ISSN: 2007B-9834

Environmental and Social Impacts of Agricultural Biodiversity Degradation from the Ultra-Processed Food Industry

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Abstract
This article analyzes the known environmental and social impacts caused by the degradation of agricultural biodiversity from practices by the "Big Food" and agro-industry associated with ultra-processed foods. Agriculture is the largest single source of environmental and biodiversity degradation, responsible for over 30% of global greenhouse gas emissions and has little or ineffective policy control. It intends to give a comprehensive analysis showing how each part of the ecosystem is negatively affected along with human health; through practices of monocropping, financialization of food systems and heavy use of fertilizers and pesticides. It takes a look at the role governments and actors in international policy-making play in being a determinant of power for the spread of ultra-processed foods and the growth of "Big Food", agro-corporations and monoculture farming. It looks at social factors such as health, agro-industry policy and global food agendas in regard to climate governance and our food system.
Keywords: Agrobiodiversity, soil degradation, monocropping, big food, food policy, ultra- processed foods and health.

Recibido: 14 de mayo de 2022. Aceptado: 22 de junio de 2022.
Received: May 14, 2022. Accepted: June 22, 2022.
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IMPACTOS AMBIENTALES Y SOCIALES DE LA DEGRADACIÓN DE LA BIODIVERSIDAD AGRÍCOLA POR LA INDUSTRIA DE ALIMENTOS ULTRAPROCESADOS

Resumen
Este artículo analiza los impactos ambientales y sociales conocidos causados por la degradación de la biodiversidad agrícola a partir de prácticas de la "Big Food" y la agroindustria asociada a los alimentos ultra procesados. La agricultura es la mayor fuente individual de degradación ambiental y de la biodiversidad, responsable de más del 30 % de las emisiones mundiales de gases de efecto invernadero y tiene un control político escaso o ineficaz. Pretende brindar un análisis integral que muestre cómo cada parte del ecosistema se ve afectada negativamente junto con la salud humana; a través de prácticas de monocultivo, financiarización de los sistemas alimentarios y uso intensivo de fertilizantes y pesticidas. Da un vistazo al papel que juegan los gobiernos y los actores en la formulación de políticas internacionales al ser un factor determinante del poder para la difusión de los alimentos ultra procesados y el crecimiento de "Big Food", las agro-corporaciones y los monocultivos. Analiza factores sociales como la salud, la política agroindustrial y las agendas alimentarias mundiales en relación con la gobernanza climática y nuestro sistema alimentario. *Palabras clave:* Agrobiodiversidad, degradación de suelos, monocultivos, Industria "Big Food", política alimentaria, alimentos ultra procesados y salud

Introduction

Our modern food system, which is made up primarily of ultra-processed food, is not only affected by climate change but also contributes to climate change. According to NOVA, a classification system used worldwide which groups all food by their nature, extent and purposes of the industrial processing they forego, states; Ultra-processed foods (UPF's) are "not real foods" and made from formulated ingredients, mostly for exclusive industrial use. They are formulas of food substances modified by a chemical process and packaged into a ready to consume addictive food and drink product using added coloring, flavors, emulsifiers and many other additives being almost exclusively produced by large transnational "Big Food" corporations which are highly profitable with an extreme concentration of power and extremely appealing and unhealthy (Mo-

nteiro et al., 2018) They use large-scale farming techniques which have externalities that contribute to climate change, pollution and biodiversity degradation. One-third of green house gas emissions come from techniques related to the UPF industry, including land change use, monocropping and pesticide use. (Gilbert, 2012)

The interrelationship between climate change and food systems in now becoming more evident between global actors with the unprecedented growth of the UPF industry and has led to international treaties and policies by organizations from the private sector and the public sector. (Urban Climate Governance, 2015) There are many global climate governance initiatives pertaining to food systems including the Sustainable Development Goal 15 (SDG 15) of the United Nations, addressing biodiversity loss and climate change in line with human well-being objectives as well as the EU "Farm to Fork Strategy", which is at the heart of the European Green Deal, which aims to make food systems fair, healthy and environmentally friendly. At the 2015 Paris Climate Conference, a new binding agreement included food production and security as an integral part of the new global climate treaty. The United Nations Development Goals, Paris Climate treaty and EU's initiatives are critical to achieving successful environmental and socio-economic outcomes but are becoming increasingly difficult to meet due to scrutiny in agricultural financial systems and "Big Food" investment agreements that currently dictate domestic policy choices. (Tsioumani, 2022)

"Big Food" refers to a handful of large trans-national food companies who dominate the global food market and primarily produce ultra-processed foods and beverages. They include Grupo Bimbo, Coca Cola, Kellogg's, Danone, Nestle and PepsiCo; just to name a few. The "agro-industry", which is closely associated and a complement to "Big Food", are large agricultural companies who produce and add value to agricultural primary ingredients, intermediates and/or residues by processing and providing a link for food from farm to market. They produce the primary raw ingredients for ultra-processed foods and beverages such as, sugar, oils, fruit, salt, rice and also include fertilizers and pesticides used for farming. The agro-industry include companies such as Monsanto, Bayer, DuPont and John Deere. The globalization of the

The globalization of the "Big Food" and the agro-industry, is critically degrading agricultural biodiversity and harming the environment. A progressively growing globalized diet characterized by a plethora of hyper-branded ultra-processed food products made and distributed on a global industrial scale degrades agricultural biodiversity and comes at the expense of the climate and our health. Ultra-processed foods are generally manufactured with the use of ingredients extracted from a few high yielding monocrop plant species, including wheat, corn, soy and oil seed crops. While the role of ultra-processed foods on agrobiodiversity loss is significant, the problem has been mostly ignored in climate change conferences, biodiversity conventions and global food systems summits.(Leite et al., 2022) Some of the main culprits of agricultural biodiversity degradation are the financialization of our food system, monocropping for use in the ultra-processed food industry and poor food policies and global food agendas.

With increasing environmental issues and current worldwide food insecurity, malnutrition and an ever-increasing challenge to feed a growing global population, we hear over and over about programs to better the nutritional value and fortification of our food through genetic engineering. If we are resorting to measures of genetic engineering to make our food edible and nutritional, the question we should be asking is, 'What happened to our food?" The answer to this question is really, "nothing". The real problem is within our food systems. Highly nutritious foods capable of fulfilling the nutritional requirements for humans without harming the environment still exist. However, due to an over-reliance on ultra-processed foods, monocropping and industrialized agricultural systems; nutritional diversity and agricultural biodiversity is increasingly being degraded at an alarming rate while at the same time destroying the environment and our health. The right question that should be asked is, "what happened to our food systems"? (Nordin & Nordin, 2017)

Globally, an estimated 37% of anthropogenic greenhouse gas emissions are said to come from the total food supply chain. (IPCC, 2019) This means that how and what we eat have significant environmental impacts. Many ultra-processed foods contain oils made from soy and palm, which have considerable negative environ-

mental and health effects. Nonetheless, the environmental impacts of ultra-processed foods go far beyond the primary resources used in the production of their ingredients. The environmental impacts of ultra-processed food diets are attributed to the production and demand of agricultural commodities. The environmental impact of ultra-processed foods are poorly evaluated, considering only the effects of the base commodities used for their production like vegetable oils and refined sugar. It is crucial that environmental considerations of food diets include the overall impact of ultra-processed foods from farm to plate, including all stages of farming, processing, packaging, and distribution; especially when making climate policies (Seferidi et al., 2020)

The environmental impacts of food processing should consider that ultra-processed foods are produced by large transnational corporations. Transnational corporations have an immense amount of power and political influence, and they can dictate where and what is grown, produced, marketed, and sold in food systems globally. These large transnational corporations use highly aggressive marketing tactics to inflate demand and create new types of food trends, construct global supply chains, encourage the growth of GMO monocrops and cheap ingredients, and use capacious packaging that incentivize mass production, international transport, and waste related to their consumption. Given the fact that most ultra-processed foods including breads and yogurt can easily be replaced using less processed counterparts on a local scale, the discretionary nature of ultra-processed foods means that the environmental impacts of new food cultures and agricultural biodiversity degradation created by "Big Food" corporations can easily be avoided. Urgent attention and policy action need to be considered regarding the effects that the ultra-processed food industry has on the degradation of agricultural biodiversity and the environment. (Seferidi et al., 2020)

Agricultural Biodiversity

According to FAO, (What Is Agrobiodiversity?, n.d.)

> "Agrobiodiversity is the variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries. It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fiber, fuel and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soil micro-organisms, predators, pollinators), and those in the wider environment that support ecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of the agro-ecosystems". (What Is Agrobiodiversity?, n.d.)

Global agrobiodiversity is in a rapid decline, including the genetic diversity of plants used for food consumption. There have been more than 7,000 edible plant species identified and used for human food consumption since the beginning of agriculture but now there are fewer than 200 species being used today. Only 9 crops are used for more than 66% of all crop production. Furthermore, 90% of energy intake for all human food consumption comes from only 15 crop plants, mostly used for the production of ultra-processed foods while 4 billion people or more rely on only 3 of these crops: rice, wheat and corn. This type of agricultural biodiversity degradation in food systems is a damaging the ecosystems that support reliable and sustainable food production. It is a major threat to a healthy, resilient and sustainable food system for human consumption. (Leite et al., 2022)

Our modern food system depends almost entirely on mono-crop production from agro-industry practices that produce high yielding fast growing agricultural products specifically grown for the ultra-processed food industry. This type of agro-industry farming has resulted in the rapid growth of cheap, nutritionally deficient foods made mostly from soybeans, wheat and corn. The end result is insufficient nutritional diversity in today's diet. These three crops have become a major source for food supply due to governmental subsidies that keep their costs low. A number of obesity related diseases including diabetes, cancer and cardiovascular disease are directly related to nutritionally deficient ultra-processed foods. (How Our Food System Affects Public Health, 2018)

Ultra-processed foods are manufactured with ingredients and processes that are designed to create highly profitable low-cost food products that have a long shelf-life and emphatic branding.

With these means, hyper-palatable and addictive products are produced that are convenient and ready-to-consume and have been shown to be harmful for human consumption. Ultra-processed food products already make up more than half of the energy intake in many countries around the world. (Beslay et al., 2020) The change to Ultra-Processed foods have been a result of the industrialization of today's food systems, technological change in the agro-industry and globalization, including the expansion and growing market and political power of transnational food and beverage corporations along with their ever expanding global sourcing and production networks.

Agricultural biodiversity is also vital for the maintenance of soil fertility, plant pollination and conservation, all of which are a necessary and important component for food production and human health. Genetic agricultural biodiversity plays an important role in providing plant species with the ability to adapt to frost, high temperatures and drought as well as their resistances to diseases, insects and parasites. (globalreach.com, n.d.) Farms are complex ecosystems with complex biodiversity. Soil, plants and animals all depend on one another for habitat and nutrients. In a healthy agro-ecosystem, soil microbes provide nutrients to plants and the root systems which protects against soil erosion. Plants provide a home and food for beneficial insects and birds that pollinate and manage pests without having to use pesticides. Animals provide natural fertilizers to crops through their manure droppings. Natural agroecosystems depend on healthy soil and plant biodiversity to stay in balance to provide nutrient rich and healthy food and environmental protection. Industrial agriculture degrades all this. Agro-industry farming and their use of chemicals impairs and or kills the microorganisms involved in the complex soil agro-ecosystem. With the use of chemicals there are significantly fewer species of soil bacteria, fungi and microorganisms. The soil becomes less biodiverse and detrimental for crops. This is also a contributor to climate change through the loss of carbon in the atmosphere and waterways. Healthy soil can safely store over 1.6 trillion tons of carbon dioxide worldwide. Soil with low biodiversity quickly loses this carbon dioxide to the environment. (European Commission, 2022)

The European Union has taken note of the dangers of agricultural biodiversity degradation and the strong correlation to our food and environment and how agriculture relies on biodiversity and how biodiversity relies on agriculture. The European Commission plans to help through the ambitious "EU Biodiversity Strategy for 2030". It is long-term plan to protect nature and reverse the degradation of ecosystems and put it on a path to recovery by 2030 and is also one of the central components of the European Green Deal. This agricultural biodiversity strategy is also essential to " farm to fork strategy". Some of the key targets related to agriculture in the "Biodiversity Strategy" are expanding breeding and resting sites for rare and threatened species, and some rare natural habitat types so that 30% of EU's land is protected. Placing at least 10% of agricultural area under high-diversity landscape features. Dedicating at least 25% of agricultural land for organic farming use. Reducing nutrient loss from fertilizers by at least 50% and reducing the risk and use of chemical pesticides by 50%. With these strategies, the EU hopes to restore, conserve and enhance agricultural biodiversity and promote a wide range of ecosystem services that are made possible by healthy soil and land biodiversity. (European Commission, 2022)

Monocropping

Monocropping is the agricultural practice of growing the same crop year after year on the same parcel of land. This practice depletes the soil of nutrients and making the land less productive over time while reducing organic matter in soil and causes significant erosion and biodiversity degradation. This causes the soil structure and quality to be so poor that farmers have no other option but to use an array of toxic chemical fertilizers to encourage crop production. Corn, soybeans and wheat are three common crops that are often used in monocropping.

The uniformity of agricultural landscapes along with the intensive use of cheap standardized crops for ultra-processed food products is negatively affecting cultivation and consumption of plant food sources that have been around since the beginning of agriculture

and severely harming soil biodiversity. The production of ultra-processed food also uses large quantities of water, land, energy, herbicides and fertilizers which causes environmental degradation and the release of greenhouse gas emissions. Along with species loss, the continued intense agricultural use for ultra-processed foods is likely to cause ecosystem collapse, further affecting biodiversity. Ultra-processed meat products, such as hot dogs and fast-food burgers cause additional agriculture biodiversity loss because the feed used for the livestock are mostly made with ingredients from the same few high-yielding crops used in the manufacture of plant-based ultra-processed foods which rely on just five plant species: corn, sorghum, barley, oats and wheat. Also, the high demand for pastureland and for monocultures required in the production of animal sourced foods directly affects the production of other plant varieties and affects the soil quality due to the high concentrations of antibiotics and hormones used in livestock. (Leite et al., 2022)

In the late 1940s, in an attempt to solve problems of world hunger, research was done in Mexico to figure out how to get wheat to grow better in Latin America along with other cereal crops like rice and corn. This research included monocropping large quantities of three different types of cereals and extensively using large areas of land. The result was a higher calorie-per-acre of the cereal-based crops but also led to a reduction in agricultural diversification and increased biodiversity degradation. This monocrop practice also led to a resulting decrease in nutrition-per-acre, including proteins, fats, vitamins and minerals. (Nordin & Nordin, 2017) This followed with the inclusion of the industrialization of monocropping, which depends on the use of fossil fuels, chemical fertilizers, heavy pesticides, and herbicides. After decades of implementing monocrop style agriculture, we are now beginning to realize the huge disadvantages of this approach. It was found that crop yields could be tripled with heavy doses of synthetic chemical fertilizers and other industrial inputs. It was unknown at the time the profound social and ecological changes monocropping had in our society. The long-term cost of depending on monocrops are reduced soil fertility, reduced genetic diversity, increased soil erosion and increased vulnerability to pests. Not only do “high-yielding” monocrops demand expensive fertilizers, but they also needed more water.

Monocropping by large transnational companies have led to rural impoverishment, increased debt, social inequality and the displacement of vast numbers of peasant farmers.

According to Websters Dictionary, "Agriculture" is defined as: "The science, art, and business of cultivating soil, producing crops, and raising livestock." (Merriam-Webster, 2022). Industrialized agriculture has put more focus on science and business for increased profits and left out the "art" of creating agricultural systems which are in harmony with natural systems. To be able to create a sustainable future, agricultural practices need to rely on the immense diversification of the earth's ecosystems, and the ability to learn from and adopt to natural patterns as the basis for all our systems of agricultural production. Diversification is the key to unlocking agriculture's true potential; it allows for the implementation of agricultural food production systems which offers abundant nutrition on a seasonal and year-round basis. It helps to restore soil fertility, biodiversity and conserve water while at the same time it allows farmers to break their economic dependency on expensive agricultural inputs such as Monsanto's patented seeds.

Governments are now spending billions of dollars to subsidize monocrop agriculture, and while agriculture is failing nutritionally, these same governments are forced to spend billions of dollars more to subsidize nutritional treatments such as fortification, supplementation, and medicinal programs.Monocrop sugar has to be fortified with vitamin A and has traces of other chemicals due to the heavy use of pesticides because of biodiversity degradation. In Malawi, they face deficiencies in most micronutrients such as vitamin A and iron, yet the country is rich in natural sources of these nutrients if forms of fruits, vegetables, legumes, nuts, oilseeds, fats and foods from animals, which are being overlooked, over-shadowed, and ignored to push the production and consumption of a limited handful of monocrops.

Financialization of Food Systems

A handful of global corporations now control the world's agriculture

and food-consumption patterns which in turn effect land use and agricultural biodiversity. The consequences of this corporate concentration of the food system include rising food prices, land domination, ecological threats and health problems, which all relate to an increasingly industrialized food system which make it difficult to meet the United Nations 2030 Sustainable Development Goals. The merging of finance and the agri-food supply chain industry has transformed the global food system to prioritize financial profits over food nutrition and security, environmental sustainability and agricultural biodiversity. In 2015, the two agrochemical giants, Dow Chemical and DuPont, announced a 130 billion U.S. dollar merger giving them a large control over the worlds seed supply and agricultural practices. (Clapp & Isakson, 2018)

The U.S. agriculture derivatives market was regulated for the better part of the 20th century which limited profits by speculators while allowing hedging by farmers and grain buyers who were directly involved in the agricultural market. In the 1980's the market was deregulated, and agriculture became inundated with speculative financial activities and complex financial investment tools that were specifically created for the agri-food sector and in turn created the development of new channels for financial accumulation. This attracted a new type of financial investor in the agri-food sector that was not possible before and transformed many parts of the agriculture market into "asset classes". This means that profit making in the agri-food sector now increasingly happens through related financial activities rather than the actual providing of food. (Clapp & Isakson, 2018)

The transformation of the agri-food sector into a finance business meant the change in cultural and physical qualities of food and land into purely profit-making financial tools of interest to sell to investors. It has turned agriculture into a complex market of derivatives, hedge funds and commodities exchange all created to hedge risks for wealthy investors in agriculture and our food supply. The food and agriculture industry has also become a target for new types of investment funds that enable investors to profit from financial exposure to farmland and agribusiness companies. This has led to global land acquisitions and soaring farmland prices which limit access for smaller farmers.

The complexity of the agricultural finance industry includes new kinds of derivatives that are marketed to farmers as insurance which are highly speculative and risky. Credit services are also provided across the food and agriculture value-chain that favor large scale agricultural monocrop producers and disadvantage local smaller organic producers, giving more leverage to the large agri-food corporations. (Clapp & Isakson, 2018)

Some important financial players in the large-scale agriculture investment sector include large investment banks, hedge funds, private equity funds, pension funds, mutual funds, commodity trading firms, insurance companies, asset management firms and even University and foundation endowments. Of these financial players you can find Goldman Sachs, Morgan Stanley, Citigroup and Deutsche Bank and other institutions alike. These institutions and funds are meant for high-net-worth individuals betting on our food system for high returns in a short period of time. This financial investment strategy in the agri-food industry has shaped the food sector supply chain from farm to plate. The primary function has been to provide profits for shareholders than to maintain sustainable agricultural biodiversity and grow nutrient rich foods for society. Compensation for CEOs in the agri-food sector are largely tied to equity values which pushes corporate managers to reshape agri-food firms to maximize profits for shareholders regardless of the social and ecological costs. This has transformed the food system in countless ways and are direct causes of food price volatility, insecure agricultural and food system livelihoods, land and biodiversity degradation, loss of consumer and producer autonomy and the homogenization of agricultural technologies. (Clapp & Isakson, 2018) Inequalities in global food systems from financialization have become prominent in recent decades due to consolidation of power and wealth among elite financial and corporate institutions. Prioritization of shareholder value has encouraged more mergers and acquisitions in the agri-food sector creating more extreme forms of corporate concentration and compromising the socio-ecological resilience of the food system. These global financial markets with short term profit seeking trends make it to address difficult the long-term needs of sustainable agriculture. Speculative farmland invest-

ments have also given way to industrial farming methods that have been associated with biodiversity loss and climate change. At the same time, the expansion of derivatives as tools for managing agricultural investment risks has promoted homogenization of agricultural technologies which has led to less resilient agricultural systems. This has also encouraged more capital intensive and ecologically damaging industrial uses of agriculture to deliver faster and substantially higher investment returns. The financial industry has also forced corporate restructuring that has led to an increased reliance on a shrinking variety of genetically modified seeds and agrochemicals, which in turn has a damaging effect on biodiversity and can lead to a greater homogenization of agricultural systems causing vulnerability to ecological shocks such as drought and climate change. (Clapp & Isakson, 2018)

Continued use of agriculture, farmland and food as financial tools for investment along with financial market deregulation on commodity and farmland speculation and derivatives based on agricultural insurance, will most likely lead to food price volatility, more environmental degradation, rising land prices and much more biodiversity loss. It will drive the unequal distribution of wealth and power to financial elites, compromise food system resilience and diminish collective efforts to build a more sustainable food system. The problem is that, for many, financialization is seen as a solution and not as a cause of food instability, biodiversity degradation and environment insecurity. (Clapp & Isakson, 2018)

Environmental Impacts

While the financialization of the food industry has had a profound impact on agricultural biodiversity and the environment, the invention of toxic mineral fertilizers which causes degradation in soil biodiversity and ecosystems, dates back almost a century. The industrialization of agriculture was made possible by the invention of mineral fertilizers and pesticides. It was first implemented in Europe and North America and then later in developing countries. The production of artificial fertilizers is energy intensive and has become a billion-dollar industry. Since 1961 the consumption of artificial fertilizers has grown sixfold with world sales being 175 billion US

dollars just in 2013. With these rising yields, there has been little done in global climate policies on the degradation of soil, climate and the environment.

A decline in soil biodiversity from the intense use of monocrops and fertilizers used in ultra-processed foods causes a fall in ecosystem services such as agroecosystems, forest ecosystems, grassland ecosystems and aquatic ecosystems. This loss of biodiversity negatively affects human welfare along with the environment. Erosion, salinization, pollution, loss of organic substance, excessive chemical and pesticide use, deforestation, urbanization and mining activities are all some of the main reasons for soil degradation. Soil degradation accounts for 35% of the raised carbon dioxide in the atmosphere and is the result of land destruction since 1850. Due to unsustainable agriculture activities, permafrost areas thaw, leading to emissions of methane gas into the atmosphere that are 28 times more potent than CO2. (Bur, 2019)

The heavy use of pesticides by the "Big Food" industry used on monocrops for the use of ultra-processed foods are toxic chemicals designed to kill certain pests. A very large percentage of pesticides go beyond their destination and leach into the environment. Pesticides easily contaminate the air, ground and water when they run off from fields and sprayed aerially. These pesticides can be found in rain, ground water, streams, rivers, lakes and oceans. Pesticide use on soil decreases the biodiversity in the soil. The decreased biodiversity leads to diazotrophy, which is the fixation of nitrogen in soil. The growth of many large plants are not possible without soil nitrogen which can lead to a decline in crop yields. Also, the application of pesticides to crops that are in bloom can kill honeybees which pollinate crop fields and flowers. This is a major cause of decreased crop pollination and plant reproduction. Animals are also affected by pesticide which contaminate their food source and poisons them when eaten. Wiped out food sources for animals that are sprayed with pesticides can cause relocation, diet change and even starvation from the absence of these foods after pesticide spraying. It does not stop there, a chain reaction in pesticide poisoning can even harm birds and other animals who depend on food supply from insects and other creatures who live in the soil. (Claydon, 2017)

There has been a loss of several bird species due to accumulation of pesticides in their tissues. Although many types of fungicides used in farming are slightly toxic to birds, they can kill off their food source of earth worms which reduce the bird population. Also, pesticides in granular form can be mistaken for grains of food that birds and other animals eat. Just a few granules of a pesticide can kill a small bird along with a reduction in bird population from herbicides. (Claydon, 2017)

Pesticides, herbicides and fertilizers used in industrial agricultural farming that make their way to lakes, oceans and other water sources cause contamination which harm and in some cases kill fish and other living aquatic organisms. Heavy pesticides and herbicides in bodies of water can kill plants, which is the water's oxygen source. This in turn kills the fish from suffocation. Industrial agricultural chemicals in lakes and other bodies of water are also known to cause physiological and behavioral changes in fish that effect their populations from abandonment of nests, immunity disorders and increased exposure to predators. (Claydon, 2017)

Environmental modelling indicates that over 60% of global agricultural land is at risk of pesticide pollution by more than one active ingredient, and that over 30% is at high risk of which a third are in high-biodiversity regions. Corporations like Monsanto, now Bayer, are one of the main culprits of the fabrication and desertion of these harmful chemicals. Actors in climate governance need to do more to fight against these big corporations to create more aggressive policies, mechanisms and response measures aimed at preventing, mitigating or adapting to the risks posed by climate change due to harmful chemical and pesticide use.

Social impacts

Unsustainable land-management practices in industrial agricultural such as monocropping and land used for crop and livestock are two of the most consequential causes of land degradation. Land degradation is known to have serious social, cultural and health effects for humans including malnutrition, disease, forced migration, and social conflicts. It is said that the drought and fertile land loss was one of the reasons for the wars in Sudan and Syria.

(Kelley et al., 2015) In Sudan, the civil war is a good example of a "climate conflict", with devastating droughts in the 1970s and 1980s which caused governments from the north and south of the country to fight against each other for their competing agricultural systems. In Syria, the rapid expansion of wheat monocrops used 90% of the county's water along with a mismanagement of the state led agricultural sector caused drought and crisis collapsing agricultural production which displaced more than 1.5 million people and caused extreme poverty for almost 3 million people. (Kelley et al., 2015)

43% of the world population lives in regions affected by land degradation and by 2050 reports estimate that 4 billion people will be living in lands unable to support farming and other agricultural needs. While most would think that land degradation is primarily a problem in the developing world, studies show that land is more degraded in developed countries with soil having a greater decline in carbon content. This decline in the availability of agricultural land will affect food prices around the world along with food nutrition. It is predicted that the effects of land degradation along with climate change will displace around 50-700 million people by the year 2050. (El-Zein, 2018)

Not only are industrial agricultural practices causing severe land degradation, but it has also not shown to address food insecurity as there are still around 815 million undernourished people worldwide. Food systems are harming both the environment and the people who depend on it.

Industrial food systems have shown to exacerbate inequalities through uneven food distribution and social exclusion tied to poverty. A large portion of malnourished people today are independent food producers like small family farms who are deprived of markets by industrial agriculture who also expropriate their land and water while polluting their soil. The poorest are increasingly being deprived of adequate income and nutrition. This overexploitation of agriculture and the ecosystem is making it more difficult to feed our fast-growing world (Feeding the World, n.d.). A well maintained agricultural biodiversity contributes directly to food security and human well-

being. Nutrition that is provided by more diverse plants and animals from domesticated and wild sources can help households in marginal areas during times of crisis by providing income opportunity to the rural poor and create and support productive agricultural ecosystems. (globalreach.com, n.d.)

Food systems from industrial agriculture are failing the food producers themselves. With each cycle of monocropping there is a lower crop yield which leads to an increased use of fertilizers and pesticides which leads to an increased dependency of these harmful chemicals which leads to depleted food nutrition and human exposure to toxic chemicals. Pesticides have been linked to multiple health problems, including neurological and hormonal system disorders, birth defects, cancer and other diseases. Studies have shown that many people who have an ultra-processed diet have pesticides present in their system. Farmworkers are also extremely vulnerable to certain types of cancer from constant exposure to these agricultural chemicals. (Nicolopoulou-Stamati et al., 2016)

Determinants of Power, Agro-industry Policies and Global Agendas

The EU quarter in Brussels has around 25,000 lobbyists from some 500 multi-national corporations that have in-house lobby offices which coordinate various campaigns including chemical-intensive farming. These multi-national corporations which include agro-industry giants like Syngenta and Bayer, who acquired Monsanto in 2018, have many tools at their disposal to influence decision-making across all levels of policy and research. It is common practice for these corporations to hire former government employees, EU officials and politicians. They also support and distribute scientific findings that advocate their own interests and agendas. EU institutions often give multi-national agro-industry corporations privileged access to be part of the decision-making process on mandates and hold meetings with industry lobbyists. This is usually done by hiring public officials as lobbyists, creating direct lines by the agro-industry to government. (Heinrich Böll Foundation et al., 2017)

In 2012-2013, during trade talks on the "Transatlantic Trade and Investment Partnership", there were more than 113 direct meetings between lobbyists form the agro-industry and food sector and the EU's Directorate General for Trade. Shortly after the trade talks, lobby groups such as the European Chemistry Industry Council, the European Crop Protection Association and Bayer, pushed hard to derail processes that establish scientific data identifying substances used in agro-farming that are harmful to health. They were successful in pushing for policy loopholes that permitted the continued use of most of these harmful substances. As a result, the EU's Commission proposals on how to regulate these substances have serious flaws. Similarly, the chemical "glyphosate", which is used in Monsanto's famous herbicide, Roundup, was maintained safe for human health by EU agencies who had contact with lobby groups and was recommended for further use even after the World Health Organization's cancer institute classified glyphosate as carcinogenic in humans and should have led to a ban in the EU. (Heinrich Böll Foundation et al., 2017)

Before being acquired by Bayer, Monsanto, who was involved in lawsuits in the United States set forth by thousands of cancer victims, was ordered to release hundreds of internal documents pertaining to their business dealings. The documents revealed Monsanto's tactics of "ghostwriting" studies by the companies' own scientists and then having independent academics edit and sign their names on them. EU regulators routinely relied on such studies. It is noteworthy that while the European Food Safety Authority relied on undisclosed studies of this kind for key decision-making, the World Health Organization has a completely transparent processes and only use publicly available data where no expert has conflicts of interest like an association with lobby groups. (Study Shows EU Glyphosate Assessment Based on Flawed Science | Corporate Europe Observatory, 2021)

The EU is not the only one in bed with the agro-industry. Findings have revealed evidence of the agro-industry's close relationship with the USDA (United Stated Department of Agriculture) and other US government agencies. An investigation uncovered internal government emails that Bayer and CropLife Am-

erica, which is a trade association representing the manufactures of pesticides and other agricultural chemicals, worked closely with US official to pressure Mexico into abandoning its intended ban on Bayer's herbicide glyphosate. (Cann et al., 2022)This is another example of how the pesticide industry uses the US government to aggressively push its own agenda on an international stage and prevent any attempts of another country to take control of their food supply.

Our global agenda and dialogue need to pay greater attention to food policy regarding the agrobiodiversity destruction caused by the global industrial food system. We are seeing a rapid rise in the consumption of ultra-processed food and beverages which in turn uses more land and is rapidly degrading our eco-system and health. This is true from both sides as industrial food systems increase access to ultra-processed foods and more monocropping and land use. With both industries rapidly growing from both ends, it makes it increasingly challenging to enable healthy and sustainable farming and dietary patterns.

While the effects of "big Food" and agro-industry on planetary and human health are well documented, awareness of their destructive impact remains almost silent and missing from international development agendas. There was no mention of the global and health impacts of the ultra-processed food and agro-industry at the Zero Draft of the United Nations Biodiversity Conference in 2021. (Leite et al., 2022) At the UN Food Systems Summit Action Track 2, regarding "Shifting to Sustainable Consumption", the focus was put on foods high in fat, salt and sugar but made little reference to the real problem at hand, which is food processing, our food supply chain, ultra-processed foods and their environmental impact. (Leite et al., 2022)

Food security governance along all parts of the food chain, from farm to fork, is key for ensuring proper global and human health. According to the FAO:

> "Food security governance" relates to formal and informal rules and processes through which interests are articulated and decisions relevant to food security in a country are made, implemented, and enforced on behalf of members of society". (Perez-Escamilla et al., 2017)

For food security governance to be successful, there are four areas that need close attention: multisectoral participatory decision making, transparency and accountability, equity in resource allocation and service delivery, and multisectoral and multilevel policies and corresponding programs. (Pérez-Escamilla, 2017). The following sections provide recommendations from the 2030 agenda for sustainable development goals adopted by the United Nations Member States in 2015. In this agenda there are 17 goals and 4 of them can be directly adapted for policy makers to address the challenge of food insecurity locally and globally. (Pérez-Escamilla, 2017)

> UN-sDG #9) "*Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation"* - Socioeconomic inequities are the root cause of food insecurity and is likely to lead to less innovation and hence prevents sustainable innovation.
>
> UN-sDG #12) *"Ensure sustainable consumption and production patterns"* - Environmental sustainability reduces the risk of widespread food insecurity. Consumers' sustainable food consumption reduces the risk of unsustainable agriculture. Food insecurity is associated with unsustainable consumption and agricultural practices and environmental degradation.
>
> UN-sDG #13) "*Take urgent action to combat climate change and its impacts"* - Environmental degradation due to climate change increases the risk of food insecurity which leads to social and environmental disruption, accelerating climate change.
>
> UN-sDG #15) *"Protect, restore, and promote sustainable use of terrestrial ecosystems; sustainably manage forests; combat desertification; halt and reverse land degradation; and halt biodiversity loss"* - Sustainability of terrestrial ecosystems reduces the risk of widespread food insecurity.
>
> Sustainable agriculture is likely to slow down climate change, which, in turn, is a major threat to food security. (Pérez-Escamilla, 2017).

Conclusions

The link between food systems and climate policy are becoming more and more complex with a concentration of power of the "Big Food" and agroindustry. An increasingly industrialized food system is making it difficult to meet Sustainable Development Goals with industry lobbyist being successful in pushing policy loopholes for the

interest of "Big Food". There are many documented environmental and social impacts stemming from the degradation of agricultural biodiversity related to the demand for ultra-processed foods that affect climate through GHG emissions. Industrial farming techniques such as monocropping and heavy pesticide and herbicide use are severely harming our environment and soil biodiversity, which we depend on for human health as well. Our current food trends and systems have caused a reduction in agrobiodiversity from 7,000 edible plants to just around 200. In our food system today, 90% of all food consumption uses only 15 crop plants while more than 4 million marginalized people only rely on 3 crop plants, all of which are monocrop production which raise GHG emissions. This change in our food systems causes a severe impact across all societies, rich or poor; and all living creatures including plants, animals, insects and micro-organisms and has had a detrimental impact on our environment and health.

"Big Food" and the agro-industry has become so large they are a global hegemon, a corporatocracy controlling our political, economic and food systems. They control food trends and how we eat with disregard to health, the environment and food security, for the interests of profit and power, giving the average consumer little choice in food variety. The ultra-processed food industry has financialized our food systems causing rising food insecurity, land domination, biodiversity degradation, ecological threats and health problems.

The production of ultra-processed food uses large quantities of water, land, energy, along with herbicides and fertilizers which causes environmental degradation and the release of greenhouse gas emissions. A decline in soil biodiversity from the intense use of monocrops and fertilizers used in ultra-processed foods also causes a fall in ecosystem services such as agroecosystems, forest ecosystems, grassland ecosystems and aquatic ecosystems. The social impacts of land degradation are known to have serious social, cultural and health effects for humans including malnutrition, disease, forced migration, and social climate conflicts including severe droughts which has led to countries fighting against each other for agricultural systems and water.

There are many organizations pushing for policy change to mitigate the harmful effects from the ultra-process food industry; yet

corporate mergers, in-house lobbying, and the close relationships "Big Food" has with the political arena makes it increasingly difficult for change; and the situation is getting worse.

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