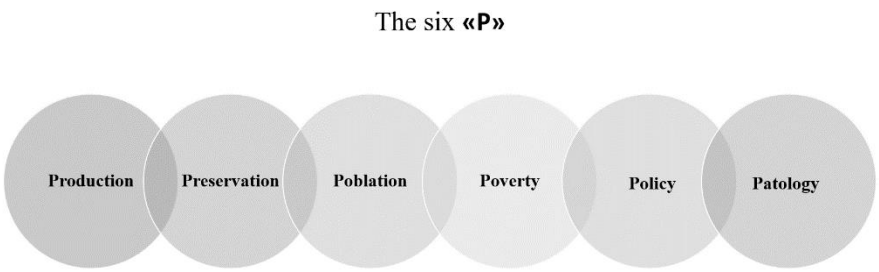

Figure 2. The six Ps, causes of poor nutrition conditions

In irrigation systems used in Northwest Mexico, the presence of Enteropathogenic and Enterotoxigenic E. Coli was detected [26,27]. Another problem in addition to the health one is the toxicological one such as the presence of antibiotics that has generated their resistance. Broad spectrum antibiotic administration practices in farm animals as a prophylactic measure [28,29]. There is evidence that a large majority of bacteria isolated from food are resistant to a wide range of antibiotics and pose a risk to human health [27,30].

3.2 Emerging Diseases

The SARS-CoV-2 pandemic has forced us to reflect on the new emerging diseases that have collapsed health systems worldwide. However, it is important to mention that the SARS-Cov-2 virus joins the list of infectious agents that have found a new host in humans. More than 1,400 infectious organisms have been described, including bacteria, viruses, parasites, fungi, and prions [31]. Emerging diseases are associated with new pathogenic agents, such as the SARS-COV-2 virus [32], however, this type of disease does not necessarily involve the presence of a new pathogenic agent, but rather the deterioration of health due to changes Social, economic and environmental impacts, but to the deterioration of health and therefore to a greater susceptibility to these infectious agents [33]. Among the emerging diseases that have emerged in recent years are the influenza virus (H1N1 and H5N1 strains), coronavirus (SARS, MERS-COV, SARS-COV-2), Zika virus and Chikungunya [34,35] and reemerging viruses such as Ebola [36,37].

On the other hand, the increase in diseases that generate a state of immunosuppression such as cancer and together with medical treatments (chemotherapy, radiotherapy or transplants), generate a greater susceptibility to diseases associated with infectious agents, which has explained that it contributes to the appearance emerging diseases [38]. Another case is the presence of concomitant diseases can also be a factor that increases the recurrence of diseases such as tuberculosis, common in patients with HIV [39]. The factors that are known to increase the risk and susceptibility to the appearance of new diseases is transmission by contaminated food and water [40,41].

3.3. Environmental Health

The relationship with health and food safety is explained by the quality and quantity of foods that the person can access that are required for the body to perform its biological functions and therefore prepare for or face adversity in the face of viruses, bacteria and other toxic agents, which have always existed among humanity.

3.3.1. Air pollution and its role during the coronavirus pandemic

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In recent decades, air quality has deteriorated worldwide, part of this is due to atmospheric pollution, which has increased due to urbanization, the use of cars, factories, the inefficient combustion of biomass among others, becoming thus in the main environmental risk for health [42].

Air pollution is considered to be the emission into the atmosphere of toxic elements, generated by human activities. Air pollution is a serious health problem, criteria pollutants such as particulate matter (PM), Sulfur Dioxide (SO2) and Nitric Oxide derivatives (NOx) have been associated with the development of cardiovascular and pulmonary diseases. [43], both in children and adults [44, 45]. Among the main associated diseases are cerebrovascular accidents, lung cancer, respiratory infections, ischemic heart disease, chronic and acute neuropathies.

During the SARS-CoV-2 epidemic, because of the confinement, in many countries the air pollution data has been significantly reduced, which has undoubtedly benefited the population in terms of the quality of the air they breathe. But not all is good news, the presence of air pollutants such as PM10, PM2.5 and Nitrogen Dioxide (NO2) can influence the epidemiology of SARS-CoV-2 infection, as shown by studies in Italy, where the Average concentrations in the last 4 years of NO2, PM2.5, and PM10 and the number of days that exceeded regulatory limits for O3 and PM10 were significantly correlated with COVID19 cases [46]. This and other studies [47] have suggested that chronic exposure to air pollution may have a favorable context for the spread and virulence of SARS-CoV-2.

Confinement, reduction of manufacturing and industrial activities have benefited air quality, reducing the emission of pollutants into the atmosphere [48]. which could have beneficial health effects. However, during a pandemic of the magnitude reached by SARS-CoV-2, this effect may be of limited utility. Pollutants have long-term effects, affecting the respiratory and cardiovascular system, which increases the risk of mortality from COVID19, so efforts must be redoubled to reduce air pollution and favor the protection of human health and the prevention of the spread of epidemics.

3.3.2. Water security

In Mexico, 8 million 411 thousand 920 households (25% of the total population) are reported that totally lack access to drinking water. Of the 2,457 municipalities and delegations in our country, only 827 (34%) have municipal wastewater treatment [49].

The current scenario involves various sociodemographic and climatic factors, such as urbanization, industrialization and the improvement of the standard of living, as well as the high demand for the use of natural resources such as water, soil, air, solar energy, among others. It has led humanity to mark a world with serious problems of environmental pollution and generating a future of environmental health and food insecurity for all living beings and even for the planet itself.

Water and the health of the population are two fundamental aspects in daily life, the quality of water determines the quality of life of humanity. On the planet, an estimated 842,000 deaths are generated annually due to the lack of safe water and poor sanitation and hygiene [50], and include 361,000 deaths of children under 5 years of age, most of them in countries of the low income [51]. Human health depends on a wide variety of factors, among which the environment is very important. According to some estimates, environmental factors are responsible for between 25 and 33% of the global burden of the disease, primarily affecting the population under five years of age. Not having access and availability of good quality water can put the health and integrity of the population at risk. Various health risks have been detected when using water, for example, for the following activities: consumption of food and beverages, recreation, exposure to wastewater, as well as medical uses. Furthermore, the main health risks are related to pollution; This can be microbiological (bacteria, viruses, parasites); chemical (metals, pesticides, disinfection by-products, etc.) and related to toxins (toxins produced by algae, etc.). Under this

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same context, in the demand for water resources, approximately 60% of the world population may suffer physical water shortage by the year 2025 [52].

There are a very large number of large basins in which the water resource is overexploited, particularly in Europe, North Africa, the Middle East, India, China and North America. In the case of Mexico, practically all the basins in the center and north of the country, in addition to the Lerma river basin and Valle de México, have high levels of exploitation or overexploitation [53, 54].

The various industrial activities generate polluting wastewater and, together with the increase in population and water scarcity, are the main factors driving the reuse of untreated wastewater for irrigation and other uses in many poor countries, which represents a significant threat to world food security. In several countries, the increased demands for water from a growing population are seen as the main driving forces behind the reuse of wastewater for urban and irrigation uses to meet their needs and food.

Wastewater can come from the amalgamation of industrial, domestic, commercial or agricultural activities and rainwater. In developing countries, such as Mexico, poor farmers often depend on wastewater to grow various crops [55], preferring short-term economic benefits, while ignoring the significant associated health and safety hazards. environment due to lack of knowledge [56]. In North American and European countries they were used to remove sewage from agricultural fields to prevent contamination of water bodies [57]. Furthermore, most countries in the Asia and Africa regions, such as China, India, Pakistan, Egypt and Morocco, continue to use untreated wastewater as a source of essential nutrients [58]. for the production of food crops [59].

In Mexico, water is considered as a good promoter of sustainable development (National Water Program), and based on the reform of article 4 of the Political Constitution of the United Mexican States, published on February 8, 2012, "Everyone they have the right to access, disposal and sanitation of water for personal and domestic consumption in a sufficient, healthy, acceptable and affordable way "[60]. The reform also establishes the participation of the three levels of government and the society itself to guarantee this right. However, Mexico is becoming a country with a water deficit. According to the National Water Commission [61] in Mexico only 50% of municipal and industrial wastewater is treated. While, in rural communities, the installation of wastewater treatment plants is hardly considered, in such cases the communities tend to discharge their wastewater into the open sky or into other water sources such as lakes, ponds, rivers, or the sea. These discharges in turn become a source of infections, also affecting the native flora and fauna of the ecosystem, giving off bad odors, giving a bad appearance and are no longer safe areas for recreational use. Faced with such a situation, the installation of wastewater treatment plants and the search for options to have a greater quantity of quality water is pertinent. One of the situations in which there is an insufficient number of treatment plants is due to the high cost they involve in terms of design, installation, operation and maintenance, among which the high energy consumption that they require is also highlighted. Many municipalities and even fewer rural populations do not have the necessary resources to cover the cost of these facilities. It is clear that the greater the demand for water, the more wastewater will be generated. One of the greatest water challenges in many countries on the planet and in Mexico is water quality, which is coupled with the low coverage of wastewater treatment.

In 2015, the industry treated 70.5 m^3 / s of wastewater, in 2,832 plants in operation nationwide. Several treatment systems only implement primary and secondary treatments, these levels being insufficient, since a series of recalcitrant compounds remain without removal, and not regulated as pesticides, drugs, antibiotics, among others, generically called emerging pollutants. Only 34% of the 2,457 municipalities and delegations in the country have a wastewater treatment service [62]. Most of the untreated wastewater discharges are made in rivers and streams, canals and on the ground or ravines. As a result, the water bodies in Mexico have a very low quality, not only considering the basic parameters with which *National Water Comission (In Spanish CONAGUA)* classifies the

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quality of water bodies, but also many other non-regulated parameters that come from discharges of industrial water or water. agricultural drains.

In addition to the above, water pollution from industries such as the steel industry, tanneries, chemicals, among others, generate wastewater discharges with metal content such as chromium, lead, cadmium or mercury constitutes a great risk for human beings, it must comply with existing standards to effectively protect health. Long-term human poisoning with pesticides or other organic products is generally related to contamination in occupational settings. The concentration of these products in the water must be kept as low as possible and compatible with the specific economic, social and environmental imperatives of each community.

71% of the surface of planet Earth is covered by the ocean, this portion contains 97% of the planet's water, the remaining 3% is present in rivers, lakes, glaciers and polar caps and in the atmosphere as water vapor. The global ocean stores carbon dioxide 50 times more than the planet's atmosphere, in addition, it carries heat from the area of the equator to the poles, which regulates the climate and weather patterns. All life on the surface depends on the health of the ocean [63].

Since the mid-20th century, oxygen concentrations have decreased by 2%, 77 billion metric tons, in the open ocean and more than 500 sites in coastal waters have reported oxygen concentrations ≤2 mg liter -1. The expansion of areas with no or little oxygen affects terrestrial and aquatic ecosystems. The cause of water and land pollution is attributed to human action [64].

According to the World Health Organization (WHO), about 780 million people around the world lack access to a source of good quality water and approximately 2.5 billion people lack access to adequate sanitation, these deficiencies They represent one of the main environmental risks, since various pathogenic microorganisms are transmitted through the environment and reach the population through the contamination of the water used for drinking. The quality of water, adequate sanitation and the application of good hygiene practices carry health benefits, especially in sanitary crises such as that triggered by SARS-CoV-2. The World Health Organization (WHO) has emphasized this, noting that the provision of safe water, sanitation and hygienic conditions are essential to protect health during the COVID-19 outbreak that has occurred in recent weeks throughout the world [65].

In healthcare settings, proper water management allows not only to adequately care for patients, but also to protect them, and protect staff and caregivers against the risks of infection [66], as it is essential for one of the pillars of reduction risk of infection such as hand hygiene [67].

3.3.3. Waste management during the coronavirus pandemic

According to figures from the Ministry of Environment and Natural Resources (SEMARNAT) in Mexico 102,895.00 tons of waste are generated daily, of which 83.93% are collected and 78.54% are disposed of in final disposal sites, recycling only 9.63% of the waste generated [68].

The generation of Urban Solid Waste (USW) reached 53.1 million tons, so that each inhabitant generates approximately 1.2 kilograms of garbage per day, that is, 438 kg per year. In the case of patients with coronavirus who remain convalescing at home, since April 1, the Secretaries of Health and the Environment, in conjunction with the Government of Mexico City, issued a statement explaining the recommended measures for separation. correct waste, to reduce the transmission of COVID-19 in the city and protect cleaning workers., in which the population is asked to separate garbage into the following categories: recyclable inorganic, non-recyclable inorganic, sanitary, and organic waste. For final disposal, it is recommended to mix non-recyclable and sanitary waste. Within the same bag, face masks, gloves, disposable tissues, gum, toothbrushes, cigarettes, medicine containers, syringes, dressings and gauze should be placed. The bag containing these non-

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recyclable sanitary wastes should be sprayed, inside and out, with a chlorinated water solution.

SEMARNAT has also estimated that patients infected with COVID-19 in Mexico have generated about 350 tons of biological-infectious waste of those classified as non-anatomical, among which are disposable materials such as gloves, gowns, goggles and face masks. Each coronavirus patient produces an average of 2 to 2.2 kilos of waste considered dangerous per day. In accordance with the "Official Mexican Standard NOM-087-ECOL-SSA1-2002(Environmental Protection - Environmental Health - Bio-infectious Hazardous Waste)", non-anatomical biological-infectious waste can be incinerated or chemically treated to eliminate its danger, and subsequently be deposited in sanitary landfills for urban solid waste. However, it is not yet known what environmental repercussions and health impacts that household waste will have [69].

The WHO has asked countries for adequate waste management during the COVID19 pandemic, since the incorrect handling of such a volume of products can cause "a rebound effect", both on people's health and the environment [70].

3.3.4. Impact of industry pollution

In our country, agriculture forms a relationship with nature, largely because it favored millenary cultures with territories of magnificent biodiversity that are located among the eight centers of origin of the cultivated species or centers of domestication, which contribute 15.4% of species in the World Food System. However, agro-industrialization has led to land degradation, greenhouse gases, water pollution, health problems, loss of soil and biodiversity. Monocultures create a vulnerable food system. With this, the contamination of the water using pesticides, and of nutrients such as nitrates and phosphates, was substantially increased; the loss of biodiversity; between 25 and 30% of Greenhouse Gas (GHG) emissions; damage to human health due to bacterial and viral diseases, and even obesity, the loss of soils due to erosion and the disappearance of wetlands. Food statistics reveal that between 2017 and 2018 record corn harvests were recorded, with 5% more than in previous years, this did not mean a food improvement, because precisely that period corresponds to the greatest hunger in history: one billion people without food [71]. However, climate change and extreme events have affected food security due to low crop yields and livestock productivity, as well as terrestrial ecosystems and species. They have also led to changes in distribution, abundance, reproduction, flowering and breeding. In addition, they have contributed to land degradation and desertification. As if that were not enough, currently between 25 and 30% of the food produced is lost or discarded. It warns then about the various consequences that inaction in the face of the climatic phenomenon that leads to a 2°C increase in the planet's temperature would entail: the effects would be more costly than applying mitigation and adaptation measures early. In a scenario of inaction, total losses in agriculture are foreseeable [72].

This pandemic situation reveals the systemic nature of our world: human, animal and ecological health are closely linked to food security. COVID -19 is a wake-up call for humanity to rethink our capitalist and highly consumerist mode of development with the ways in which we relate to nature. The times demand a comprehensive response to the current crisis, where the root causes behind the already apparent fragility and socio-ecological vulnerability of our world are addressed. For decades, many agro-ecologists have denounced the impacts of industrial agriculture on human health and ecosystems. Large-scale monocultures occupy about 80% of the 1.5 billion hectares devoted to agriculture worldwide. Due to their low ecological diversity and genetic homogeneity, they are highly vulnerable to weed infestations, insect invasions and disease epidemics, and recently to climate change. To control pests, about 2.3 billion kg of pesticides are applied each year, less than 1% of which reaches the target pests [73]. Most end up in the soil, air, and water systems, causing environmental and public health damage estimated at more than $10 billion a year in the US alone. These figures do not include pesticide poisonings of people, which worldwide, they affect approximately 26 million people annually [73,

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74]. These calculations also do not consider the costs associated with the acute and chronic toxic effects caused by pesticides via residues in food. There are several works that have reported on how industrial livestock confined in "feedlots" are particularly vulnerable to devastation by different viruses such as avian flu and influenza. Large farms that have tens of thousands of chickens or thousands of pigs in the name of efficient protein production create an opportunity for viruses like influenza to mutate and spread. The practices in these industrial operations (confinement, respiratory exposure to high concentrations of ammonia, hydrogen sulfide, etc. emanating from the waste) not only leave animals more susceptible to viral infections but can also sponsor the conditions for the which pathogens can evolve into more virulent and infectious virus types. These ever-changing viruses give rise to the next human pandemic. This, linked to the situation, worsens as biodiverse agro-landscapes in which crops are surrounded by areas of natural vegetation, are being replaced by large areas of monoculture that cause deforestation and the appearance of diseases.

3.4. Economic Factors

Food security is undoubtedly one of the great challenges and challenges that governments face. It is proposed that the population have nutritious, culturally appropriate and ecologically sustainable food. However, social and economic strategies have not shown significant progress. According to data from the Human Development Report of the United Nations Development Program (UNDP) 2019, 17.6% of the Mexican population is below the national food poverty line.

Faced with such a scenario, the role played by the formulation of policies around international trade stands out, which has favored the establishment of a corporate agri-food regime, which dictates the rules for the production and distribution of food at a global level. This has shown the deepening and the impacts of the international division of labor around transnational complexes of primary products [75], turning them into a commodification dynamic.

In the Mexican case, these effects were manifested with greater force after the entry into force of the North American Free Trade Agreement (NAFTA) in 1994, which implied structural reforms aimed at agriculture and consequently changes in the productive structure. and modifications in the cropping pattern [76], the importation of large volumes of cheaper food increased, resulting in the displacement of small national agricultural producers and raising large transnational companies.

According to the Agroindustry Atlas 2019 of the Heinrich Böll Foundation, fifty business groups invoice 50% of world food production sales. Among them are: Unilever, Nestlé, Kraft-Heinsz, Mars, Sigma, Kellogg, Pepsico. “Several of them operate in Mexico, with farms for chickens, pigs or cattle. To these we must add Mexican transnational companies such as Gruma, Bimbo and Bachoco” [76]. More than two decades after the implementation of NAFTA, these large agri-food companies have obtained extraordinary profits but leaving serious damage to health and the environment in their wake.

About health, the high consumption of bottled beverages and ultra-processed products in Mexico has increased non-communicable diseases and obesity rates, which are considered a cause of death. According to the Organization for Economic Cooperation and Development (OECD), diabetes and obesity are the great challenges of the health system in Mexico.

Mexico has one of the highest obesity rates in the OECD, which implies a reduction in life expectancy by more than four years during the next thirty years. Obesity-related diseases are projected to have a negative impact on GDP between 2020 and 2050 [77]. Without the application of cost-effective measures and interventions for the prevention and control of patients with obesity, it is estimated that the direct costs for 2023 will amount to $ 184,982 million pesos (about 8,400 million dollars) [78].

Likewise, the lack of regulation on the use of glyphosate in agriculture has caused a state of alarm, for decades the damage to health that it causes has been scientifically

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documented, such as: encephalopathies, autism, various types of cancer, malformations, among others. Velázquez [79] has documented the impacts of pesticides on the Zirosto day laborers in Michoacán, as they are exposed in the avocado plots and in the blackberry or berry harvest for export.

It is worth mentioning that the demand for so-called berries has increased in the last ten years, which has led to an increase in the production area, an example is the production of strawberries in the State of Michoacán, the number of hectares produced increased from year 2004 to 20017 by 233%. This type of intensive cultivation requires, as we have already mentioned, large areas of land and significant amounts of labor, as well as an intensive use of large volumes of water [79]. It is significant that the state of Guanajuato is the first producer of broccoli in the country and the second producer of asparagus after Sonora and at the same time is one of the states of the Mexican Republic with the highest water stress and with health problems correlated with contaminated water.

These studies show that globalized agricultural employment provides precarious and temporary jobs, also exposing workers to pollutants without any protection, where in many cases, given the productive feminization, many women are forced to be hired as day laborers in seasonal agricultural productions that they are linked to non-traditional agricultural exports, deepening capitalist relations of production and placing them in a situation of vulnerability, being an easy target for greater exploitation and a greater burden of socio-environmental costs [80].

The health and socio-environmental impacts derived from the agri-food regime and, in general, from extractivist policies urge us to rethink development policies and visualize horizons where a health care and care policy is pressing. The health crisis that we are experiencing due to COVID-19 made visible the logic of care and returned to the center of the debate the discussion about the jobs that are developed around it and which in turn are the least valued, the most despised and the least protected [81]. It highlighted the dismantling of health systems. This health crisis has also shown something that economic policy makers seem to ignore: the fact that unlimited growth cannot be possible in an ecological system subject to biophysical limits [82].

Therefore, thinking about alternatives implies questioning the current production model and the implicit destruction of nature that it brings with it. It also implies the questioning of an idea of society marked by individual interest. And of the dichotomy that arises between human beings and nature. We need a policy that is committed to planetary life. Specific actions are urgently needed such as: the elimination of pesticides, a law that declares the country free of transgenic crops, the dismantling of the agri-food corporations' system, it is necessary to promote local self-sufficiency and support small producers.

Agroecology is a tool that can serve in the construction of alternatives that bet on social and environmental well-being, the adoption of this has been useful as an instrument in the construction of food sovereignty and as a tool for struggle, defense, (re) configuration and transformation of disputed lands and territories into peasant territories [83]. It is necessary to lay the foundations to formulate actions with an ethical sense of life and that have socio-environmental justice as a horizon.

3.5. Regulatory Framework

On October 13, 2011, the right to nutritious, sufficient and quality food was integrated into the constitutional text. While, in 2012, only a few months later (on February 8), the right to water and a healthy environment was clearly accepted in an associated way. Although since 1999 the human right to an adequate environment was integrated into the fourth constitution, its association with the other economic and social rights described here is perfectly delineated. The Magna Carta in its first third, fourth, fifth and sixth paragraphs makes it clear in this way: Everyone has the right to nutritious, sufficient and quality food. The State will guarantee it. Everyone has the right to health protection. The Law will define the bases and modalities for access to health services and will establish

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the concurrence of the Federation and the federative entities in matters of general health, in accordance with the provisions of section XVI of article 73 of this Constitution. Everyone has the right to a healthy environment for their development and well-being. The State will guarantee respect for this right. Damage and environmental deterioration will generate responsibility for whoever causes it in terms of the provisions of the law. Everyone has the right to access, disposal and sanitation of water for personal and domestic consumption in a sufficient, healthy, acceptable and affordable way. The State will guarantee this right and the law will define the bases, supports and modalities for the access and equitable and sustainable use of water resources, establishing the participation of the Federation, the federative entities and the municipalities, as well as the participation of the citizens to the achievement of said purposes (Article 4 of the Political Constitution of the United Mexican States - CPEUM) [84].

Given this, a complex institutional panorama is proposed for coordination based on the design of the Mexican State where responsibility corresponds not only to the Federal Government (through various secretaries of State, such as the Ministry of Agriculture and Rural Development, the Ministry of Welfare or Ministry of the Environment and Natural Resources), if not to the state and municipal governments, in addition to adding in a democratic context the importance of the participation of society, for which the state governments must ensure [85]:

- Respect. The non-existence of barriers for the population to obtain food, access to water and a healthy environment. The same to avoid interventions so that society can materialize its own mechanisms that help and complement the action of the State.
- To protect. Neither companies nor individuals must not deprive people of access to food, water and a healthy environment, nor must they affect the possibilities of future generations to access it. The same can offer or advertise "goods" that may be detrimental to health, proper nutrition or that affect the environment.
- Perform or facilitate. The actions or policies must seek to strengthen access to food, water and a healthy environment for the entire population, even when a group or a person is incapable, and in that sense, everything institutionally and humanly possible must be done to achieve this. The case of people who have been victims of natural or human catastrophes such as wars, economic or health crises is highlighted.

The global health emergency due to COVID-19 in the world puts the responsibility of the Mexican State in matters of food, water and a healthy environment at a new crossroads from 2020 and onwards, and makes it necessary for this institutional framework to be consolidate with policy instruments that allow their articulation quickly:

The 'new normal' in terms of public policies that ensure the food-water-environment triad leads us to reflect on the need for a change in the state-society relationship. The role of governments (of the three orders, but with an emphasis on local ones) becomes central due to their ability to make binding not only regulations, but also to materialize collective action of different actors that require collaboration for greater commitment and effectiveness of all actions. undertaken.

A vision focused on the regional level (in States and municipalities) is essential, since inequalities are detected at the territorial level, and economic, social and even cultural dynamics acquire their own forms and weigh at that level of social interaction.

The COVID-19 pandemic will be mitigated, in addition to medical advances in its treatment (beyond the possible vaccine), health for successful management and low infection rates, with actions that enable sustainable social development that emphasizes in equitable, fair and adequate access to food, clean water and care for the environment (figure 3).

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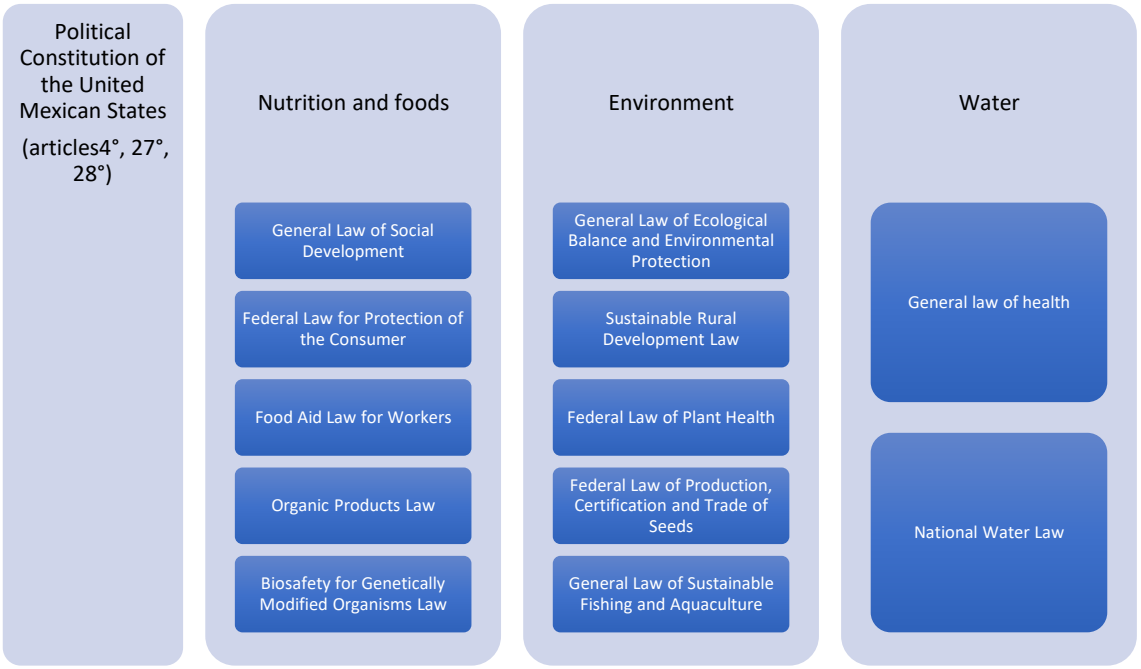

Figure 3. Political Constitution of the United Mexican States (articles 4°, 27°, 28°).

4. Lessons learned from food safety, environmental health and the economy in Mexico

Guaranteeing a right to health is achieved when a government contributes to achieving favorable environments to achieve healthy lifestyles in the population, but despite the goals set for the Sustainable Development Goals agenda for 2030, the latest report of the FAO shows that despite declining levels of child malnutrition, the figures for obesity in adults and anemia in women of reproductive age have increased, as climatic conditions threaten to delay progress towards eliminating hunger and poverty. poor nutrition [86]. It is known that a person with diabetes spends 30% of their income on their treatment. These figures have been exacerbated as part of the impacts caused by COVID-19, mainly in the population that was already vulnerable and the population that was on the poverty line or with health problems has been added. In addition to this, the closure of schools, businesses, loss of employment have contributed to the increase in food insecurity and exorbitant health conditions of those who were previously at risk [87], which complicates compliance with international agendas in matter of the right to health and food.

One of the lines of action and intervention to this health and climate crisis is a systemic approach such as agroecology that, at this time of the coronavirus pandemic, can contribute to integrate a link between agriculture and health [72]. Agroecology has gained much attention in the last three decades as the basis for the transition to agriculture that would not only provide rural families with significant social, economic and environmental benefits, but would also feed the urban population in an equitable and sustainable way. There is an urgent need to promote new local and sustainable food systems to ensure the production of sufficient, healthy and affordable food for a growing urbanized human population. The agricultural system based on agroecological principles has the advantage of exhibiting high levels of diversity and resilience while offering reasonable yields and ecosystem services. Agroecology proposes restoring the landscapes that surround the farms, which enriches the ecological matrix and its services such as natural pest control, water and soil conservation, etc., but it also creates "ecological firebreakers" that can even prevent pathogens from escaping their habitats. Therefore, under this scenario, the use of efficient eco-technologies that are economically viable is a vital option of urgent

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application. From the same perspective, one of the advantages that agroecology offers is that it contemplates locally producing a large part of the food necessary for rural and urban communities, particularly in a world threatened by climate change and other contingencies, such as pandemics. However, it must be emphasized that support is needed to amplify agroecology to optimize, restore and improve the productive capacities of small local and urban farmers. Successful local agroecological initiatives must be widely disseminated through farmer-to-farmer pedagogical strategies, the creation of agroecological lighthouses, the reactivation of traditional systems and the reconfiguration of entire territories under agroecological management. To improve the economic viability of these efforts, equitable local and regional market opportunities must also be developed, governed by the principles of solidarity economy. At this point, the role of consumers is key if they understand that eating is an ecological and political act, so that when they support local farmers, rather than the corporate food chain, they create socio-ecological sustainability and resilience. This does not lead to reflect on the fact that ecosystems sustain economies and even health; but economies do not sustain ecosystems. COVID-19 reminds us that disrespectful treatment of nature including the biodiversity of plants and animals has consequences, and when they are harmed, ultimately, so are humans. This current crisis caused by COVID-19 also offers us an opportunity for humanity to reflect on the impact we have caused on the planet and lead us to lay the foundations of a new world and softer ways of interacting and respecting nature. with its own natural resources.

Derived from this analysis where, based on the evidence, an increase in the levels of poverty in the world and therefore of food and nutritional insecurity is observed, the economic impacts will be even greater, this coupled with a poor quality of life [88]. In Mexico and in the world with increased obesity figures, a problem that conditions a greater development of diabetes, hypertension, dyslipidemia and especially infectious diseases due to the inflammatory component that it entails with the elevation of cytokines that are part of an immune system that requires that people have adequate nutrition (foods that provide them with vitamins, minerals, proteins, essential fats in quantity and quality) but that having a metabolic disease plus a poor diet and adding a stressor is where health vulnerability and getting sick increased the cost of health [89].

The COVID-19 pandemic should teach governments and decision-makers lessons, as is happening so far in Mexico with reforms to the Food Labeling Law approved in March 2020, the Reform in Oaxaca to prevent access to children processed foods or foods of poor nutritional quality [90], as well as other actions in health matters, are steps to advance in accordance with the Political Constitution of the United Mexican States in its 4th article that mentions the right to health, to healthy eating, access to drinking water and a healthy environment, mainly.

Therefore, a proposal to promote food insecurity would be from the following actors:

We have raised the following questions and proposals for action.

How do we best define the problem of food insecurity in developed nations?

What have we learned from actions taken to date?

What works and what does not?

A lack of individual rights and guarantees, actions from the government to enforce and apply human rights in health.

Regulate the industry to generate more responsible food and production practices with the integration of sustainable policies and codes of ethics.

Governments must invest and rely on Science and Technology to allow access to drinking water treatment and fulfill the right to water.

Regulate and apply the law of natural resources that are part of health protection and integrate new paradigms and economic approaches. This current economic model must be reviewed and adapted to contain the problems of contamination and deterioration to health, the environment and even the economy itself derived from the COVID-19 pandemic.

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For Mexico, the current reform to the General Health Law, human rights, the advance to the decree for the reduction of Glyphosate, the approval of the Food Labeling Law in March 2020 and the reform in the State of Oaxaca on the protection of access to industrialized food for boys and girls.

Public prevention and self-care policies are needed. The COVID-19 pandemic has reflected a poor level of schooling and education, of appropriating science and technology.

What actions or policy levers show promise?

Health policies should continue to be updated and linked to policies on education and access to science and technology. Access to healthy and safe environments requires a network of actors (figure 4). Greater integration of academics and researchers to join the legislative work to advance to protect food production, prevent its waste, promote agroecological practices, access to quality education, companies responsible for the health of their consumers and workers, which generates a sustainable economy.

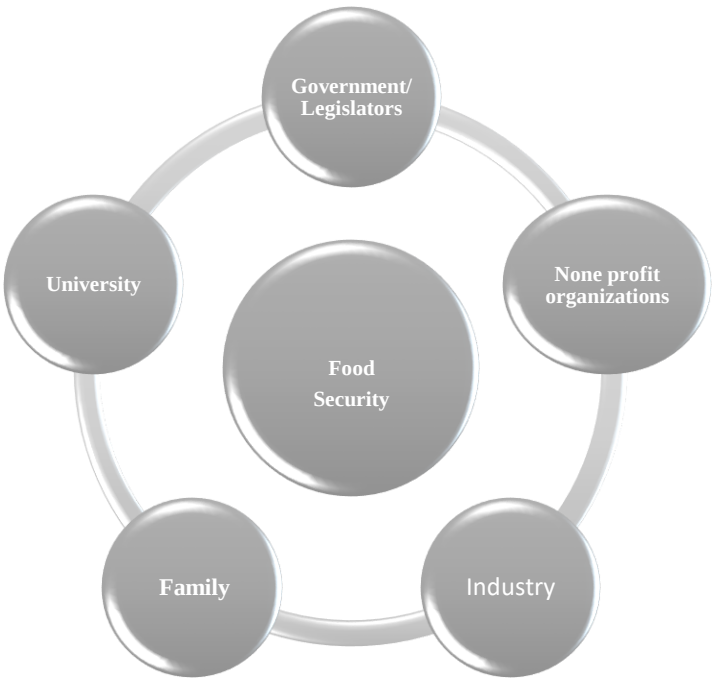

Figure 4. Network of actors to face food insecurity problems.

5. Conclusions

The economic impacts have diminished attempts to eradicate hunger and food insecurity) as well as poverty as global goals. Food insecurity requires a network of actors and intersectoral, inter-institutional work to address it now from the complexity of a

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pandemic. Therefore, the purpose of this review is to present a national panorama (Mexico) that has similarities to the situation that exists in the world on the challenges and opportunities for food security, environmental health and the economic model in Mexico and to derive proposals from these experiences and lessons learned for decision makers, academia and civil society organizations and business groups. Regarding the economic activities that compete with food security, the primary sector contributes 3.1% to the gross domestic product (GDP) of our country (2% agriculture and 1% livestock, 0.1% for forestry and fishing activities, respectively). However, also from these activities products are derived for the food and beverage and tobacco industry, with which their economic importance becomes relevant, achieving an increase of up to 7.5% [13]. For the purposes of the subject dealt with in this work in terms of the Mexican legal framework to understand the economic, social and cultural rights associated with health, the environment, water and food, we must speak of the fourth constitutional article. A regulatory framework should consider for its design interventions through public policies that aim to reduce the limitations of access to food. It is essential to understand the market conditions that influence the generation of differences in access to food [13].

Therefore, food security and the economic crisis represent an indispensable transition in the Era of COVID-19. Studies are needed to explore and integrate the impacts on food management and the economy in this Era. The economic system has generated environmental impacts (water, air, soil), and human health problems such as high rates of overweight worldwide. Mexico ranks first in obesity, derived from the overexploitation of natural resources. Therefore, the objective of this work was to analyze the impacts on food safety, environmental health and the economy in Mexico, before and during the contingency due to COVID-19. And with it, integrate the lessons learned. Results: A model was generated based on the lessons learned from this contingency, integrating food safety, environmental health and the economy, where the design and promotion of public policies (health, environment and economy) is induced. As well as migrating to a health prevention system and an agroecological model. From a multidisciplinary and intersectoral intervention perspective that should be between government, academia, researchers, civil society organizations, business groups and the citizens themselves by reforming and enforcing the right to enjoy adequate food and a healthy environment. . Faced with the Era of COVID, the lessons learned should promote a sustainable life transition towards this new reality and focus on promoting an innovative and ethical culture of generating an economy, with a gender balance, resilience to climate change, the transparent management of technology and a priority in health and this will lead to advances in the population's food security.

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