

## IMPACTS OF VEGETARIAN DIET ON HEALTHY EATING PATTERNS AND ENVIRONMENTAL SUSTAINABILITY

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**Abstract:** Human eating habits have changed over time and currently the majority of foods eaten by people affect their physical health and that of the environment. The objectives of our research are to highlight the importance of a plant-based diet in promoting human health as well as the socio-environmental harm of this type of diet, identify the main barriers encountered in obtaining a healthy diet, contribute to raising awareness of the socio-environmental impacts caused by the creation and consumption of animals and their consequences and raise aspects of public policy to encourage healthy eating. The present study is a narrative review, carried out by searching for scientific publications from 2006 to 2022, in the electronic databases National Center for biotechnology Information (PubMed), Scientific Electronic Library Online (SciELO) and ScienceDirect. The mapped data highlights the severity of the socio-environmental impacts caused by the creation and consumption of animals that have a decisive influence on global warming, air, soil, marine systems and freshwater pollution; in the loss of habitats and extinction of species and the overexploitation of natural resources, land and oceans.

**Keywords:** Vegetarian diet, veganism, sustainable eating, human health, environmental sustainability

## INTRODUCTION

Human eating habits have been shaped throughout our history by climatic conditions, the environment and availability of food, biological and cultural adaptations inherited from our ancestors, and socioeconomic factors.

Most of the foods people eat affect their physical health and the health of the environment. Diets low in fruits, vegetables, nuts and whole grains and high in red and processed meat are responsible for the

emergence of health problems around the world. (FOROUZANFAR et al., 2015). In addition to unbalanced diets, around 2 billion people are reported to be overweight and obese, 2 billion have nutritional deficiencies, and around 800 million still suffer from hunger due to poverty and poorly developed food systems. (FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. et al., 2018)

The environmental impacts of food production are equally daunting. Agriculture is responsible for about a third of all greenhouse gas emissions, (MENEGAT; LEDO; TIRADO, 2022) occupies about 40% of the Earth's surface and uses 70% of all freshwater resources, (SPRINGMANN et al., 2018) and excessive application of fertilizers in some regions has led to the pollution of surface waters and groundwater and created dead zones in the oceans. As a result, the global food system has contributed to the crossing of several of the proposed planetary boundaries that attempt to define a safe operating space for humanity on a stable Earth system. In the absence of dedicated mitigation strategies or changes in demand, many of these environmental impacts are expected to intensify as demand for foods with greater environmental impact, such as meat and dairy, increases and the global population grows from 7 billion to 10 billion predicted over the next 30 years. (SPRINGMANN et al., 2018)

Plant-based diets could play an important role in reversing the epidemic of obesity and chronic disease. In the context of sustained lifestyle intervention programs, they can halt or even reverse type 2 diabetes mellitus and cardiovascular disease (AUNE et al., 2016; BENISI-KOHANSAL et al., 2016) and (ZONG et al., 2016). et al., 2016)

Many individuals who support vegetarian diets also adopt healthy lifestyle habits, including regular physical activity, abstinence

from smoking and alcohol, healthy social relationships, emotional balance, and improved cognitive and behavioral patterns.

Today, successful social media campaigns highlight the occurrence of vegetarianism among athletes and people working in healthcare.

## PROBLEM SITUATION

The creation and consumption of animals and their consequences are leading us towards an unsustainable future, compromising new generations who will find it more difficult not only to live with quality, but also to survive. We need to be aware of this entire process and we no longer have much time to decide on the changes that become necessary.

Today, the planet is experiencing all types of crises that originate in the environment, which deserve reflection:

- i. global warming, driven by greenhouse gas emissions, a significant fraction of which has environmental origins. (SEEG - Analysis of Brazilian emissions and their implications for Brazil's climate goals 1970 – 2020, greenhouse gases 2021)
- ii. pollution of air, soil, marine systems and freshwater (including drinking water supplies), by toxic xenobiotics, heavy metals, powerful medicines and pesticides, plastics/microplastics, etc., some of which are powerful endocrine disruptors that, among others, reduce fertility in animals, including humans (MIGLANI et al., 2022)
- iii. pollution of aquatic systems by agricultural fertilizers that cause eutrophication, excessive growth of water bodies by photosynthetic microbes that are often toxin producers and that result in oxygen minimum zones and the associated loss of wildlife (BYERS et al., 2022).

- iv. loss of habitats and extinction of species. (LAMBERTINI, 2020)
- v. increasing transmission of animal-to-human infections – zoonoses – some of which are highly dangerous, such as HIV, MERS, Nipah virus, Lyme disease and Zika virus, some of which have the potential to become catastrophic pandemics; (GRACE D, 2012)
- vi. saw. the spread of antimicrobial resistance among environmental microbes and the subsequent transfer of resistance to human pathogens, making them difficult or impossible to treat (LARSSON; FLACH, 2022)
- viii. overexploitation of natural, terrestrial and oceanic resources (SCHUCK; RIBEIRO, 2015)
- viii. successive violation of planetary limits (STEFFEN et al., 2015)

We need to make efforts to reduce these crises and eating a plant-based diet would help to considerably minimize all of these impacts listed above.

## GENERAL GOAL

The objective of the research is to identify the impacts of a vegetarian diet on healthy eating practitioners regarding the socio-environmental benefits of this type of diet.

## SPECIFIC OBJECTIVE

Identify the main barriers encountered in obtaining a healthy diet;

Contribute to awareness of the socio-environmental impacts caused by the creation and consumption of animals and their consequences;

Raise aspects of public policy to encourage healthy eating.

## MATERIAL AND METHODS

The present study is a narrative review, carried out by searching for scientific publications from 2006 to 2022, in the electronic databases National Center for Biotechnology Information (PubMed), Scientific Electronic Library Online (SciELO) and ScienceDirect. The following key words were used for selection: environmental impact, environmental nutrition, health ovo-lacto-vegetarian, planetary health, plant-based diet, sustainability, sustainable diet, vegan and vegetarian meat analogue AND plant based, meat analogue AND food product, meat analogue AND by-product, vegan food AND by-product, vegetarian diet, sprouts AND bioactive compounds, sustainable food systems.

The selection of all articles was, in the initial phase, carried out by reading the respective titles and abstracts, also resorting to searching the reference lists of identified studies. There was no restriction on bibliographies published in Portuguese, English or Spanish and study design. As exclusion criteria, the following were considered: the date of publication (before 2003), titles and abstracts that disagree with the theme, and the non-relevance of the article after complete reading. In the end, 41 scientific publications were eligible.

## RESULTS AND DISCUSSION

Over the last 50 years, our world has been transformed by an explosion in global trade, consumption and human population growth, in addition to an intense process of urbanization, which has changed our way of life in unprecedented ways. However, this has imposed an enormous cost on the nature and stability of Earth's operating systems that sustain us.

It is estimated that the world population has exceeded 8 billion human beings on November 15, 2022, (Worldometer - real time

world statistics) and, every year, we create and slaughter for our consumption, billions of land animals, in addition to a much larger number of aquatic animals. World meat production reached 337 million tonnes in 2020, an increase of 45%, or 104 million tonnes compared to 2000. Although many species are raised for slaughter, just three represented almost 90% of global production during the period 2000-2020: chicken, pork and cattle (The state of food security and nutrition in the world 2022, FAO, 2022)

By 2050, the human population is expected to increase to more than 9 billion, bringing unparalleled environmental and nutritional challenges. (World Population Outlook 2019: Highlights, <https://population.un.org/wpp/>). During the same period, global demand for meat is expected to increase proportionately and meeting this demand will require an additional millions of tons of meat per year.

Taking into consideration, that each of these animals needs land, water, food, energy, in addition to generating large numbers of waste that goes into the atmosphere, soil and water, we can understand why most environmental issues are directly associated with the livestock industry

Among all the impacts listed above, food production is responsible for a substantial use of natural resources and is one of the main contributors to the environmental degradation of planet Earth. It contributes 20-30% of total anthropogenic greenhouse gas emissions, accounts for 70% of all freshwater use, and is a major source of water pollution. Around 80% of global deforestation is related to livestock farming; and this activity is the main cause of changes in land use and loss of biodiversity. Without corrective measures, the environmental impact of the carnivore diet could increase by 50 to 90% in 30 years, reaching levels that are beyond planetary limits (FRESÁN; SABATÉ, 2019)

The creation and consumption of animals is an extremely inefficient production system: on average, approximately ten times more calories are used to feed animals than are contained in their meat. Even small changes in our allocation of crops for animal feed and biofuels could significantly increase global food availability. (CASSIDY et al., 2013)

In practice, even in relatively high productivity systems like the American one, compared to the Brazilian one, each calorie of meat produced requires the use of cultivation areas at least six times larger than what is needed to produce a calorie with vegetable crops such as potatoes, corn and rice. In the case of beef production, the area required can be more than 100 times larger (ESHEL et al., 2014)

This reasoning explains the fact that, in intensive livestock systems, for every calorie present in an animal's meat, on average, ten calories are spent on its food. In extensive systems, on the other hand, large extensions of areas are needed for pasture, which would be much more productive in terms of biomass and energy if made available for agriculture. ((FERNANDO et al., 2015)

### **IMPACT OF LAND USE AND DEFORESTATION**

On a global scale, the impact of livestock farming on the planet's land is immense. There is also a highly unequal distribution of land use between livestock and crops for human consumption. Currently, almost 30% of the globe's land areas are used as pasture – an area equivalent to the African continent. Furthermore, around a third of the three billion hectares of all arable land, an area larger than Australia, is devoted to growing grain to feed animals raised for food. In other words, we use almost half of the land not covered by ice on the planet (75% of agricultural areas) for pasture or feed production. (SCHUCK; RIBEIRO, 2015)

### **IMPACT OF LIVESTOCK FARMING ON WATER CONSUMPTION**

Another environmental impact of the production of food of animal origin is that of all economic sectors, livestock farming makes the most inefficient use of water resources. The agricultural sector is responsible for more than 90% of global water consumption, and at least a third of this is mainly used for irrigation and growing crops to produce feed.

The same energy inefficiency that we saw in the relationship between land use and the number of calories produced by the livestock sector is reflected in the use of water resources: for one kilo of meat, twenty times more water is used than in the production of one kilo. of plant food (BROOM, 2019; MEKONNEN; HOEKSTRA, 2011)

It takes ten to twenty thousand liters of water to produce just one kilogram of beef, and most of this water is used to grow crops used to feed livestock.

We can use the same reasoning in the production of other foods of animal origin, such as chicken and pork, which also require a much higher water intake than plant foods. (BROOM, 2019; HOEKSTRA; MEKONNEN, 2011)

The export of agricultural products still makes us the fourth largest exporter of virtual water in the world, with a total of 112 trillion liters exported per year. Exporting meat ultimately means exporting water practically for free (HOEKSTRA; MEKONNEN, 2011)

Another harmful environmental attack caused by the creation and consumption of animals is non-specific pollution by agricultural nutrients, the main cause of compromising the water quality of rivers and wetlands (a wetland is a distinct ecosystem that is flooded or saturated by water, permanently (for years or decades) or seasonally (for weeks or months) (Wikipedia [https://pt.wikipedia.org/wiki/Zona\\_%C3%BAmida](https://pt.wikipedia.org/wiki/Zona_%C3%BAmida))

and lakes respectively and is a major contributor to groundwater contamination ((U.S. Environmental Protection Agency, 2019. Polluted Runoff: Nonpoint Source (NPS) Pollution. <https://www.epa.gov/nps/nonpoint-source-agriculture>). When excess nutrients (in the form of chemical fertilizers or manure) are applied to cropland with phosphorus in the soils and there is rain or snowmelt after application, nutrient runoff into water bodies results in ecosystem responses such as excessive algal growth.

The rapid growth of algae is known as a harmful algal bloom and the toxins released during this bloom can be harmful to both aquatic life and human health. These events can cause massive fish deaths, closure of beaches and shellfish beds, death of marine mammals and seabirds, coral reefs and alter marine habitats (SAMPAT et al., 2021). In short, according to the United Nations, Livestock farming is probably the largest sectoral source of pollution of springs and water bodies, contributing to the processes of eutrophication (abnormal increase in the level of organic material and nutrients), creation of oceanic dead zones, degradation of marine life and public health problems. The two main sources of pollution are the large volume of waste produced in industrial farms, slaughterhouses and the runoff of fertilizers, pesticides and other additives used in crops intended for feed production. (“Live stock’s long shadow”, 2006)

## **IMPACTS OF GREENHOUSE GAS PRODUCTION**

Soil cultivation for food production and animal husbandry has increased the emission of greenhouse gases, causing global warming. This effect has altered rainfall and wind patterns, which, in turn, are responsible for rising sea levels, acid rain and respiratory diseases. Thus, human interference with

nature is harmful to Man himself, as its consequences are the advance of the sea into coastal cities, the reduction of soil fertility, the displacement of food cultivation areas, which generates low agricultural productivity in some locations., and changes in seasonality in food and raw material prices. (MARIA DE FREITAS et al., 2016)

In 2016, the agricultural sector was responsible for 69% of greenhouse gas emissions in Brazil, according to a report released by the Climate Observatory - a network that brings together 77 civil society organizations dedicated to discussing climate change in Brazil. Included in this percentage were pollutants resulting from the digestive process of livestock, the use of fertilizers and deforestation to open new areas for economic activity.

Currently, according to the Climate Observatory report, greenhouse gas emissions in Brazil have reached the highest level in the last 19 years. The data is part of the 10th edition of the Greenhouse Gas Emission Estimation System (SEEG)

According to SEEG, Brazil emitted 2.42 billion gross tons of CO<sub>2</sub> in 2021. The figure represents an increase of just over 12% compared to the number recorded in 2020. Twenty years ago, in 2003, Brazil hit 3.02 billion gross tons of carbon dioxide.

SEEG divides total emissions between five sectors: waste, industrial processes, energy, agriculture and land and forest use changes (MUT). The last sector, which encompasses deforestation, liming (soil treatment for agricultural uses), organic carbon in the soil and the burning of forest residues, increased by 18.5% compared to the previous year and represents 49% of all emissions in the country. In 2021, deforestation in the Amazon accounted for 77% of MUT emissions. (SEEG Analysis of Brazilian emissions and their implications for Brazil’s climate goals 1970 –

2020 greenhouse gases 2021)

Both in 2003 and 2021, deforestation was the main responsible for the increase in emissions. Data from the Prodes system (Monitoring of Deforestation of the Brazilian Amazon Forest by Satellite) produced by INPE (National Institute for Space Research), show that in 2003, deforestation in the Amazon reached 25,400 km<sup>2</sup>, the third worst result since 1988. In 2022, rate was 11568 km<sup>2</sup>. (PRODES, Satellite Monitoring of Deforestation in the Brazilian Amazon Forest <http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes>)

Although the absolute number is lower, deforestation rates have been increasing year after year.

## ENVIRONMENTAL IMPACT ON THE OCEANS

Pollution, which is the accumulation of unwanted waste released into the air, water and land by human activity, is the biggest environmental cause of disease in the world today. It is responsible for around nine million premature deaths per year, enormous economic losses, erosion of human capital and degradation of ecosystems. Ocean pollution is an important but insufficiently recognized and inadequately controlled component of global pollution. It poses serious threats to human health and well-being. The nature and magnitude of these impacts are just beginning to be understood. (LANDRIGAN et al., 2020)

It arises from multiple sources and crosses national borders. It is the consequence of reckless, greedy, ignorant and unsustainable exploitation of the Earth's resources. It endangers marine ecosystems. Prevents the production of atmospheric oxygen. Its threats to human health are large and growing, but still incompletely understood. Its economic costs are just beginning to be counted. (LANDRIGAN et al., 2020).

The excessive supply of nutrients caused by the massive use of fertilizers and the dumping of waste on the coast (which has livestock activity as one of its biggest contributors) is today responsible for the unprecedented expansion of the number and area of oceanic dead zones throughout the world.

Although nutrients such as phosphorus and nitrogen are essential for plant growth and have allowed a significant increase in agricultural productivity in recent decades, the number of nutrients dumped in coastal areas represents one of the biggest threats to this ecosystem (DIAZ; ROSENBERG, 2008)

Once deposited in the marine environment, their high concentration promotes accelerated growth of phytoplankton, often aggravated by the decline in the population of organisms capable of consuming them. Excess unconsumed phytoplankton settles on the sea floor, where it will rot due to microbial activity. This decomposition process consumes a large number of oxygens, making the environment hypoxic and unsuitable for most of the fauna that lives there. The number of ocean dead zones has increased exponentially since 1970. (BYERS et al., 2022). Until this decade, the number of dead zones was scarce. In 1995, there were already 195 dead zones; in 2008, 400 (DIAZ; ROSENBERG, 2008).

The paradigm that climate change is altering global marine biodiversity is one of the most widely accepted. Currently, the oceans absorb much of the CO<sub>2</sub> present in the atmosphere, which reacts with the water and causes high acidity (reduced pH). With atmospheric CO<sub>2</sub> levels rising rapidly, the oceans are acidifying at an accelerated rate. With a decrease in water pH, there is a concomitant reduction in the availability of calcium carbonate, an essential element for the formation and maintenance of the structure of coral reefs, molluscs, echinoderms (such as sea stars and urchins) and plankton species that They are the basis

of many marine food chains. Many organisms with calcareous structures are literally dissolving, with unpredictable consequences for the marine life that depends on them. It is estimated that one to two thirds of all coral reefs in the world will degrade in the next two decades (NAGELKERKEN; CONNELL, 2022).

Associated with the impact of the excessive supply of nutrients caused by the massive use of fertilizers and the dumping of waste into the marine environment, concomitant with the acidification of the oceans, unsustainable fishing has increased, especially between the 1970s and 1980s, a period of great expansion of industrial fishing boats and which begins the collapse of fishing stocks in the world, making it clear that these were finite resources, thus demanding the need to think about policies for the conservation of these resources. In 1970 the proportion of unsustainable fishing was 10%, in 2017 this number reached 34.2%. (The State of World Fisheries and Aquaculture, 2022)

Currently, commercial fishing has intensified with the use of techniques that have allowed the exploitation of marine resources on a scale greater than their natural replacement capacity. Fishing vessels with more power, autonomy and sophisticated refrigeration systems have made it possible to capture progressively greater quantities of fish, which today reach hundreds of tons per net cast. Thousands of deep trawler fishing vessels began to operate and sweep the ocean floor with nets that today reach a depth of 1,500 meters, fishing lines of up to 60 km are now common in the high seas. Using advanced technology, schools can be detected by satellites and sonars. In this sense, fish catches grew at a rate twice as high as population growth. (DAVIES et al., 2009)

The fishing industries associated with aquaculture seriously impact the environment, mainly with the processing of fish. At this stage there is the dumping of antibiotics and hormones, the spread of diseases and exotic fish species, the disposal of plastic nets that take time to decompose and trap non-target animals, such as mammals and turtles, an effect known as ghost fishing (BILA; DEZOTTI, 2007)

One of the most pressing threats to the world's remaining fish stocks is commercial fishing, especially the indiscriminate capture of non-target organisms, commonly referred to as "bycatch". While bycatch can be sold, it can also be rendered unusable or unwanted for a variety of regulatory and economic reasons and subsequently thrown back into the sea, often dead or dying. This unused subset of bycatch is known as 'discards'. Bycatch is so widespread that it covers a wide spectrum of marine fauna, in addition to fish, molluscs and other marine invertebrates, there are thousands of mammals (such as dolphins, seals and whales), turtles on hooks, species already on the verge of extinction, juvenile fish in nets and benthic invertebrates in trawling and dredging gear. (DAVIES et al., 2009)

In Japan, the last remaining bluefin tunas are traded daily. In Asia, due to the fame of their fins as an aphrodisiac delicacy, millions of sharks of different species, many at risk of extinction, are killed every year. The age and size of fish sold have also been decreasing progressively. Many animals did not reach sexual maturity and, therefore, did not reproduce, compromising the maintenance of the species. (SCHUCK; RIBEIRO, 2015)



## **IMPACTS OF INTENSIVE CAPTIVE BREEDING (AQUACULTURE)**

Aquaculture, or the creation of aquatic organisms, is one of the fastest growing branches of animal protein production in the world. There are several species cultivated, considering continental and marine environments, ranging from fish, crustaceans and molluscs, to algae and aquatic plants.

Mariculture, developed in saltwater environments, is mainly represented in Brazil by the cultivation of marine shrimp and bivalve molluscs, although marine fish farming is one of the country's greatest aquaculture potentials, given the extensive coastal coast and the possibility of cultivation 'in and off shore', that is, close to the coast and in open waters respectively. However, despite several initiatives, large-scale marine fish farming is still not a Brazilian reality, which is due to a series of factors. (DOS SANTOS NASCIMENTO et al., 2022)

The State of World Fisheries and Aquaculture report (known as SOFIA) is released every biennium bringing recent data and statistics on fishing and aquaculture production in the world. The publication is the responsibility of FAO (Food and Agriculture Organization of the United Nations), which collects data from different countries and institutions and organizes reports, obtaining a general and current overview of fishing and aquaculture in the world.

In 2020, the production of aquatic animals was more than 60% higher than the average in the 1990s, considerably outpacing the growth of the world population, largely due to the increase in aquaculture production. This study also reveals that aquatic foods provide around 17% of animal protein worldwide, corresponding to more than 50% in several countries in Asia and Africa. The sector employs around 58.5 million people in primary production, of which approximately

21% are women. (The State of World Fisheries and Aquaculture 2022). As with intensive meat production, the negative impact of this activity is considerable. Intense crowding causes acute stress in animals, abnormal behavior, injuries, parasitic infections and high mortality, requiring the intense use of pesticides, bactericides, fungicides and antibiotics. In addition to environmental contamination due to the excessive use of these additives, aquatic animals in captivity are responsible for the annual emission of millions of tons of excrement that pollutes the water adjacent to the enclosures and contributes to the degradation of nearby ecosystems and the spread of diseases in other species. (SCHUCK; RIBEIRO, 2015)

The construction of aquatic farms on the coast has also eliminated half of the Earth's mangroves and at least a third of Brazilian mangroves. The destruction rate is already higher than that of tropical forests. The mangrove is a fragile ecosystem and very relevant in terms of being the birthplace of several species and security against floods and storms. (SCHUCK; RIBEIRO, 2015)

## **IMPACT ON BIODIVERSITY**

The concept of biodiversity is closely associated with the genetic variety capable of differentiating individuals and their respective populations. Therefore, biological diversity is the result of the long process of evolutionary history, which allows the selection of the set of species in a given location. And, this set of species that make up ecosystems provides fundamental services for the existence of humanity. However, extensive human exploitation promotes several changes in the dynamics of ecosystems, which culminates, in many cases, in the loss of local biodiversity and consequently ecosystem services. This imposes a great challenge on us today, which is to stop these pressures (ARAÚJO CAMPOS;

JOVEM-AZEVEDO, 2019)

Currently, there are 34 areas in the world classified as Biodiversity Hotspots, corresponding to areas rich in endemic species, those that only occur there. Particularly, Brazil has two ecosystems that include Hotspots (Atlantic Forest and Cerrado) and it is still estimated that our country has around 20% of all world biodiversity, risks to global biodiversity. (ARAÚJO CAMPOS; JOVEM-AZEVEDO, 2019)

Since the Industrial Revolution, human activities have increasingly destroyed and degraded forests, fields, wetlands and other important ecosystems, threatening human well-being. Seventy-five percent of our planet's ice-free land surface has already been significantly altered; most of the oceans are polluted; and more than 85% of wetlands were lost. ("Live stock's long shadow", 2006).

Responsible for occupying 75% of all planted areas on the planet and 30% of all land, livestock farming plays an important role in the current crisis of biodiversity loss. It is caused by a combination of several environmental degradation processes. Land use related to livestock farming can modify or destroy ecosystems that are habitats for certain species. It contributes to climate change, which in turn has a modifying impact on ecosystems and species. terrestrial and aquatic.

Several ecosystems are affected by nutrient and pathogen discharges into marine and freshwater ecosystems, by the production of ammonia and acid rain). The sector also affects biodiversity through the introduction of invasive alien species (livestock themselves and diseases for which they may be vectors) and overexploitation, for example, through overgrazing of pastures ("Live stock's long shadow", 2006).

In Brazil, the problem affects all biomes, but the Cerrado is where habitat loss has occurred most rapidly in recent decades, with

a direct impact on the various forms of life that make this biome one of the areas with the greatest biodiversity on the planet, but also one of the most threatened. The loss of natural habitats and the accelerated disappearance of species are the visible face of the serious crisis affecting the Planet's biodiversity.

The most recent version of the Living Planet Report published in 2020 by WWF, one of the largest and most experienced independent conservation organizations, with more than five million supporters and an active global network that includes more than 100 countries, revealed an average drop of 68% in monitored populations of mammals, birds, amphibians, reptiles and fish between 1970 and 2016. (LAMBERTINI, 2020)

The increase in deforestation and conversion of native forests, especially for soy production and livestock farming, has reduced the habitat of most species in the Amazon and Cerrado. This is what this analysis carried out by WWF-Brazil and partners shows, which evaluated 486 species (183 birds, 101 amphibians, 118 mammals and 84 lizards and snakes). Some lost more than half of their original distribution area, with the greatest losses being found in the Cerrado. (LAMBERTINI, 2020)

Biodiversity loss is not just an environmental problem. It also affects development, the economy, global security, ethics and morals. Furthermore, it is a matter of self-preservation. Biodiversity plays an extremely important role in the supply of food, fiber, water, energy, medicines and other genetic resources; and is vital for climate regulation, water quality, pollution, pollination services, and flood and storm control. Furthermore, nature supports all dimensions of human health, in addition to offering intangible contributions, such as inspiration and learning; physical and psychological experiences; and the formation of our identity. These elements are

fundamental to the quality of life and cultural integrity of human beings. (LAMBERTINI, 2020)

## **INFLUENCE OF ZOOSES ON HUMAN HEALTH**

Most infectious animal diseases that can be transmitted to humans (zoonoses) are linked to the production and consumption of foods of animal origin. In underdeveloped countries, thirteen zoonoses originating from pigs, chickens and cattle are associated with around 2.4 billion cases of human infection and causing more than two million deaths every year. (GRACE D, 2012)

In poor countries in Africa and Asia, 7% of animals are infected with tuberculosis (3% to 10% of tuberculosis cases in humans have zoonotic origin), more than a quarter of animals show signs of contamination by leptospirosis, therefore acting, as a reservoir of this pathogen and for bacteria responsible for foodborne bacterial diseases, such as Salmonella, Campylobacter and Listeria infections (GRACE D, 2012).

Other common pathogens in livestock around the world are the bacteria *Escherichia coli*, various parasites (such as *Giardia lamblia*, *Cryptosporidium parvum*, *Toxoplasma gondii* and *Ascaris Suum*) and viruses (such as rotavirus, hepatitis E virus, enterovirus and adenovirus (SCHUCK; RIBEIRO, 2015)

Probably one of the biggest risks of livestock farming to public health is its contribution to the emergence of lineages (strains) of antibiotic-resistant bacteria. Most animals raised for consumption, especially chickens and pigs, routinely receive doses of antibiotics and other compounds with antibacterial activity (such as chemotherapy drugs). In addition to the prophylactic nature of disease prevention in an environment where living conditions are precarious and diseases spread rapidly, the large-scale use of antibiotics in

sub-therapeutic doses is common, due to their proven effectiveness in promoting growth and of weight gain. (MORA-GAMBOA et al., 2022)

It is known that environmental changes generated from deforestation resulting from urban development have increased morbidity and mortality from emerging and re-emerging infectious diseases. For example, there are viral pathologies such as Malaria and Dengue, in addition to the emergence of infectious diseases such as HIV/AIDS, ranavirus, new strains of cholera and other viral hemorrhagic diseases in amphibians. (FREIRE DA SILVA et al., 2022)

## **MORBIDITY AND MORTALITY FROM DIET-RELATED CHRONIC DISEASES**

Populations around the world are aging at a faster rate than ever before and this demographic transition will have a major impact on almost every aspect of society. The prolongation of life expectancy has been accompanied by an increase in the chronic-degenerative conditions most observed in older populations, the so-called chronic non-communicable diseases (NCDs), such as cardiovascular diseases (CVD), neurodegenerative diseases, cancer and diabetes., responsible for around 70% of global mortality annually, including early deaths (occurring between 30 and 70 years of age) (MURRAY et al., 2015)

Obesity, cardiocirculatory diseases, diabetes, and some types of cancer are some of the main Chronic Non-Communicable Diseases (NCDs) that are significantly related to poor eating habits. According to the World Health Organization (WHO), NCDs are responsible for 41 million deaths per year, equivalent to 71% of all deaths in the world, with cardiovascular diseases (CVD) standing out, followed by cancer, respiratory diseases

and diabetes mellitus, which are responsible for more than 80% of premature deaths (30 to 69 years) due to NCDs. They correspond to 72% of all causes of death in Brazil, with 54.7% of deaths due to NCDs identified in 2018 and 11.5% due to their complications. (DA SILVA et al., 2022)

A number of factors contribute to the complex aging process, which ultimately define whether or not someone will develop age-related chronic diseases later in life. These determinants comprise genetic susceptibility, as well as various behavioral, environmental, and dietary factors, all of which have been shown to influence specific pathways that regulate the aging process and life extension, which makes longevity a multidimensional phenomenon (DOMINGUEZ et al., 2022)

Several meta-analyses of prospective cohort studies have reported associations of whole grain consumption with a lower risk of ischemic heart disease (IHD), stroke, CVD, and cancer, as well as reduced risk of total mortality and CVD mortality, cancer, respiratory diseases, diabetes and infectious diseases (AUNE et al., 2016; BENISIKOHANSAL et al., 2016) and (ZONG et al., 2016)

Of all the risk factors associated with the leading causes of death in the United States, unhealthy diets rank as the most significant risk. Cardiovascular disease remains the leading cause of death worldwide, with almost half of these deaths due to ischemic heart disease. (BERGMARK et al., 2022).

The term “plant-based diets” encompasses a wide range of eating patterns that contain smaller numbers of animal products and larger numbers of plant products, such as vegetables, fruits, whole grains, legumes, nuts, and seeds (SATIJA; HU, 2018)

However, there is strong evidence and biological plausibility to support the roles of specific plant-based foods in preventing

cardiometabolic diseases and premature mortality. Fruits and vegetables are rich sources of fiber, antioxidants and various nutrients, and have been inversely associated with the risk of chronic diseases and mortality. A meta-analysis of 95 cohort studies found that a 200 g/d increase in fruit and vegetable consumption was associated with a 16% lower risk of stroke, 8% lower risk of CVD, 3% lower risk of cancer total and 10% lower risk of mortality from all causes

In conclusion, fruit and vegetable intake has been associated with reduced risk of cardiovascular disease, cancer, and all-cause mortality. These results support recommendations to increase fruit and vegetable intake for the prevention of cardiovascular disease, cancer, and premature mortality. (AUNE et al., 2017)

A meta-analysis found a strong dose-response relationship between whole grain consumption and reduced total and cause-specific mortality. Consuming at least 70 g/d of whole grains was associated with a 22% lower risk of total mortality, 23% lower risk of CVD mortality, and 20% lower risk of cancer mortality, compared with consuming little or no whole grains (ZONG et al., 2016)

There is strong evidence that the intake of saturated fat (found mainly in foods of animal origin) and unsaturated fat (found predominantly in plant-based foods) has diverse effects on health, having divergent associations with total and cause-specific mortality. These findings support current dietary recommendations to replace saturated and trans fats with unsaturated fats. (WANG et al., 2016)

There is evidence that the type of protein consumed is important for health. Among U.S. healthcare workers with at least 1 unhealthy risk factor (smoking, alcohol intake, overweight or obesity, or physical inactivity), animal protein intake was

associated with a higher risk of death from CVD, while consumption of vegetable protein was associated with a lower risk of death from all causes (SONG et al., 2016).

Of all animal foods, red meat appears to be especially unhealthy and has been linked to premature mortality and Type 2 Diabetes Mellitus. Among men in the Health Professionals Follow-Up Study (followed for  $\leq 22$  years) and women in the Nurses' Health Study (followed for  $\leq 28$  years), an increase in 1 serving of processed and unprocessed red meat per day was associated with a 13% and 20% increase in mortality risk, respectively (PAN et al., 2012)

Eliminating the consumption of animals in the diet therefore represents one of the most promising solutions for preserving the environment and ensuring food security for future generations. Without the need to raise and feed animals, we could increase the number of calories available for consumption produced on existing agricultural land by around 50%, and obtain enough to feed an additional 3.5 billion people on the planet., 2015)

The contrast between foods of animal and plant origin in terms of energy efficiency is enormous. While soybeans have an efficiency rating (i.e., the ratio of calories produced to calories used) of 415, beef's is 6.4. (ESHEL; MARTIN, 2006) Large tracts of land used inefficiently in the production of grains used as animal feed by the livestock sector could be used more efficiently if these grains were consumed directly by the population.

A meat-based diet also implies greater use of what threatens us and increasing the energy efficiency of food production is unequivocal. Any project whose goal is to implement a sustainable and effective production system in which land use is optimized in order to satisfy the needs of as many people as possible must consider vegetarianism as part of the solution

(SCHUCK; RIBEIRO, 2015)

According to the Global Hunger Index - Sinopse 2022, "The situation is likely to worsen given the current wave of overlapping global crises - conflict, climate change and the economic repercussions of the COVID-19 pandemic - all of which are powerful drivers of hunger. The war in Ukraine has further increased global food, fuel and fertilizer prices and has the potential to further worsen hunger in 2023 and beyond. These crises come on top of underlying factors such as poverty, inequality, inadequate governance, weak infrastructure and low agricultural productivity, which contribute to chronic hunger and vulnerability. Globally and in many countries and regions, current food systems are inadequate to face these challenges and end hunger." (WIEMERS, 2022)

## CONCLUSION

With the recommendations of several scientific studies and organizations that point out the relevance of reducing the consumption of products of animal origin in the human diet, given the current scenario and considering the projections that show the benefits for human health and the planet of such a reduction, vegetarianism presents itself as a necessary practice from the point of view of sustainability, even if it initially seems like a radical idea.

The development of policies to reduce the consumption of foods of animal origin is essential in the context of the objectives of the United Nations Agenda for Sustainable Development, simultaneously contributing to the promotion of Food Security (SDG 2), Health (SDG 3), Sustainable Management of Water (SDG 6), Sustainable Consumption and Production Patterns (SDG 12), Mitigation of Factors Associated with Climate Change (SDG 13) and Conservation of Aquatic and Terrestrial Life (SDGs 14 and 15).

The FAO report on the State of Food and Nutrition Security in the World in 2021 makes clear that, “with less than a decade to go until 2030, we are not on track to end world hunger and malnutrition – in fact, we are in the wrong direction. The image is bleak. After remaining largely unchanged for five years, the prevalence of malnutrition increased from 8.4% in 2019 to around 9.9% in 2020, meaning that between 720 and 811 million people worldwide were hungry in 2020 – 161 million more than in 2019. In addition to hunger, the outlook is also bleak. For the global prevalence of moderate or severe food insecurity, the estimated increase in 2020 was the same as the previous five years combined. Thus, almost one in three people in the world (2.37 billion) did not have access to adequate food in 2020 – an increase of almost 320 million people in just one year”. (The State of Food Security and Nutrition in the World 2021, 2021)

This review made it clear that raising animals for human consumption is one of the main causes of almost all current environmental crises, such as forest destruction, desertification, loss of biodiversity, scarcity of fresh water, water pollution and soil erosion, associated with individual harm to physical health.

We personally believe that despite the socio-environmental repercussions of consuming or not consuming meat going

beyond individual space, it is necessary to understand that the option for a vegetarian or omnivorous diet must not be imposed, as it is a personal decision and involves many others. factors beyond sustainability, such as physical health, cultural identity, personal values, etc. We must also consider the social aspect, in which the income of many individuals depends on agropastoral activities and fishing for their livelihood. The aquatic food sector alone employs around 58.5 million people in primary production worldwide. Their jobs cannot be destroyed overnight without serious danger. (The State of World Fisheries and Aquaculture 2022, 2022)

We cannot demand, but make everyone aware that they start adopting different eating patterns, as each person needs time to become aware of these new values, and this is one of the objectives of this monograph.

Society imposes on a new child that is born that, when developing, it must be fed meat or other types of animal food. We are in the midst of a society with ancient carnivorous habits and only through awareness of the undisputed physical and planetary harm and the incorporation of new ethical and moral values, can we expect more healthy behaviors.

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