FACULTY OF LAW AND CRIMINOLOGY

The Farm to Fork Strategy and its Impact on Pesticide Use in the European Union

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“And this world has room for everyone, and the good Earth is rich and can provide for everyone. The way of life can be free and beautiful, but we have lost the way. Greed has poisoned men's souls, has barricaded the world with hate, has goose-stepped us into misery and bloodshed . We have developed speed, but we have shut ourselves in, machinery that gives us abundance has left us in want. Our knowledge has made us cynical, our cleverness hard and unkind. We think too much, and feel too little. More than machinery, we need humanity. More that cleverness, we need kindness and gentleness. Without these qualities life will be violent, and all will be lost” – Charlie Chaplin

“Only when the last tree has died and the last river been poisoned and the last fish been caught will we realise we cannot eat money.” - Alanis Obomsawin

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List of Abbreviations

AECS	Agri-environmental and climate schemes
CAP	Common Agricultural Policy
CJEU	Court of Justice of the European Union
CSP	CAP Strategic Plan
ECA	European Court of Auditors
EC	European Commission
ECI	European Citizens' Initiative
EEA	European Environmental Agency
EFSA	European Food Safety Authority
EFSCM	European food security crisis preparedness and response mechanism
EPA	Environmental Protection Agency
EP	European Parliament
EU	European Union
F2F	Farm to Fork
GAEC	Good Agricultural and Environmental Conditions
GHG	Greenhouse Gas
IARC	International Agency for Research on Cancer
IPCC	International Panel on Climate Change
IUCN	International Union for Conservation of Nature
JRC	Joint Research Centre
NAP	National Action Plan
PPP	Plant Protection Product
SDG	Sustainable Development Goal
SMR	Statutory Managements Requirements
SUD	Sustainable Use of Pesticides Directive
SUR	Sustainable Use of Plant-Protection Products Regulation
TEU	Treaty on the European Union
TFEU	Treaty on the Functioning of the European Union
UNCCD	United Nations Convention to Combat Desertification
UN	United Nations
USDA	United States Department of Agriculture

Abstract (NL)

De productiviteit van het industriële landbouwmodel in de Europese Unie is vooralsnog sterk afhankelijk van het gebruik van pesticiden. Deze stoffen hebben een negatieve impact op de gezondheid van de mens, alsook de natuur, waardoor de vraag naar actie door beleidsmakers steeds luider klinkt. De Europese Commissie komt hier met de introductie van de Farm to Fork Strategie, waarin het vooropstelt om het gebruik van pesticiden met 50 procent te verlagen tegen 2030, aan tegemoet.

De implementatie van de Strategie, die zelf niet juridisch bindend is, brengt verschillende juridische en politieke uitdagingen met zich mee. Bestaande wetgeving inzake pesticiden ontbreekt op verschillende vlakken transparantie, iets waar ondernemingen misbruik van maken. Op het nationale niveau wordt de haalbaarheid van de Farm to Fork doelstellingen verhinderd door een Gemeenschappelijk Landbouwbeleid dat niet ambitieus genoeg is. Daarbovenop blijken lidstaten zich in hun Strategische Plannen terughoudend op te stellen om groene maatregelen aan te nemen. Aan de basis van deze terughoudendheid ligt de vrees voor dalende oogsten alsook een afname van Europese voedselzekerheid.

Deze vrees gaat echter voorbij aan het feit dat de industriële landbouw niet bestand is tegen de toenemede droogtes en hittegolven ten gevolge van de klimaatsverandering. Daarnaast bevat de Strategie ook maatregelen die de voedselzekerheid blijven garanderen. Gezien landbouw sterk afhankelijk is van ecosysteemdiensten vormt het aanhoudende biodiversiteitsverlies een bedreiging voor diens stabiliteit. Het behalen van de Farm to Fork doelstellingen zou dan ook niet alleen ecosystemen ten goede komen, maar ook de Europese voedselproductie. Een deel van deze voordelen in de EU leiden echter tot een toename in biodiversiteitsverlies en voedselonzekerheid in derde landen. Dit wijst er op dat de impact van landbouw op ecosystemen niet enkel bepaald wordt door de productiemethoden, maar ook door de consumptiegewoonten van EU burgers.

Introduction

Problem Statement

The devastating environmental impact of agricultural policy in the European Union in recent decades has largely gone unnoticed by policymakers. Despite a general push to put most European economic sectors on the path to sustainability, farming continues to lag miles behind. Its contributions to habitat loss, biodiversity decline and climate change are tolerated for the sake of short-term food security. With the introduction of the Farm to Fork Strategy, which is part of the European Green Deal, the European Commission wishes to change this by accelerating the transition to a sustainable agricultural model. Farm to Fork consists of a multitude of initiatives that are meant to modernise several aspects of the food chain, ranging from curbing food waste, to increasing seed diversity and security. At its core, however, lies the significant reduction of fertiliser and pesticide use. The latter is arguably the most important part of the Strategy, which is why this thesis will predominantly focus on the challenges and risks of its implementation.

Research questions

To start off, the first chapter of the Part I paints a picture of the history of pesticide use, followed by an introduction to the current state of global agriculture and each of its features in the second chapter. The final chapter of the first Part gives a brief overview of the Farm to Fork Strategy itself, as well as the Biodiversity Strategy and the European Common Agricultural Policy. Part I thus aims to provide the reader with a background on the intricacies of agricultural policy, which is essential in better understanding the underlying dynamics of its reform. The legal and political obstacles of this reform are discussed in the four main chapters of the second part, each corresponding to one of the four research questions of this thesis.

The implementation of the pesticide reduction target of the Farm to Fork Strategy raises questions and concerns by politicians, farmers and environmentalists alike. In the first chapter of Part II, the challenges of harmonising the agricultural policy and existing pesticide regulations of the European Union with the provisions of the Farm to Fork Strategy are discussed. The scope of this question is narrowed down by focussing on transparency issues, both legal and political as these are often two sides of the same coin. The second chapter of Part II gives a more in-depth view of the implementation of reduction targets of the Farm to Fork Strategy into national law of member states. This includes an overview of the Common Agricultural

Policy, as well as its implementation by member states. In the third and fourth chapter, I try to find an answer to the common concerns regarding the effects of reducing agricultural input use on food security and biodiversity in the European Union. To conclude this thesis, tried and tested alternative agricultural models are briefly covered, as well as their historic implementation into practice.

Methodology

The method used in the research of this thesis is a review of existing literature. This includes, *inter alia,* legislation on agricultural policy on the European and member state level, jurisprudence of the Court of Justice of the European Union regarding the approval and marketing process of pesticides, as well as scientific literature and reports that aim to give a better understanding of the Farm to Fork's benefits and risks to food security and biodiversity.

Part I

1 Background

1.1 Historic use of pesticides

Throughout the centuries, pesticides have certainly played a role in curbing insect and other pest populations. The use of some substances to protect crops even dates back millennia, as arsenic was already used in Roman civilisation as an insecticide.[1] Two thousand years later, in the 19th century, arsenic was still used to minimise damage to crops by exterminating insect populations, and while its use was originally limited to protecting potato fields from the Colorado potato beetle (*Leptinotarsa decemlineata*), it became a standard insecticide that was widely used by the second half of this century.[2] While these pesticides were effective in increasing food security, they came at a price for human health, much in the same way modern-day pesticides do. Despite the health issues associated with these substances, some of them are still used to this day.[3] By the second half of the 20th century farmers began to rely more on synthetic pesticides to protect their crops.

1.2 WW2 and onwards

Synthetic pesticide production significantly increased during the Second World War, in part due to the war research on these chemicals.[4] Dichloro-diphenyl-trichloroethane, commonly known as DDT, was first discovered to have insecticidal properties in 1939 by a Swiss chemist named Paul Herman Müller.[5] Soon after this discovery, DDT began to be widely used in the war efforts to protect soldiers from insect-borne human diseases, such as typhus and malaria, which are transmitted by lice and mosquitos.[6] Because of its effectiveness and a lack of immediate evidence that DDT was harmful to human or environmental health,

[1] MATTHEWS, G., *A History of Pesticides*, Oxfordshire, CABI, 2018.
[2] *Ibid.*
[3] BENCKO, V., YAN LI FOONG, F., "The history of arsenical pesticides and health risks related to the use of Agent Blue", *Annals of Agricultural and Environmental Medicine*, 2017, Vol. 24, 312-316.
[4] DANIEL, P., *Toxic Drift: Pesticides and Health in the Post-World War II South*, Baton Rouge, Louisiana State University Press, 2005.
[5] POUDEL, S., et al., "Pesticide Use and its Impacts on Human Health and Environment", *EES*, 2020, 47-51.
[6] *Ibid.*

it was widely and indiscriminately used by the Allied Powers in Europe and several other continents.[7] Organophosphates on the other hand, were developed by German scientists during this same period to act as toxic nerve agents.[8] This indicates that during this period, many technological advancements were made in the field of pesticide development and manufacturing.

After the war, chemical companies began to pivot the narrative surrounding DDT and other pesticides by advertising its possible agricultural uses. Instead of chemicals to combat diseases in warzones, they were marketed as plant protection products (hereafter: PPPs) that would increase food security and reduce dependency on imported chemicals.[9] In the years that followed, synthetic pesticide production ramped up drastically despite a lack of knowledge on the adverse effects of these substances.[10] Because of its effectiveness and its role in suppressing epidemics in war-torn areas, DDT was almost revered as a chemical, which is why warnings regarding its toxicity were often met with scepticism.[11] In 1948, Müller even received the Nobel Prize in Physiology or Medicine for his research into pesticides.[12] After all, it was an easy to produce, cheap pesticide that had a very broad application, as it affects most organisms it comes into contact with.[13] Furthermore, because DDT is very persistent in the environment, farmers did not have apply it as frequently as they did other pesticides. The downside of this is that DDT-particles accumulate and remain in organisms for decades through the processes of biomagnification and bioaccumulation.[14]

Due to political and economic pressure, governmental agencies, such as the United States Department of Agriculture (hereafter: USDA), ignored initial warnings and preliminary evidence by scientists on the risks of indiscriminate use of DDT. By the 1950s scientific studies regarding its environmental and health cost began to mount, yet it would take until the publication of Rachel Carson's book *Silent Spring*, in the year

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[7] ZIMDAHL, R., "Chapter 7 – DDT : An insecticide", in ZIMDAHL, R., *Six Chemicals That Changed Agriculture*, Academic Press, 2015, www.sciencedirect.com/science/article/pii/B9780128005613000079

[8] REUTTER, S., "Hazards of chemical weapons release during war: new perspectives", *Environmental Health Perspectives,* 1999, 985-990, www.ncbi.nlm.nih.gov/pmc/articles/PMC1566814/?page=2

[9] ZIMDAHL, R., "Chapter 7 – DDT : An insecticide", in ZIMDAHL, R., *Six Chemicals That Changed Agriculture*, Academic Press, 2015.

[10] SONNENBERG, J., "Shoot to Kill: Control and Controversy in the History of DDT Science*" Stanford Journal of Public Health,* 2015, web.stanford.edu/group/sjph/cgi-bin/sjphsite/shoot-to-kill-control-and-controversy-in-the-history-of-ddt-science/

[11] *Ibid.*

[12] POUDEL, S., et al., "Pesticide Use and its Impacts on Human Health and Environment", *EES*, 2020, 47-51.

[13] ZIMDAHL, R., "Chapter 7 – DDT : An insecticide", in ZIMDAHL, R., *Six Chemicals That Changed Agriculture*, Academic Press, 2015, www.sciencedirect.com/science/article/pii/B9780128005613000079

[14] WESTON, P., "Banned pesticide DDT still damaging ecosystems 50 years after it was sprayed", *Independent*, 12 June 2019, www.independent.co.uk/climate-change/news/ddt-ban-pesticide-damage-ecosystems-new-brunswick-study-a8955171.html

1962, for public opinion regarding DDT and other pesticides to shift.[15] While this book has mainly had a profound impact on environmentalism in the United States, its importance in what is now the European Union should not be understated. *Silent Spring* was an indictment of DDT in particular and is often seen as a contributing factor in the establishment of the US Environmental Protection Agency (hereafter: EPA) in 1970.[16] Two years after the birth of EPA, DDT was banned in the United States, while it would take up until 1986 for the chemical to be completely banned in the European Union.[17] That being said, DDT-use in the agricultural sector was already largely prohibited by late 1978.[18] Most developed nations have currently banned DDT, while developing nations still heavily rely on it to control vector-borne diseases.[19]

As will be discussed below, the scientific and political debate regarding pesticides is often polarised, with proponents praising their role in food security and disease management, while critics demonise them for their environmental impact. According to Carson, the truth lies somewhere in the middle. She believed that pesticides, especially biological ones, can have a minimal impact on the environment when used in moderation while simultaneously playing a key role in the food security of a nation.[20]

2 Industrialisation of agriculture

Before going over the legal aspect of this thesis, it is important to understand how the agricultural system that currently dominates the global food market works. In the following chapter I will discuss the industrialisation of agriculture as it has been drastically changing farming systems over the past century. This industrialisation is therefore relevant to the European pesticide policy as they are in many ways intrinsically linked. As will be discussed below, the dominating industrial farming system relies on large quantities of pesticides to maintain its stability.

[15] PIMENTEL, D., "Silent Spring, the 50th anniversary of Rachel Carson's book", *BMC Ecology*, 2012, Vol. 12, 20.
[16] LEWIS, J., "The Birth of the EPA", *EPA Journal*, 1985, archive.epa.gov/epa/aboutepa/birth-epa.html
[17] PAN, "Which pesticides are Banned in Europe", PAN, 2008, www.pan-europe.info/old/Resources/Links/Banned_in_the_EU.pdf
[18] *Ibid.*
[19] VAN DEN BERG, H., et al, "Global Trends in the Use of Insecticides to Control Vector-Borne Diseases", *Environmental Health Perspectives*, 2012, Vol. 120, 577-582.
[20] CARSON, R., *Silent Spring*, Boston, Houghton Mifflin Company, 1963.

Because ecosystems are increasingly approached from a holistic viewpoint[21], the focus will not only be on pesticide use in agriculture, but also on other inputs that are connected to pesticide use.

The industrialisation of agriculture is characterised by four distinct pillars; mechanisation and subsequent specialisation, artificial fertilisers, pesticides, and finally, the decrease in species and genetic diversity of crops.[22] Each of these four pillars came about independently yet are still interconnected. One could even argue that the industrialised agricultural system would collapse, or at the very least suffer, if one of these four pillars were removed. In fact, this is an argument that is voiced by agricultural companies and their lobby groups that have a vested interest in maintaining the status quo, such as Bayer, BASF, Syngenta and the interest group Copa Cogeca.[23] The influence of these groups on European agricultural policy, the European Green Deal in particular, will however be extensively covered in the legal part of this work.

Despite the financial motive that often hides behind the argument of maintaining all four pillars, it should not be easily dismissed. Over the last few decades it has become increasingly clear that each aspect of the industrialised farming system is harmful to the environment and jeopardises long-term food security. However, the reality is that the stability of such a system is largely dependent on inputs, like pesticides and fertilisers. As agriculture became more specialised, farmers no longer relied on the livestock they once owned to produce organic fertilisers. Instead, synthetic fertilisers replaced their organic counterpart, which turned out to be both cheaper and easier to produce. Despite the increase in productivity and food security of monocultures, they also came with certain risks. Homogeneous fields are more susceptible to diseases and pests, which increased the dependency on pesticides in the agriculture industry. Finally, genetic modification was used to increase yields by, *inter alia*, introducing pesticide resistance in crops. It is therefore relevant to discuss all aspect of industrial farming, as European pesticide policy has to take all four pillars into consideration. That is also why in addition to the European Farm to Fork Strategy, I will also discuss the relevant targets set forth in the European Biodiversity Strategy. However, I will first illustrate the complexity of industrial farming by discussing each pillar and its consequences in a chronological order.

[21] LI, B-L, "Why is the holistic approach becoming so important in landscape ecology", *Landscape and Urban Planning*, 2000, Vol. 50, 27-41.
[22] X, "Industrialisation of Agriculture", *Johns Hopkins*, www.foodsystemprimer.org/food-production/industrialization-of-agriculture/
[23] CROPLIFE EUROPE, "Our network", *Croplife*, Our network – CropLife Europe

2.1 Mechanisation and specialisation

2.1.1 Mechanisation

For the past century, manual labour has steadily been replaced by machines in the agriculture sector. Technological innovations eliminated the need for pack animals in developed nations as machinery is more energy efficient and thus cheaper.[24] The dependence on mechanised farming equipment also marks the beginning of the reliance on fossil fuels in agriculture.[25] Productivity quickly rose in the industry which led to a decrease in demand for manual and animal labour.

This is also reflected in the decline of the number of farmers throughout the 20th century in developed nations, a trend which continues to this day. At the start of the century, 41 percent of the total US population was employed in the agriculture industry, by 1970 this had dropped to a mere 4 percent.[26] Numbers regarding farmers in Europe are scarce but they do seem to indicate a similar trend to what the United States went through. In the year 1846, 42 percent of the total Belgian population was employed in the agriculture industry. By 1950 this had decreased to 12 percent, and 30 years later, in 1970, this had further decreased to a mere 3 percent.[27]

However, two remarks should be made regarding these European numbers. Firstly, these numbers do not fully take the transition to industrial food processing into account, so it is possible that the actual figure is higher than 3 percent. Secondly, the European continent was slower to transition to machinery than the United States. In fact, European farmers still predominantly relied on animals in the first half of the 20th century[28], which means that the steady decline of European farmers is not solely attributable to mechanisation. Instead it likely is a contributing factor, along with other technological advances that increased productivity in agriculture.[29]

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[24] GRABOWSKI, R., "Agriculture, mechanisation and land tenure", *The Journal of Development Studies,* 1989, 45, tandfonline.com/doi/abs/10.1080/00220389008422181

[25] PERELMAN, M., "Mechanization and the Division of Labor in Agriculture", *American Journal of Agricultural Economics*, 1973, Vol. 55, 523.

[26] DIMITRI, C., EFFLAND, A., CONKLIN, N., "The 20th Century Transformation of U.S. Agriculture and Farm Policy", *USDA*, 2005, 2.

[27] BISSCHOP, C., *Meer dan boer alleen: Een geschiedenis van de landelijke gilden, 1950-1990*, Leuven, Universitaire Pers leuven, 2015.

[28] *Ibid.*

[29] *Ibid.*

2.1.2 Specialisation

Specialisation of agriculture is the process of concentrating time and effort to produce a limited number of crops, such as wheat, corn or soy.[30] As the expression 'do not put all your eggs in one basket' notes, there are certain financial risks tied to producing only a handful of crops. To reduce this risk, farmers rely on economies of scale, i.e. increasing the size of their farms, and on economic agricultural policies, such as income support through the European Common Agricultural Policy (hereafter: CAP).

One of the driving forces behind specialisation was, and continues to be, mechanisation.[31] As machines are more efficient than manual labour, farmers no longer had to rely on a diversity of crop species, each having different harvest dates, to match the availability of labour.[32] Machinery often fits the need of growing and harvesting specific crops so there was a financial incentive to transition from a polyculture to a monoculture system.[33] Consequently, farmers no longer needed to invest in a variety of machinery, pesticides and fertilisers, but instead could focus their efforts on developing the best management practices for a specific crop.[34]

2.1.3 Machinery in monocultures

The global rise of heavy machinery in monocultures has had many benefits, both social and economic, over the past century. The increase in productivity resulted in an increase in yields and thus food security.[35] Secondly, the decline in the percentage of famers as a result of mechanisation meant the available workforce increased significantly, which diversified the economy.

Despite the benefits of mechanisation and the prosperity it brought about, both to farmers and society as a whole, there are also downsides associated with it. These downsides are detrimental to man and nature

[30] CZYZEWSKI, A., SMEDZIK-AMBROZY, K., "Specialization and diversification of agricultural production in the light of sustainable development", *Journal of International Studies*, 2015, Vol. 8, 63-73.
[31] BOWLER, I.R., "Intensification, Concentration and Specialisation in Agriculture: the case of the European Community", *Geographical Association*, 1986, Vol. 71, 17.
[32] ABSON, D., "The Economic Drivers and Consequences of Agricultural Specialization", *Agroecosystem Diversity*, 2019, 301-315.
[33] POWER, J.F., FOLLET, R.F., "Monoculture", *Scientific American*, Vol. 256, 78-87.
[34] *Ibid.*
[35] MCGUIRE, A., "Ecological Theories, Meta-Analysis, and the Benefits of Monocultures", *CSANR*, 26 May 2015, csanr.wsu.edu/theories-meta-analysis-monocultures/

in the long run and have to potential to dwarf the initial benefits of mechanisation, and by extension monocultures in its entirety.

The main disadvantage of using heavy machinery is the resulting increased levels of soil degradation.[36] Firstly, soil degradation is caused by erosion that occurs when machinery disturbs the soil. Erosion can best be described as

"*a two-phase process consisting of the detachment of individual soil particles from the soil mass and their transport by erosive agents such as running water and wind. When sufficient energy is no longer available to transport the particles, a third phase, deposition, occurs*".[37]

This soil mass contains valuable nutrients, most notably phosphorus, nitrogen and potassium, which each play a key role in plant growth.[38] As the nutrient-rich soil is washed away by rainwater, it enters waterways and ultimately ends up in aquatic and terrestrial ecosystems where it causes eutrophication.[39] However, because the process of eutrophication relates to the increase of nutrients, it will be covered in the section on fertilisers. Apart from the ecological damages of erosion, there are also consequences for agricultural productivity. It leads to a decline in crop yield as the amount of available nutrients decreases, as does the organic matter in the soil.[40]

Secondly, the weight of agricultural machinery has gradually increased as a result of mechanisation which in turn increased the levels at which soil is compacted.[41] This process is another contributing factor to soil degradation and can even lead to an increase in erosion.[42] As the soil is compacted, the time it takes for plant roots to elongate increases, thus slowing down the growth rates of crops.[43] This is often amplified by

[36] KELLER, T., SANDIN, M., COLOMBI, T., HORN, R., OR, D., "Historical increase in agricultural machinery weights enhanced soil stress levels and adversely affected soil functioning", *Soil and Tillage Research*, 2019, Vol. 194.
[37] MORGAN, R., *Soil Erosion and Conservation*, Oxford, Blackwell Publishing, 2005.
[38] GERLOFF, G., *Plant efficiencies in the use of nitrogen, phosphorus, and potassium*, Ithica, Cornell University Agricultural Experiment Station, 1976.
[39] EKHOLM, P., LEHTORANTA, J., "Does control of soil erosion inhibit aquatic eutrophication", *Journal of Environmental Management,* 2012, Vol. 93, 140-146,
[40] LAL, R., "Soil Erosion Impact on Agronomic Productivity and Environment Quality", *Critical Reviews in Plant Sciences*, 1998, 329.
[41] KELLER, T., SANDIN, M., COLOMBI, T., HORN, R., OR, D., "Historical increase in agricultural machinery weights enhanced soil stress levels and adversely affected soil functioning", *Soil and Tillage Research*, 2019, Vol. 194.
[42] *Ibid.*
[43] *Ibid.*

the reduced soil aeration properties of compacted soil.[44] Finally, compaction negatively affects the porosity of farmland[45], which is linked to an increase in frequency and severity of floods.[46]

In conclusion, mechanisation has paved the way for monocultures to replace polycultures. This transition increased the productivity of farmers and farmland alike significantly, which generally improved food security. However, there are several long-term risks associated with mechanisation, as the use of heavy farming equipment leads to erosion and soil compaction. Yields decrease or stagnate as nutrients are washed away by rainwater, and the water retention capacities of soil are reduced due to decreasing organic matter. This can lead to disastrous consequences when droughts occur. In the 1930s, droughts plagued a significant area in North-America which led to dust storms that widely destroyed crops.[47]

2.2 Fertiliser

The second aspect of industrialising agriculture is the widespread and broad use of fertilisers to increase yields. Before the specialisation of agriculture, farmers relied on livestock and plant material to produce natural fertilisers, mainly manure and compost.[48] This created a closed nutrient cycle where there was little need for external fertiliser inputs.[49] That changed as farmers shifted their focus from raising livestock and growing a variety of crops, to a limited number of crop species. Producing or gathering natural fertilisers *en masse* is a tedious process that is costly in time and labour.[50] In the 19th century for example, Britain imported large quantities of guano[51] from Peru[52] to fertilise its fields.

This began to change when chemists found a way to synthesise these fertilisers. By the second half of the 19th century, phosphorus and potassium were being produced in factories around Europe and the United

[44] STEPNIEWSKI, W., GLNSKI, J., BALL, B., "Effects of Compaction on Soil Aeration Properties"*, Developments in Agricultural Engineering*, 1994, Vol. 11, 167-189.
[45] HORN, D., DOMZZAL, H., SLOWINSKA-JURKIEWICZ, VAN OUWERKERK, C., "Soil compaction processes and their effects on the structure of arable soils and the environment", *Soil and Tillage Research,* 1995, 31.
[46] ROGGER, M., et al, "Land use change impacts on floods at the catchment scale: Challenges and opportunities for future research", *Water Resources Research*, Vol. 53, 5209-5219.
[47] HAVENS, A.V., "Drought and Agriculture", *Weatherwise*, 1954, Vol. 7, 51-68.
[48] BOODY, G., DEVORE, B., "Redesigning Agriculture", *BioScience,* 2006, Vol. 56, 839-845.
[49] *Ibid.*
[50] MATHEW, W.M., "Peru and the British Guano Market, 1840-1870", *The Economic History Review*, 1970, Vol. 23, 112-128.
[51] Guano are the excrements of bats and seabirds that contain large amounts of nutrients, *Ibid.*
[52] For a short period of time, guano was the main commodity export of Peru and was even considered a large source of government revenue, *Ibid.*

States.[53] Despite its abundance in earth's atmosphere[54], the production of nitrogen would prove to be more difficult, since almost all of the available nitrogen in nature is in an unreactive form, meaning that it cannot be directly used by organisms.[55] By 1908, Fritz Haber and Carl Bosch had developed a way to synthesise nitrogen by producing ammonia.[56] For the first few decades after this discovery, its application in agriculture was limited. During the first and Second World War ammonia was mainly produced to build explosives, and it is only after these wars had ended that production shifted towards agricultural applications.[57]

The synthesis of ammonia by Haber and Bosch, something for which they received the Nobel Prize in Chemistry in 1918 and 1931 respectively[58], has by some been described as "*one of the greatest inventions of the 20th century*".[59] It provided a nitrogen source that was significantly less expensive and required less energy than its alternative, organic fertilisers.

The synthetic fertiliser production is therefore one of the contributing factors in the sharp population increase in the 20th century. Between 1950 and 2000 the world population increased by 200 percent, from roughly 3 billion to 6 billion.[60] The required increase in agricultural output was made possible by technological advances. Productivity more than doubled in the 20th century alone, as one hectare of arable land could sustain 4.3 people in 2008, which was just 1.9 people one century earlier, in 1908.[61] In 2008, nitrogen fertilisers were responsible for food production for nearly half the world's population.[62]

Despite these benefits, there are also risks associated with the widespread use of fertilisers, synthetic ones in particular. As fertiliser use increases, so does the amount that leaches into the environment where it negatively affects biodiversity and ecosystems.

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[53] RUSSEL, D., WILLIAMS, G., "History of Chemical Fertilizer Development", *Soil Science Society of America Journal*, 1977, Vol. 41, 260-265.
[54] 78% of the earth's atmosphere is comprised of nitrogen - ERISMAN, J. et al, "How a century of ammonia synthesis changed the world", *Nat GeoSci,* 2008, 636-639, 2008_Erismanetal_NatureGeo.pdf
[55] ERISMAN, J., BLEEKER, GALLOWAY, J., SUTTON, M., "Reduced nitrogen in ecology and the environment", *Environmental Pollution*, Vol. 150, 140-149.
[56] RUSSEL, D., WILLIAMS, G., "History of Chemical Fertilizer Development", *Soil Science Society of America Journal*, 1977, Vol. 41, 260-265.
[57] Ibid.
[58] ERISMAN, J. et al, "How a century of ammonia synthesis changed the world", *Nat GeoSci*, 2008, 636-639.
[59] HARFORD, T., "How fertiliser helped feed the world", *BBC News*, 2 January 2017, How fertiliser helped feed the world - BBC News
[60] HIRSCHMANN, C., "Population and society: historical trends and future prospects", in CALHOUN, C., ROJEK, C., TURNER, B. (eds.), The SAGE Handbook of Sociology, London, SAGE Publications, 2005
[61] ERISMAN, J. et al, "How a century of ammonia synthesis changed the world", *Nat GeoSci,* 2008, 636-639, 2008_Erismanetal_NatureGeo.pdf
[62] Ibid.

When it comes to nitrogen fertilisers, over 80 percent of the nitrogen that is applied on farmland escapes into the environment[63], though some of it is again denitrified back to its unreactive, gaseous form.[64] This increase in available nitrogen in terrestrial and aquatic ecosystems, a process called eutrophication, is linked to a decrease in biodiversity and ecosystem stability.[65] Plants that require large amounts of nitrogen begin to thrive in their ecosystem and gradually supress other plant species.[66] This in turn affects other organisms, such as animals and fungi. As nitrogen and phosphorus enter the ocean, the growth rate of algae greatly increases, which deprives other plants of sunlight and leads to a decrease in oxygen in bottom waters.[67] In terrestrial ecosystems, eutrophication is even thought to be a contributing factor in the widespread decline of butterfly populations, as the increase of brambles and grasses supresses the growth of nectar sources.[68]

2.3 Pesticides

In what follows, I will discuss the current role of pesticides in European agriculture, their benefits and risks, and the European trends regarding pesticide use. This will give an insight into why a significant part of the Farm to Fork Strategy is dedicated to reducing pesticide use in the EU.

As previously mentioned, the need for pesticides increased as fields became more homogeneous. These monocultures currently dominate the world and are often described as green deserts because they do not support biodiversity.[69] The lack of diversity in species increases the availability of host plants, meaning that pests and diseases can spread more rapidly in monocultures compared to polycultures.[70]

[63] BRAUN, "Reactive Nitrogen in the Environment: Too much or Too Little of a Good Thing", *UNEP* and *WHRC*, 2007, Reactive_Nitrogen.pdf (unep.org)
[64] GALLOWAY, J.N, et al, "Nitrogen cycles : past, present, and future", *Biogeochemistry*, 2004, Vol. 70, 153-226.
[65] VERHEYEN, K., et al, "Driving factors behin the eutrophication signal in understorey plant communities of deciduous temperate forests", *Journal of Ecology*, 2012, Vol. 100, 352-365 and SIMKIN, S., et al, "Conditional vulnerability of plant diversity to atmospheric nitrogen deposition across the United States", *PNAS,* 2016, 113.
[66] MEE, L., "Reviving Dead Zones", *Scientific American*, 2006, Vol. 295, 78-85.
[67] *Ibid.*
[68] WALLISDEVRIES, M., VAN SWAAY, C., PLATE, C., "Changes in nectar supply: A possible cause of widespread butterfly decline", *Current Zoology,* 2012, Vol. 58, 384-391, Word - 3 (Michiel F.WALLISDEVRIES)
[69] Monocultures make up 91 percent of global farmland – ALTIERI, M., "Green deserts: Monocultures and their impacts on biodiversity", in EMANUELLI, M.S., JONSEN, J., SUAREZ, S.M. (eds.), *red sugar, green deserts*, FIAN International, 2009.
[70] WOLFE, M., "Crop strength through diversity", *Nature*, 2000, Vol. 406, 681-682.

Potatoes, for example, are susceptible to late blight fungus (*Phytophthora infestans)* and the Colorado beetle (*Leptinotarsa decemlineata*), which both target members of the nightshade family.[71] By intercropping them with other plants, like garlic, the spread of these pests can be significantly slowed down or even stopped.[72] As farmers moved away from intercropping, pesticides began to play an increasingly important role in maintaining the increase in productivity that mechanisation had brought about.

2.3.1 European trends

Ever since their commercial introduction in the agriculture industry 70 years ago, the production and consumption of pesticides has steadily increased.[73] Globally, over 3 million tonnes of pesticides are applied to farmland every year, costing almost 40 billion euros.[74] According to the FAO, China is ranked first when it comes to consumption, as it annually applies 1.76 million tonnes of pesticides. The USA comes in second with 407.000 tonnes, and Brazil finishes third at 377.000 tonnes. Surprisingly, the European Union is only placed fourth as its member states combined consumed roughly 333.000 tonnes pesticides in 2019. This signifies a notable decline in the EU as annual pesticide sales fluctuated between 350.000 and 360.000 tonnes between 2011 and 2018, thus being relatively stable.[75] However, the significance of this decline should not be overstated as the figure for 2019 could simply be an outlier.

What is of significance are the statistics on pesticide sales in individual states over the last decade. These numbers seem to indicate that between 2011 and 2019, there was a general decline in pesticide sales in most member states, but not in all. In fact, there was an increase in several member states, such as a 100 percent increase in Cyprus, 55 percent in Latvia, 40 percent in Austria and 5 percent in Spain and Germany.[76]

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[71] KASSA, B., SOMMARTYA, T., "Effect of Intercropping on Potato Late Blight, Phytophthora infestans (Mont.) de Bary Development and potato Tuber Yield in Ethiopia", *Agriculture and Natural Resources*, Vol. 40, 2006, 914-924,
[72] PERRIN, R., PHILLIPS, M., "Some Effects of Mixed Cropping on the Population Dynamics of Insect Pests", *Entomologia Experimentalis et Applicata*, 1978, 585-593.
[73] TILMAN, D., CASSMAN, K., MATSON, P., NAYLOR, R., POLASKY, S., "Agricultural sustainability and intensive production practices", *Nature,* 2002, 671-677.
[74] SHARMA, A., et al, "Global trends in pesticides : A looming treat and viable alternatives", *Ecotoxicology and Environmental Safety*, 2020, Vol. 201, 110812.
[75] The annual sale of pesticides in the EU fluctuated between 350.000 and 360.000 tonnes - EUROSTAT, "Agri-environmental indicator – consumption of pesticides", *Eurostat*, 2022, Agri-environmental indicator - consumption of pesticides - Statistics Explained (europa.eu)
[76] *Ibid.*

That being said, most member states have experienced a decline in pesticide sales, including major consumers like Italy and the Netherlands.[77]

To conclude, the European Union is not a homogeneous entity when it comes to pesticide policy as each member state has its own stance and priorities.

2.3.2 Benefits of pesticide use

As already briefly touched upon, pesticides have, over the past 70 years, been central in maintaining food security in our industrial model. To summarise, pesticides have played, and continue to play a role in protecting human and livestock health by suppressing insect populations that act as carriers for Lyme, Malaria and the West Nile virus.[78] Secondly, they are used to control pests that may affect human activities. An example of this would be the use of pesticides to reduce vegetation at road junctions, therefore reducing car accidents.[79] Finally, and this is arguably the most important application, they are used to control pests and weeds in agriculture.[80]

Aside from the direct, so called primary benefits, i.e. improved human and livestock health and increased yields, there are also indirect benefits that do not manifest immediately. These are the secondary benefits which include, *inter alia,* declining rates of social unrest due to food insecurity, habitat loss due to crop losses and soil erosion rates.[81] That being said, pesticide use is also associated with several disadvantages and risks.

[77] Ibid.
[78] SARAVI, S., SHOKRADEH, M., "Role of Pesticides in Human Life in the Modern Age: A Review", in STOYTCHEVA, M. (ed.), *Pesticides in the Modern World: Risks and Benefits*, IntechOpen, 2011 and ZIMDAHL, R., "Chapter 7 – DDT : An insecticide", in ZIMDAHL, R., Six Chemicals That Changed Agriculture, Academic Press, 2015.
[79] COOPER, J., DOBSON, H., "The benefits of pesticides to mankind and the environment", *Crop Protection*, 2007, Vol. 26, 1337-1348.
[80] *Ibid.*
[81] *Ibid.*

2.3.3 Risks of pesticide use

To many, the benefits of pesticides do not outweigh their environmental and health risks.[82] Pesticides are by their very nature toxins, and while they are marketed to target certain organisms, they often also affect non-target species.[83] Due to exposure to relatively low concentrations their toxicity to non-target species seems limited at first sight, but many of these chemicals are persisting in the environment and are prone to both bioaccumulation, i.e. "*the net accumulation of a contaminant in, and some special cases on, an organism from all sources including water, air, and solid phases in the environment*"[84], and biomagnification, i.e. "*the increase in concentration from prey to predator and with trophic level or position in food webs*".[85]

It has already been established that occupational and chronic exposure to pesticides can lead to cancers, affect the nervous system and cause a myriad of other health issues.[86] Having said that, this predominantly affects developing countries where farmers do not have access to extensive education nor proper equipment[87], and is thus of lesser importance in the European Union, which is why the human health risks will not be covered extensively in this work.

What is relevant in the European Union, are the well-documented risks to biodiversity and ecosystem health.[88] Pesticides inevitably escape into nature via waterways or evaporation where they are absorbed by non-target species.[89] Through the aforementioned process of biomagnification, organisms that are higher up the food chain contain much higher levels of active substances. Already back in 1967 it was observed that thinning of eggshells of certain birds of prey occurred after exposure to DDT.[90] Furthermore, the harmful effects of pesticides are not limited to organisms that are found high up on the food chain in

[82] An illustration of the is the proposed reduction of pesticides in the Farm to Fork Strategy.
[83] AKTAR, W., SENGUPTA, D., CHOWDHURY, A., "Impact of pesticides use in agriculture: their benefits and hazards", *Interdisciplinary Toxicology*, 2009, Vol. 2, 1-12.
[84] NEWMAN, M., *Fundamentals of ecotoxicology*, Boca Raton, CRC Press, 2014, 99.
[85] *Ibid. 122*
[86] ALAVANJA, M. HOPPIN, J., KAMEL, F., "Health Effects of Chronic Pesticide Exposure: Cancer and Neurotoxicity", *Annual Review Public Health*, 2004, 155-197.
[87] SARKAR, S., et al., "The use of pesticides in developing counties and their impact on health and the right to food" *Think Tank*, 2021, www.europarl.europa.eu/RegData/etudes/STUD/2021/653622/EXPO_STU(2021)653622_EN.pdf
[88] SHAZADI, K., GUL, A., HAKEEM, K.R., "Effects of Pesticides on Environment", in HAKEEM K.R. (ed.), *Plant, Soil and Microbes*, Springer International Publishing Switzerland, 2016.
[89] MAJEWSKI, M., CAPEL, P., "Pesticides in the Atmosphere: Distribution, Trends, and Governing Factors", Taylor & Francis, 1995, Pesticides in the Atmosphere: (Distribution, Trends, and Governing Fact)
[90] RATCLIFFE, D.A, "Decrease in Eggshell Weight in Certain Birds of Prey", *Nature*, 1967, Vol. 215, 208-210.

an ecosystem, such as apex predators, but also affect plants and insects.[91] Exposure to these chemicals is not always fatal for insects, as some of its effects are sub-lethal.[92] This would also explain why certain harmful PPPs get approved in the European Union, as their sub-lethal properties can go unnoticed until there is a significant decline in insect populations. An example of this are neonicotinoids, approved for use in the EU in 2011 and subsequently banned in 2013 after several studies found their use negatively impacted bee populations.[93] The case surrounding neonicotinoids still raised several questions regarding the effectiveness of EU pesticide legislation, which is why it, alongside the approval of glyphosate, will be discussed in the chapter on harmonising EU pesticide policy with the Farm to Fork Strategy.

2.4 Species and Genetic Diversity of Crops

Finally, the decrease in species and genetic diversity of agricultural crops over the past decades also contributes in shaping European pesticide policy. It further cements the reliance on pesticide use as crops become more susceptible to widespread and uncontrolled diseases.

2.4.1 Species diversity

As discussed in the part on mechanisation and fertiliser, the agriculture industry began to transition to a monoculture system in the second half of the 20th century. The variety of crop species decreased as famers were financially pushed to focus their efforts on only producing certain crops, such as corn, wheat, potatoes, soybeans and rice.[94]

A loss of diversity in species destabilises the functionality of an ecosystem and ultimately results in a loss of productivity.[95] Disrupting the agroecosystem not only leads to erosion and increases the need for fertiliser use, but also increases the prevalence of pathogens and pests as their populations are no longer kept in

[91] SHAZADI, K., GUL, A., HAKEEM, K.R., "Effects of Pesticides on Environment", in HAKEEM K.R. (ed.), *Plant, Soil and Microbes*, Springer International Publishing Switzerland, 2016.
[92] *Ibid.*
[93] HENRY, M. et al., "A Common Pesticide Decreases Foraging Succes and Survival in Honey Bees", *Science*, 2012, Vol. 336, 348-350 and STOKSTAD, E., "Field Research on Bees Raises Concern About Low-Dose Pesticides", *Science*, Vol. 335, 1555.
[94] ALTIERI, M., "Green deserts: Monocultures and their impacts on biodiversity", in EMANUELLI, M.S., JONSEN, J., SUAREZ, S.M. (eds.), *red sugar, green deserts*, FIAN International, 2009.
[95] DUFFY, E., GODWIN, C., CARDINALE, B., "Biodiversity effects in the wild are common and as strong as key drivers of productivity", *Nature*, 2017, Vol. 549, 261-264.

check by natural repellents and predators.[96] The abundance of host plants only exacerbates this risk and allows for these pests to spread like wildfire between crops.

2.4.2 Genetic diversity

In recent decades, a similar trend in line with the aforementioned homogenisation of crop species occurred, namely genetic modification and selective breeding. Crops with economically desirable characteristics, such as colour, size, flavour and growth rate, were selected and bred to increase productivity and sales. Older heirloom cultivars were replaced by newer, often hybridised ones, a process called genetic shift.[97] This has generally led to minor decline in genetic diversity, but a significant genetic shift.[98]

In extreme cases however, plant breeding can decimate genetic diversity of a plant variety. The consequences of such practices highlights the risks of genetic erosion in these crops. For example, the Cavendish banana is a variety that dominates the industry, as it makes up nearly 50 percent of the global banana market.[99] A large portion of this market, namely 85 percent, is consumed locally, and because bananas are the most popular fruit in the world they play a significant role in maintaining food security in certain communities.[100] As is the case with most commercial banana varieties, the fruit of the Cavendish cultivar is seedless, meaning farmers rely on cloning as the method of propagation.

2.4.3 Link with pesticide use

Historically, the risks of only cultivating a handful of genetically homogeneous crops to food security are evident. The 19th century Irish Potato Famine that cost the lives of roughly one million people occurred when the late blight fungus swept through Irish potato fields, which mainly consisted of a single potato

[96] ALTIERI, M., "The ecological role of biodiversity in agroecosystems", *Agriculture, Ecosystems and the Environment,* 1999, Vol. 74 19-31.
[97] FU, Y-B., "Impact of plant breeding on genetic diversity of agricultural crops: searching for molecular evidence", *Plant Genetic Resources*, 2006, Vol. 4, 71-78.
[98] FU, Y-B., "Understanding crop genetic diversity under modern plant breeding", *Theoretical and Applied Genetics*, Vol. 128, 2131-2142.
[99] FAO, "Banana facts and figures", *FAO*, EST: Banana facts (fao.org)
[100] ORDONEZ, N., et al, "Worse Comes to Worst: Bananas and Panama Disease – When Plant and Pathogen Clones Meet", *PLoS Pathogens*, 2015, Vol. 11, 1-7.

variety.[101] In the 1960s, the Gros Michel banana variety, which dominated the market at the time, was wiped out by the Panama disease (*Fusarium oxysporum)*.[102] A few years later, in the 1970s, a lack of genetic diversity was linked to the spread of southern corn leaf blight (*Bipolaris maydis)* that cost the United States several billions of dollars.[103] To combat the rampant spread of pests and diseases in monocultures, farmers began to rely on the widespread use of pesticides, which is still the case today.

Despite the risks of selectively breeding or engineering traits in crops to food security, it also, in theory, begins to play an increasingly important role in reducing the need for pesticide and fertiliser use.[104] Farmers become less reliant on these substances as plants are genetically modified to be more resistant to pests and diseases.[105] A well-known example of genetic engineering in agriculture are the *Bacillus thuringiensis* crops, such as *Bt* corn, potatoes and cotton, which are resistant to certain insect pests.[106]

In practice, there is mounting evidence that genetically modified organisms, or GMOs, can lead to an increase in pesticide use. When glyphosate resistance was introduced in crops, the amount of herbicides used in agriculture grew significantly[107], and as weeds developed resistance to glyphosate after years of use, farmers fell back on herbicide mixes.[108]

[101] FRY, W., GOODWIN, S., "Resurgence of the Irish Potato Famine Fungus", *BioScience*, 1997, Vol. 47, 363-371.
[102] PLOETZ, R., "Panama disease: Return of the first banana menace", *International Journal of Pest Management*, 1994, Vol. 40, 326-336.
[103] ULLSTRUP, A., "The Impacts of the Southern Corn Leaf Blight Epidemics of 1970-1971", *Annual Review of Phytopathology*, 1972, Vol. 10, 37-50.
[104] OLIVER, M., "Why We Need GMO Crops in Agriculture", *The Journal of the Missouri State Medical Association*, 2014, Vol. 111, 492-507.
[105] AZADI, H., HO, P., "Genetically modified and organic crops in developing countries: A review of options for food security", *Biotechnology Advances,* 2010, 160-168.
[106] ABBAS, M., "Genetically engineered (modified) crops (Bacillus thuringiensis crops) and the world controversy on their safety", *Egyptian Journal of Biological Pest Control*, 2018, Vol. 28, 1-12.
[107] BENBROOK, C., "Impacts of genetically engineered crops on pesticide use in the U.S. -- the first sixteen years", *Environmental Sciences Europe*, 2012, Vol. 24, 1-13.
[108] EVANS, J., et al, "Managing the evolution of herbicide resistance", *Pest Management Science*, 2015, Vol. 72, 74-80.

2.5 Conclusion

Pesticide use and its impact goes much further than just pesticide policy and is instead influenced by other aspects of the industrialised system. Because machines were often designed for a specific crop, mechanisation paved the way for monocultures as farmers decreasingly relied on crop rotation and intercropping. This increased productivity of farmland but negatively affected the nutrient cycle, leading to the reliance on synthetic fertilisers in agriculture.

It also led to a decrease in natural predators as monocultures cannot support a wide variety of biodiversity. By the beginning of the second half of the 20th century, pesticides were commercially introduced to keep pest populations in check. In the decades after that, species and genetic diversity would greatly decrease as polycultures would become a thing of the past. This lack of diversity put crops at an even greater risk of diseases and pests, since there was an abundance of host plants with a similar genotype. Ultimately, this resulted in an even larger increase in pesticide use, despite their risks.

Each of these four innovations are interdependent in that they all play a role in maintaining industrial agricultural systems. However, they are also detrimental to biodiversity on farmland, and in many ways also to the stability of neighbouring ecosystems. While the focus of this work is on the environmental, and by extension social and economic, impact of pesticide policy in Europe, it is also necessary to include these other pillars of monoculture farming in this assessment. A reduction of pesticides is only possible if it is part of a transition towards a sustainable model of agriculture.

3 Agri-environmental Policy

3.1 Farm to Fork Strategy

The Farm to Fork Strategy, which is at the heart of the EU Green Deal, was published in May 2020 and is a part of the Commission's attempt to make European food systems fairer and more sustainable, while also reducing the impact of food production on the environment.[109]

Since this work relates to the impact of the Farm to Fork Strategy, it is imperative to describe the targets set forth in this strategy that could directly or indirectly impact pesticide use in the EU. As indicated in the previous chapter, this does not only include the reduction or prohibition of certain pesticides, but also targets on increasing diversity in crops, encouraging biodiversity and organic farming.[110] Considering that the other parts of the Farm to Fork Strategy are not relevant to the scope of this work, they will not be extensively covered. This includes targets on sustainable food processing, promoting responsible business practices and sustainable food consumption, combating food fraud and reducing food waste.[111]

In the Strategy, the EU Commission sets forth its ambitions to reduce the overall chemical pesticide use and risk by 50 percent, while also reducing the use of hazardous pesticides by 50 percent by 2030. The Commission repeatedly emphasised that multiple steps will be taken to ensure farmers' incomes while transitioning to a sustainable agriculture system.[112] According to the Strategy, it will:

"revise the Sustainable Use of Pesticides Directive, enhance provisions on integrated pest management (IPM) and promote greater use of safe alternative ways of protecting harvests from pests and diseases. IPM will encourage the use of alternative control techniques, such as crop rotation and mechanical weeding, and will be one of the main tools in reducing the use of, and dependency on, chemical pesticides in general, and the use of more hazardous pesticides in particular".[113]

The Farm to Fork Strategy seems to indicate the aim to shift away from standard monoculture farming practices, and instead transition back to natural alternatives.[114] This transition is to happen without

[109] European Commission, "A Farm to Fork Strategy: For a fair, healthy and environmentally-Friendly Food system", *EC*, 2020, https://ec.europa.eu/food/sites/food/files/safety/docs/f2f_action-plan_2020_strategy-info_en.pdf.
[110] *Ibid.*
[111] *Ibid.*
[112] *Ibid.*
[113] *Ibid.*
[114] This includes crop rotation, increasing agrobiodiversity to keep pest population in check and using organic pesticides.

jeopardising food security in the EU, which is a concern often voiced by the agriculture industry and its supporters.[115] The argument pertains to the impact of the Strategy on food security so its validity will be discussed when answering the third research question.

3.2 Biodiversity Strategy

While the EU Biodiversity Strategy for 2030, which is also a part of the European Green Deal, is not adopted in the Farm to Fork Strategy, it is still relevant to discuss it as both their targets either directly overlap or indirectly influence each other. The overall goal of the Strategy is to "*put Europe's biodiversity on the path to recovery by 2030 for the benefit of people, the planet, the climate and the economy*".[116] It consists of four pillars, two of which are explicitly linked to the future of European agriculture.

While some of the key commitments of Pillar Two are in essence a reiteration of the Farm to Fork targets, such as a reduction in pesticides of 50 percent by 2030, most are specific goals that complement the Farm to Fork Strategy in many ways. Reversing the decline of pollinators, increasing biodiversity on agricultural land and ensuring the conservation of EU protected habitats by 2030 are all targets that largely depend on transitioning to a sustainable agricultural model.[117]

Pillar Three of the Biodiversity Strategy sets forth commitments to integrate biodiversity in all sectors of society, such as banking and agriculture.[118] Furthermore, current biodiversity legislation, like the Habitats Directive, must be strengthened and a European governance framework should be drafted.

The importance of biodiversity, regardless of its intrinsic value, can hardly be overstated, as it is essential in ensuring a steady food supply. The benefits of the Natura 2000 network alone are estimated to reach 200 to 300 billion euros each year, and over one million farming jobs are linked to these networks.[119]

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[115] POIRON, A., "Why Attacks Against the EU Farm to Fork Strategy Completely Miss the Point", *Slow Food*, 9 February, 2022, Why Attacks Against the EU Farm to Fork Strategy Completely Miss the Point - Slow Food Europe and HEFFERON, K., MILLER, H., "The EU's 'Farm to Fork' Strategy Is Ill-Conceived and Destructive*", European Scientist*, 11 February 2021, www.europeanscientist.com/en/features/the-eus-farm-to-fork-strategy-is-ill-conceived-and-destructive/

[116] European Commission, Directorate-General For Environment, "EU biodiversity strategy for 2030: bringing nature back into our lives", *Publications Office of the European Union*, 2021, op.europa.eu/en/publication-detail/-/publication/31e4609f-b91e-11eb-8aca-01aa75ed71a1

[117] *Ibid.*

[118] *Ibid.*

[119] European Commission, "The business case for biodiversity: The European Green Deal", *EC*, 2020.

Pollinators are the backbone of food production and the decline of their population numbers, for which agriculture is partly responsible, not only puts food production at risk, but also the stability of most terrestrial ecosystems.[120] A 2017 study found that in several German nature reserves, the insect biomass had decreased by an average of 78 percent over just 25 years.[121] Roughly 84 percent of crop species and 78 percent of wild flower species in Europe are dependent on pollinators to propagate, which is why implementing this Strategy is all the more important to sustaining ecosystems and food production.[122]

3.3 Common Agriculture Policy

Because the Strategies are not legally binding themselves, the success of their implementation largely depends on CAP measures. An agricultural policy that is not in line with these targets would essentially undermine them, thus significantly hindering its success by 2030.[123] The CAP was first launched in 1962, after it originated in the 1957 Treaties of Rome, wherein its goal is described as "*boosting agricultural production in order to guarantee food supplies at affordable prices in Europe still impacted by war*".[124] This goal has changed over the past decades to include environmental protection, but its core message remains the same; creating a food production system that works for both farmer and consumer.[125] A criticism regarding the CAP that is often voiced is that environmental protection is less important and comes second to the social and, more importantly, the economic aspects.[126]

Agriculture might not be a domain that is often associated with the EU by the general populace but it lies at the heart of EU policy, despite its relative decline in expenditure over the past decades. In 1980, over 65 percent of the total annual EU budget was allocated to the CAP, which has dropped to roughly 35 percent

[120] KLEIN, A-M., et al, "Importance of pollinators in changing landscapes for world crops", *Proceedings of the Royal Society B,* 2006, Vol. 274, 303-313.
[121] VOGEL, G., "Where have all the insects gone?"*, Science*, 2017,Vol. 356, 576-579.
[122] European Commission, Directorate-General For Environment, "EU biodiversity strategy for 2030: bringing nature back into our lives", *Publications Office of the European Union*, 2021, EU biodiversity strategy for 2030 - Publications Office of the EU (europa.eu)
[123] CLIENTEARTH, "Lawyers warn Commission over 'illegal' and conscious failure to align CAP reform proposal with Green Deal", *ClientEarth,* 8 July 2020.
[124] Article 39 Treaty of Rome, 25 March 1957.
[125] Article 39 TFEU
[126] ECA, "Biodiversity on farmland: CAP contribution has not halted the decline", *ECA Special Report* 2020, 13, SR 13 2020: Biodiversity on farmland: CAP contribution has not halted the decline

in 2020[127] This means that the CAP budget was close to 60 billion euros in 2020, of which over 40 billion was used to directly finance farmers' incomes.[128] The remainder of the budget is used for the Rural Development Programme to compensates farmers for losses associated with environmentally friendly farming methods.[129]

The CAP is adjusted and reformed every few years to respond to emerging changes or threats to the food production industry. The latest reform, formally adopted in December of 2021, particularly pertains to the first and second research question of this work and will therefore be covered in the next chapters.[130] This will include an analysis of the present and future shortcomings of CAP in light of the Farm to Fork and Biodiversity Strategies' targets.

[127] European Commission, "Common Agricultural Policy : Key graphs & figures", *EC,* 2020, ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/cap-expendituregraph1_en.pd
[128] European Commission, "The common agricultural policy at a glance", *EC,* ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-glance_en#thenewcap
[129] Direct payments make up Pillar I of the CAP, and the Rural Development Programme is Pillar II – PE'ER, G., et al., "A greener path for the EU Common Agricultural Policy", *Science*, 2019, Vol. 365, 449-451, www.science.org/doi/full/10.1126/science.aax3146
[130] FOOTE, N., "CAP reform: Signed, sealed- now all eyes are on how it will deliver", *Euractiv*, 23 November 2021, www.euractiv.com/section/agriculture-food/news/cap-reform-signed-sealed-now-all-eyes-are-on-how-it-will-deliver/

Part II

1 Challenges in harmonising CAP and pesticide legislation with Farm to Fork targets

The harmonisation of existing agricultural policy and pesticide legislation with the Farm to Fork's progressive targets is hindered by two obstacles; a political and a legal one. On the one hand, the influence of the private sector on agricultural policy and its implementation in the European Union is still significant despite existing regulations on transparency in lobbying and combating corruption.[131] Pesticide regulations, on the other hand, continue to allow for harmful substances to be used in EU agriculture, thereby failing to protect the environment. Having said that, both obstacles are deeply rooted in the undue pressure from stakeholders. This pressure on policymakers is not always explicit, i.e. in the form of lobbying, but also occurs implicitly. The mere thought of food shortages can trigger panic buying which negatively affects food security[132], and while the expression "*society is three meals away from anarchy"*[133] may be an exaggeration, it holds at least some truth[134], something politicians seem to understand as well.[135]

As the public's perception of food insecurity rises, so does governmental distrust [136], which explains the lack of political will to fully harmonise CAP with Farm to Fork. Industrial farm lobbies have, and continue to push the narrative that Farm to Fork targets will lead to a significant decrease in food production, thus putting food security at risk.[137] The veracity of these claims is questionable to say the least, as some of the impact studies lobbyists refer to are funded by CropLife Europe, an organisation that represents the interests of

[131] SABEV, D., eta a, "Where does the EU money go? An analysis of the implementation of CAP funds in Bulgaria, the Czech Republic, Hungary, Slovakia and Romania", *The Greens/EFA*, 2021, 6769 (greens-efa.eu)
[132] BOYACI-GÜNDÜZ, C., IBRAHIM, S., WEI, O., GALANAKIS, C., "Transformation of the Food Sector: Security and Resilience during the COVID-19 Pandemic", *Foods*, 2021, Vol. 10, 497.
[133] THOMAS, J., MORA, K., "Community resilience, latent resources and resource scarcity after an earthquake: Is society really three meals away from anarchy?", *Natural Hazards*, 2014, Vol. 74, 477-490.
[134] For example, the social unrest following the Arab Spring in 2010 and 2011 was at least in part caused by increasing food prices and food insecurity - SOFFIANTINI, G., "Food insecurity and political instability during the Arab Spring", *Global Food Security*, 2020, Vol. 26, 1-8.
[135] STRUNA, H., "Macron wants to 'adapt' EU Farm to Fork to the post-Ukraine war world", *Euractiv*, 18 March 2022, Macron wants to 'adapt' EU Farm to Fork to the post-Ukraine war world – EURACTIV.com
[136] HAN, G., YAN, S., "Does Food Safety Risk Perception Affect the Public's Trust in Their Government? An Empirical Study on a National Survey in China", *International Journal of Environmental Research and Public Health*, 2019, Vol. 16, 1874.
[137] WAX, E., "MEPs vote on EU's green food plan amid lobbying blitz", *Politico,* 17 October 2021, www.politico.eu/article/meps-vote-eus-green-food-plan-farm-to-fork/

agrochemical companies.[138] Regardless, it is an indication that many of the challenges of implementing Farm to Fork are political in nature. The control corporations exert over CAP and pesticide policy will therefore also be covered in this chapter.

1.1 Political obstacles

1.1.1 Market power of agribusiness

To find an answer to the question what the obstacles are in harmonising the EU's agricultural policy with the targets of Farm to Fork it is pertinent to understand the power a very limited number of private entities hold over global food production. Indeed, this market control is not limited to pesticide production, but spreads throughout all aspects of the food supply chain. The grip of corporations on agriculture has only increased and is increasingly seen as a threat to food security.[139] Compared to other states, EU antitrust laws are regarded as very stringent[140], but they do not seem to function properly when it comes to curbing corporate control in the agriculture sector.[141]

As explained, a diverse seed supply lies at the basis of a sustainable food system. Currently, just four corporations control more than half of the global seed market.[142] These same corporations often have a large market share in the pesticides, fertiliser and machinery industry, a trend which has only been exacerbated by the mergers between rivalling companies in recent years.[143] After acquiring Monsanto,

[138] Corporate Europe Observatory, "Leak: industrial farm lobbies' coordinated attack on Farm to Fork targets", *CEO*, 12 November 2021, corporateeurope.org/en/2021/10/leak-industrial-farm-lobbies-coordinated-attack-farm-fork-targets

[139] GRAIN, "Growing Corporate Hold on Farmland Risky for World Food Security", *Our Wold*, 16 June 2014, ourworld.unu.edu/en/growing-corporate-hold-on-farmland-risky-for-world-food-security.

[140] BRADFORD, A., "The Brussels Effect", *Northwestern University Law Review*, 2012, Vol. 107, 1-68.

[141] CSERES, K., ""Acceptable" Cartels at the Crossroads of EU Competition Law and the Common Agricultural Policy: A Legal Inquiry into the Political, Economic, and Social Dimensions of (Strengthening Farmers') Bargaining Power", *The Antitrust Bulletin*, Vol. 65, 401-422.

[142] These four companies are Bayer, Corteva, ChemChina and Limagrain - SHIELD, C., "Seed monopolies: Who controls the world's food supply?" *Dw*, 8 april 2021, Seed monopolies: Who controls the world's food supply? | Global Ideas | DW | 08.04.2021

[143] ALLIOT, C., et al., "Agrifood Atlas: Facts and figures about the corporations that control what we eat", *Heinrich Böll Stiftung*, *Rosa Luxemburg Stiftung, Friends of the Earth Europe*, 2017.

Bayer now controls one third of the global seed market, and over one fifth of the pesticide market, while ChemChina holds roughly 7 percent of the seed market and 23.5 percent of the pesticide market[144].

Corporate control puts food sovereignty and security at risk as the lack of competition leaves farmers vulnerable to unfair prices and exploitation.[145] Furthermore, their grip on food security makes it possible for these corporations and interest groups to influence public policy.[146]

1.1.2 Influence of private entities

In the world of policymaking, the implementation of disruptive proposals, such as the Farm to Fork Strategy, is often hindered by the influence and pressure of these private entities.[147] This is mainly done through lobbying, or by swaying public opinion to apply pressure on policymakers.[148] Despite the abundance of anticorruption laws on the European level, neither of said practices is illegal. This raises the question as to what the exact difference is between corruption and lobbying, as one is illegal while the other is barely regulated.

1.1.2.1 Corruption and lobbying

The EU is viewed as a leader in the field of fighting corruption, although there are still significant differences between Member States.[149] Historically, criminal substantial law and criminal procedure have been competences of individual Member States, while the EU provided a framework for cooperation.[150] In recent decades, however, the EU has taken measures to combat the so called 'euro-crimes' that are described in article 83 TEU. One of these "*particularly serious crimes with a cross-border dimension resulting from the*

[144] *Ibid.*
[145] MAMMANA, I., "Concentration of Market Power in the EU Seed Market", *The Greens/EFA Group*, 2014 and WITTMAN, H., "Food Sovereignty: A New Rights Framework for Food and Nature?", *Environment and Society: Advances in Research,* 2011, Vol. 2, 87-105.
[146] Corporate Europe Observatory, "Toxic residues through the back door", *CEO*, 16 February 2020, corporateeurope.org/en/2020/02/toxic-residues-through-back-door
[147] HERMAN, E., "Behind the CAP Reform – The Rooted Lobbying of Copa-Cogeca", *Eyes on Europe*, 2 February 2021, www.eyes-on-europe.eu/behind-the-cap-reform-the-rooted-lobbying-of-copa-cogeca/
[148] FOOTE, N., "Agri stakeholders gear up for last minute push ahead of Farm to Fork vote", *Euractiv*, 8 september 2021, Agri stakeholders gear up for last minute push ahead of Farm to Fork vote – EURACTIV.com
[149] MELNYK, D., PARFYLO, O., BUTENKO, O., TYKHONOVA, O., ZAROSYLO, V., "Practice of the member states of the European Union in the field of anti-corruption regulation", *Journal of Financial Crime*, 2021.
[150] ROZMUS, M., TOPA, I., WALCZAK, M., "Harmonisation of criminal law in the EU legislation – the current status and the impact of the treaty of Lisbon"*, ePub*, 2014.

nature or impact of such offences or from a special need to combat them on a common basis"[151] is corruption, which means that minimum standards can be set on the EU level. Furthermore, the EU has adopted specific legislation to fight corruption involving EU or member state officials in which corruption is defined as "*the deliberate action of an official, who, directly or through an intermediary, requests or receives advantages of any kind whatsoever, for himself or for a third party, or accepts a promise of such an advantage, to act or refrain from acting in accordance with his duty or in the exercise of his functions in breach of his official duties*".[152] A simpler, albeit vaguer, definition of corruption is "*the abuse of power for private gain*".[153]

Lobbying, on the other hand, is "*any action attempting to directly or indirectly influence a policy-making process in favour of particular interest groups*".[154] This action can take many forms, ranging from providing policymakers with expertise in certain areas, to contributing votes or money to a politician's campaign.[155] To most, the fine line between corruption and lobbying is murky at best, and non-existent at worst, as they are both methods of influencing government officials.[156] One prevailing theory is that corruption includes all actions to influence rule enforcers, while lobbying aims to influence rule makers.[157] In Brussels, the capital of EU lobbying, there are estimated to be 25,000 lobbyists with a combined budget of 1.5 billion euros.[158] Granted, it is not the 3.2 billion euros[159] that are spent on lobbying in the US but it is still indicative of the influence corporations seek in the EU law making process. An illustration that this is money well spent is the privileged position agricultural interest groups have managed to secure in setting the EU's agricultural policy.[160]

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[151] Article 83 TEU

[152] Article 2, 1. Convention drawn up on the basis of Article K.3 (2) (c) of the Treaty on European Union on the fight against corruption involving officials of the European Communities or officials of Member States of the European Union, *OJ* C 195, 25 June 1997, 2-11.

[153] European Commission, "Corruption", *EC*, 2022, home-affairs.ec.europa.eu/policies/internal-security/corruption_en

[154] LUNDY, D., "Lobby Planet Brussels: The Corporate Europe Observatory guide to the murky world of EU lobbying", *CEO*, 2017

[155] HALL, R., DEARDORF, A., "Lobbying as Legislative Subsidy", *American Political Science Review*, 2006, Vol. 100, 69-84.

[156] CAMPOS, N., GIOVANNONI, F., "Political institutions, lobbying and corruption", *Journal of Institutional Economics*, 2017, Vol. 13, 917-939.

[157] *Ibid.*

[158] LUNDY, D., "Lobby Planet Brussels: The Corporate Europe Observatory guide to the murky world of EU lobbying", *CEO*, 2017.

[159] HALL, R., DEARDORF, A., "Lobbying as Legislative Subsidy", *American Political Science Review*, 2006, Vol. 100, 69-84.

[160] X, "CAP vs Farm to Fork: Will we pay billions to destroy, or to support biodiversity, climate, and farmers?", *Corporate Europe Observatory*, 2020.

1.2 Legal obstacles

1.2.1 Rules for thee but not for me

The cases surrounding the approval of glyphosate and neonicotinoids have in many ways highlighted how the pesticide approval process is still rampant with negligence and partiality. Despite the stringency of Regulation 1107/2009 concerning the placing of plant protection products on the market[161], there was a lack of transparency in the approval of these substances.[162] In response to the European Citizens' Initiative (hereafter: ECI) to ban glyphosate, the European Parliament adopted Regulation (EU) 2019/1381[163] to increase transparency in the approval process of Regulation 1107/2009. Since the approval of pesticides determines the impact of pesticide policy on the environment and thus the proposed Farm to Fork targets, it is relevant to discuss the workings and shortcomings of Regulation 1107/2009. This will be illustrated by the aforementioned glyphosate and neonicotinoids cases, and the recent changes to this piece of legislation. It will give an understanding of how current legislation hinders the implementation of Farm to Fork targets, including the reduction of risks and use of pesticides by 50 percent by 2030.

1.2.1.1 C-499/18

An interesting case before the Court of Justice of the European Union (hereafter: CJEU) on the workings of the pesticide approval process in the European Union is C-499/18[164], in which behemoth Bayer takes on the decision of the Commission to ban two active substances used in neonicotinoids in the Implementing Regulation No 485/2013.[165] These substances, called imidacloprid and clothianidin, were approved for use

[161] Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC, OJ L, 24 November 2009, 309, 1-50.
[162] Corporate Europe Observatory, "Transparency for public trust?", *CEO*, 16 April 2019, corporateeurope.org/en/2019/04/transparency-public-trust
[163] Regulation (EU) 2019/1381 of the European Parliament and of the Council of 20 June 2019 on the transparency and sustainability of the EU risk assessment in the food chain and amending Regulations (EC) No 178/2002, (EC) No 1829/2003, (EC) No 1831/2003, (EC) No 2065/2003, (EC) No 1935/2004, (EC) No 1331/2008, (EC) No 1107/2009, (EU) 2015/2283 and Directive 2001/18/EC, *OJ* L 231, 6 September 2019, 1-28.
[164] CJEU 6 May 2021, Bayer CropScience AG and Bayer AG v European Commission, nr. C-499/18, ECLI:EU:C:2021:367
[165] Commission Implementing Regulation (EU) No 485/2013 of 24 May 2013 amending Implementing Regulation (EU) No 540/2011, as regards the conditions of approval of the active substances clothianidin, thiamethoxam and imidacloprid, and prohibiting the use and sale of seeds treated with plant protection products containing those active substances, *OJ* L 139, 25 May 2013, 12-26.

as an insecticide in the European Union by Implementing Regulation No 540/2011.[166] This means that at the time of their approval in 2011, they were considered to be safe for use as they met the requirements set forth in Regulation No 1107/2009.

This changed one year later, in 2012, when two papers were published in *Science* that found the use of neonicotinoids to have a negative effect on the health of honeybee (*Apis melifera)* and bumblebee (*Bombus*) populations.[167] The European Food Safety Authority (hereafter: EFSA) responded to these studies by making its own risk assessment in which it found that certain applications of both clothianidin and imidacloprid were harmful to pollinators.[168] As a ban on neonicotinoids was not supported by a qualified majority in the European Parliament but was still supported by fifteen Member States, the Commission withdrew their approval in Implementing Regulation No 485/2013 for certain uses of imidacloprid and clothianidin.

In the case of *Bayer CropScience and Others v Commission*, Bayer sought the annulment of this Implementing Regulation before the General Court.[169] This was ultimately denied by the General Court, after which Bayer appealed the decision before the Court of Justice. In this case, C-499/18, Bayer believed that the General Court misinterpreted article 21 of Regulation No 1107/2009, and that the requirements for the review of approval had in fact not been met.[170] Most of its arguments revolved around the Commission's decision, which it believed not to be based upon "*new scientific and technical knowledge and monitoring data*"[171], and could therefore not justify the review of approval.[172] Bayer also argued that the precautions taken by the EFSA and Commission were disproportionate to their goals. Both arguments were dismissed by the Court, as the Commission can review the approval of an active substance at any time.[173]

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[166] Commission Implementing Regulation (EU) No 540/2011 of 25 May 2011 implementing Regulation (EC) No 1107/2009 of the European Parliament and of the Council as regards the list of approved active substances, *OJ* L 153, 11 June 2011, 1-186.
[167] HENRY, M. et al., "A Common Pesticide Decreases Foraging Success and Survival in Honey Bees", *Science*, 2012, Vol. 336, 348-350 and STOKSTAD, E., "Field Research on Bees Raises Concern About Low-Dose Pesticides", *Science*, Vol. 335, 1555.
[168] EFSA, "Conclusion on the peer review of the pesticide risk assessment for bees for the active substance clothianidin", *EFSA Journal*, 2013, Vol. 11, 3067 and EFSA, "Conclusion on the peer review of the pesticide risk assessment for bees for the active substance imidacloprid", *EFSA Journal*, 2013, Vol. 11, 3068.
[169] Judgement of the General Court of 17 May 2018, Bayer CropScience AG and Others v European Commission, nr. T429/13 and T-451/13, ECLI:EU:T:2018:280
[170] Article 21 Regulation No 1107/2009
[171] *Ibid.*
[172] CJEU 6 May 2021, C-499/18, para. 45
[173] Article 21, 1. Regulation No 1107/2009

Furthermore, the Court notes that the provisions of Regulation No 1107/2009, article 21 included, are based on the precautionary principle.[174]

1.2.1.2 Glyphosate

The renewal of approval for glyphosate by the Implementing Regulation No 2017/2324[175] at the end of 2017 was a controversial decision that garnered the attention of citizens in all member states. It was an example of the shortcomings of the implementation of Regulation No 1107/2009 that gave rise to the ECI to ban glyphosate and protect people and the environment from toxic pesticides.[176] With over one million signatures from European citizens, it was the fourth initiative at the time to meet the requirements of the ECI Regulation.[177] The demands of this ECI were threefold; banning glyphosate-based herbicides, increasing transparency and eliminating industry funded studies in the approval process, and finally, setting EU-wide reduction targets for pesticide use.[178]

While the Commission rejected the first demand and all but ignored the third one, it proposed a piece of legislation to increase transparency in the food production chain. This proposal eventually led to Regulation (EU) No 2019/1381 which also amends several articles of Regulation No 1107/2009. In what follows, the transparency issues regarding the glyphosate approval will be outlined, as well as how recent changes to legislation addresses these issues.

[174] CJEU 6 May 2021, C-499/18, para. 79.
[175] Commission Implementing Regulation (EU) 2017/2324 of 12 December 2017 renewing the approval of the active substance glyphosate in accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council concerning the placing of plant protection products on the market, and amending the Annex to Commission Implementing Regulation (EU) No 540/2011, *OJ* L 333, 15 December 2017, 10-16.
[176] European Commission, "Communication From the Commission on the European n Citizens' Initiative "Ban glyphosate and protect people and the environment from toxic pesticides", *EC*, 2017, C(2017)8414.
[177] Regulation (EU) No 211/2011 of the European Parliament and of the Council of 16 February 2011 on the citizens' initiative, *OJ* L 65, 11 March 2011, 1-22.
[178] *Ibid.*

1.2.1.2.1 Approval

Glyphosate-based pesticides have since their commercial introduction in 1974 grown to be the most consumed herbicide on a global scale.[179] They were long thought to be relatively safe to man and nature, and cheap compared to its alternatives, especially in combination with transgenic glyphosate-resistant crops.[180] This is because glyphosate not only replaced other herbicides, but also reduced tillage, erosion and even fossil fuel use.[181] In recent years however, public opinion regarding these chemicals has been shifting. Firstly, the benefits of glyphosate use have been diminishing as resistance in weeds increases.[182] Secondly, research into the long-term effects of glyphosate emerged that found exposure could have adverse health effects.[183] The International Agency for Research on Cancer, for example, categorised glyphosate as "*probably carcinogenic to humans"* in 2015 based on several studies.[184]

Controversy surrounding the chemical only increased when internal Monsanto documents became part of the discovery process in a US case against the agrochemical giant.[185] These documents gave several insights into the efforts of pesticide companies to influence public policy, from lobbying government officials and influencing scientific studies to make them appear more favourable to glyphosate, to ghostwriting risk assessments.[186] Finally, internal emails showed that Monsanto personnel were discouraged from saying Roundup, a product that contains glyphosate, did not cause cancer, as "*they have not done the necessary testing on the formulation to make that statement"*.[187]

The EFSA and the Federal Institute for Risk Assessment, or BfR, of Rapporteur Member State Germany were not convinced by these findings and instead came to a different conclusion; glyphosate was not

[179] DUKE, S., POWLES, S., "Glyphosate: a once-in-a-century herbicide", *Pest Management Science,* 2008, Vol. 64, 319-325.
[180] CERDEIRA, A., DUKE, S., "The Current Status and Environmental Impacts of Glyphosate-Resistant Crops", *Journal of Environmental Quality*, 2006, Vol. 35, 1633-1658 and BENNET, R., PHIPPS, R., STRANGE, A., GREY, P., "Environmental and human health impacts of growing genetically modified herbicide-tolerant sugar beet: a life-cycle assessment", *Plant Biotechnology Journal*, 2004, Vol. 2, 273-278.
[181] *Ibid.*
[182] DUKE, S., "The history and current status of glyphosate", *Pest Management Science*, 2018, Vol. 74, 1027-1034.
[183] MYERS, J.P, et al, "Concerns over use of glyphosate-based herbicides and risks associated with exposures: a consensus statement" *Environmental Health*, Vol. 15, 19.
[184] IARC, "Evaluation of five organophosphate insecticides and herbicides", *IARC Monographs,* 2015, Vol. 112, www.iarc.who.int/wp-content/uploads/2018/07/MonographVolume112-1.pdf
[185] MCHENRY, L., "The Monsanto papers: Poisoning the scientific well", *International Journal of Risk & Safety in Medicine*, 2018, Vol. 29, 193-205.
[186] Corporate Europe Observatory, "What the Monsanto Papers tell us about corporate science", *CEO*, 1 March 2018, corporateeurope.org/en/food-and-agriculture/2018/03/what-monsanto-papers-tell-us-about-corporate-science
[187] Ibid.

carcinogenic and met the other requirements of Regulation No 1107/2009.[188] An assessment of the substance of this decision goes beyond the scope of this research question and will therefore not be discussed. Instead, as mentioned, the decision raised several legal questions regarding the transparency of the risk assessment of the EFSA and Rapporteur member state.

1.2.1.2.2 Ghostwriting, interference in the scientific process and plagiarism

While it is not directly related to the plant protection product approval process, ghostwriting negatively affects the quality of scientific studies. Ghostwriting is the practice "*in which the companies secretly author journal articles in the names of prominent academic researchers in order to build a literature base to support products and neutralize criticism*"[189], and the lack of objectivity on the part of the authors is detrimental to the credibility of their findings.[190] Since secrecy is the essence of this practice, it often goes unnoticed, and in the case of glyphosate it only came to light after Monsanto was forced to release internal communications.[191]

Secondly, Monsanto is shown to have directly interfered in studies regarding glyphosate. For example, after the publication of a study that detailed the long-term toxic effects of Monsanto's Roundup it pushed the journal's editor to retract the study.[192] This was then followed by defamatory statements in *Forbes* by Henry I. Miller alleging fraud on the part of the study's author.[193] Miller, a molecular biologist and fierce opponent of the Farm to Fork Strategy[194], has since been exposed as a ghostwriter for Monsanto.[195] Furthermore, Monsanto has also been reported to have secretly funded glyphosate studies, which can lead to inaccurate

[188] BfR, "Assessment of the BfR concerning epidemiological studies on carcinogenic effects of glyphosate in the context of the EU active substance review", *BfR*, 2015 and EFSA, "Conclusion on the peer review of the pesticide risk assessment of the active substance glyphosate", EFSA Journal, 2015, Vol. 13, 4302.
[189] MCHENRY, L., "The Monsanto papers: Poisoning the scientific well*", International Journal of Risk & Safety in Medicine*, 2018, Vol. 29, 193-205.
[190] MCHENRY, L. "Of Sophists and Spin-Doctors: Industry-Sponsored Ghostwriting and the Crisis of Academic Medicine", *Mens Sana Monographs*, 2010, Vol. 8, 129-145.
[191] GILLAM, C., "How Monsanto manipulates journalists and academics", *The Guardian*, 2 June 2019, www.theguardian.com/commentisfree/2019/jun/02/monsanto-manipulates-journalists-academics
[192] MCHENRY, L., "The Monsanto papers: Poisoning the scientific well", *International Journal of Risk & Safety in Medicine*, 2018, Vol. 29, 193-205.
[193] Ibid.
[194] HEFFERON, K., MILLER, H., "The EU's 'Farm to Fork' Strategy Is Ill-Conceived and Destructive", *European Scientist*, 11 February 2021.
[195] HAKIM, D., "Monsanto emails raise issue of influencing research on Roundup weed killer", *New York Times*, 1 August 2017, Monsanto Emails Raise Issue of Influencing Research on Roundup Weed Killer – (The New York Times)

results due to funding bias.[196] It subsequently used these studies in the renewal process to prevent a ban on the chemical.[197] The EFSA responded to concerns raised by the Monsanto Papers with a statement in which it said to have only considered studies that followed the OECD's 'Good Laboratory Practices' in its glyphosate assessment.[198] However, a recent study by two researchers at the Institute of Cancer Research evaluated the scientific quality of the glyphosate studies that were submitted in the renewal process. This evaluation is based on the guidelines that were available in 2021, although the authors stress that almost all of these newer guidelines were already available at the time of the EFSA and BfR's assessments, in 2015.[199] According to the researchers, out of the 53 industry studies that were submitted, only two were in line with the OECD guidelines and could be considered reliable. Seventeen were partly reliable, which means that over half of the submitted studies, 34 to be precise, were not reliable.[200]

Thirdly, a 2019 report concluded that some chapters of the BfR's Renewal Assessment Report were heavily plagiarised from industry studies.[201] The BfR denied this allegation by explaining that it is standard practice to copy existing studies in such a report, as it is not up to the EFSA or Rapporteur Member State to conduct their own research.[202]

To conclude, the glyphosate renewal process had several shortcomings, regardless of whether glyphosate is in fact carcinogenic or not. The EFSA and BfR partially based their assessment on studies that were either secretly funded by the industry or did not meet a sufficient scientific standard. To be clear, these shortcomings are mostly an indictment against the workings of both agencies in this case, not against the approval process of Regulation No 1107/2009 itself. There are several provisions in this Regulation that require assessments to be independent, objective and transparent and data to meet a certain standard.[203]

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[196] CARRINGTON, D., "Revealed: Monsanto's secret funding for weedkiller studies", *The Guardian*, 12 March 2020 And CHOPRA, S., "Industry Funding of Clinical Trials: Benefit or Bias?" *JAMA*, 2003, Vol. 290, 113-114.
[197] Ibid.
[198] EFSA, "EFSA statement addressing stakeholder concern related to the EU assessment of glyphosate and the "Monsanto papers"", *EFSA*, 2017, www.efsa.europa.eu/sites/default/files/170523-efsa-statement-glyphosate.pdf
[199] NERSESYAN, A., KNASMUELLER, S., "Evaluation of the scientific quality of studies concerning genotoxic properties of glyphosate", *ICR,* 2021, Evaluation_scientific_quality_studies_genotoxic_glyphosate.pdf
[200] Ibid.
[201] WEBER, S. and BURTSCHER-SCHADEN, H., "Detailed Expert Report on Plagiarism and superordinated Copy Paste in the Renewal Assessment Report (RAR) on Glyphosate", *S&D, The Greens EFA, GUE/NGL*, 2019, Expertise-RAR-Glyphosat-2018-01-11-1.pdf (left.eu)
[202] BfR, "Glyphosate assessment: BfR rejects plagiarism accusations", *BfR*, 2017, Glyphosate assessment: BfR rejects plagiarism accusations - BfR (bund.de)
[203] Article 36, 1. and 8 *juncto* Annex II Regulation No 1107/2009.

Furthermore, the first article of the Regulation explicitly notes that its provisions are underpinned by the precautionary principle.[204] That being said, the fact that the industry does its own testing is often seen as a flaw, as are the lenient guidelines on objectivity and conflicts of interest.[205] Another weakness in the approval process is the fact that the EFSA only assesses the risk of the active substance and not its interaction with other ingredients of the PPP[206], as this is done on the level of member states, which only adds to the confusion.[207] In response to the REFIT evaluation of General Food Law and the ECI to ban glyphosate, the Commission adopted Regulation (EU) No 2019/1381 in an attempt to increase transparency.

1.2.1.3 Regulation (EU) No 2019/1381

Risk analysis as a principle in European food law was introduced by article 6 of the General Food Law Regulation, which also established the EFSA.[208] This Regulation, alongside several others on food law in general, including Regulation No 1107/2009, were amended by Regulation No 2019/1381. The main goals of these amendments is to increase transparency in the food chain process in its entirety, and promote the use of independent, objective studies. To give an example, article 8 of the General Food Law Regulation now includes a comprehensive section on risk communication and, more interestingly, a section was added to article 32.

According to article 32b of the General Food Law Regulation, the EFSA will establish a database in which studies used in the authorisation or renewal process that are commissioned or carried out by the industry will be included. Furthermore, before commissioning a study, the applicant and laboratory now have to notify the EFSA of the title and scope of the study and which laboratory will carry it out. If a study that has not been registered in this database is included in the application process, said process is invalid unless the

[204] Article 1, 4. Regulation No 1107/2009
[205] PAN, "PAN Europe's briefing on REFIT of PPP and MRL Regulations (EC No 1107/2009 and 396/2005)", *PAN*, 2020, Summary REFIT analysis BY PAN EUROPE (pan-europe.info)
[206] STORCK, V., KARPOUZAS, D., MARTIN-LAURENT, F., "Towards a better pesticide policy for the European Union", *Science of The Total Environment,* 2017, Vol. 575, 1027-1033.
[207] ROBINSON, C., PORTIER, C., ČAVOŠKI, A., MESNAGE, R., ROGER, A., CLAUSING, P., LYSSIMACHOU, A. "Achieving a High Level of Protection from Pesticides in Europe: Problems with the Current Risk Assessment Procedure and Solutions*." European Journal of Risk Regulation*, 2020, 451.
[208] Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety, *OJ* L 31, 1 February 2002, 1-24.

applicant can provide a valid reason for this failure to register.[209] The same applies to studies that have been registered but are not included in the application process.[210] This is to ensure that unfavourable studies are not held back by the industry and is thus a response to the criticism regarding data cherry-picking.[211] Finally, if there are "*exceptional circumstances of serious controversies or conflicting results*" the Commission can request the EFSA to conduct verification studies.[212]

The new Transparency Regulation also contains several provisions that are meant to increase both public access to documents and public participation in the approval process.[213] Rules regarding the confidentiality of information in the approval or renewal process have been updated to include a detailed description of the grounds on which such a request can be granted.[214] Information regarding these requests will also be made available to the public.[215]

To ensure the efficient and transparent collection and processing of documents, standard data formats and information systems are to be implemented in the application procedure.[216] Lastly, several articles of Regulation 1107/2009 were amended to reflect and include the changes of the General Food Law Regulation in the PPP approval process. For example, under article 7 and 14 of Regulation No 1107/2009 applicants now submit their applications in accordance with the standard data formats of article 39f of the General Food Law Regulation, and articles 16 and 63 now promote transparency in decisions of confidentiality.

Despite the changes the Transparency Regulation has brought about, several flaws in the pesticide approval process are not, or only partially, addressed. While the independence and transparency of studies have been greatly increased to reduce data cherry-picking by the industry, issues pertaining to the interpretation

[209] Article 32b, 4. Regulation (EC) No 178/2002.
[210] Article 32b, 5. Regulation (EC) No 178/2002.
[211] COJA, T., STEINWIDER, J., "The new European Transparency Regulation: a panacea for EU risk assessment?", *Journal of Consumer Protection and Food Safety*, 2022, Vol. 17, 1-3.
[212] article 32d, Regulation (EC) No 178/2002
[213] Article 32c of Regulation (EC) No 178/2002 was amended to include the consultation of stakeholders and the public in the risk assessment of a PPP.
[214] article 39a Regulation (EC) No 178/2002.
[215] article 39d Regulation (EC) No 178/2002.
[216] article 39f and 39g Regulation (EC) No 178/2002.

of said data still remain.[217] This is especially worrying as only two out of the eleven submitted studies in the pending glyphosate application are considered to be reliable.[218]

One of the controversies that sparked the glyphosate debate was the discrepancy between the assessment of the EFSA and that of the IARC on the carcinogenicity of glyphosate. This discrepancy can likely be attributed to the different formulations used in both assessments, as the EFSA purely looks at the active substance, i.e. glyphosate, while the IARC also includes glyphosate-based formulations.[219] The approval of active substances can give the impression that formulated products used in real-life situations, like Roundup, are not harmful to non-target organisms when in reality this has not been tested. It is still up to Member States to decide on the approval of these specific formulated products which has led to widely varied policies.[220]

Granted, the Transparency Regulation is a step in the right direction to create an impartial, transparent approval process for PPPs, but has not addressed all the shortcomings that came to light in the aftermath of the glyphosate renewal. Concerns regarding the objective interpretation of data were not adequately addressed, nor were formulated products included in the approval or renewal process.[221]

[217] CHATZOPOULOU, S., ERIKSSON, N., ERIKSSON, D., "Improving Risk Assessment in the European Food Safety Authority: Lessons From the European Medicines Agency", *Frontiers in Plant Science*, 2020, Vol. 11, 349.
[218] KNASMUELLER, S., NERSESYAN, A., "Evaluation of the scientific quality of new studies concerning the genotoxic properties of glyphosate submitted to the EU authorities by the Glyphosate Renewal Group in 2020", *ICR*, 2021.
[219] SZÉKÁCS, A., DARVAS, B., "RE-registration Challenges of Glyphosate in the European Union", *Frontiers in Environmental Science*, 2018, Vol. 6, 78.
[220] Luxembourg has banned all products containing glyphosate since 2020 while France, Belgium, Portugal, the Netherlands, Denmark and Spain have all restricted the sale of these products in one way or another - HESSLER, U., "What's driving Europe's stance on glyphosate", *DW*, 25 June 2020, www.dw.com/en/whats-driving-europes-stance-on-glyphosate/a-53924882
[221] MORVILLO, M., "Glyphosate Effect: Has the Glyphosate Controversy Affected the EU's Regulatory Epistemology?", *European Journal of Risk Regulation*, 2020, Vol. 11, 422-435.

1.3 Conclusion

The implementation of the pesticide reduction target of the Farm to Fork Strategy faces a multitude of obstacles that can be reduced to political and legal ones. These challenges are often intertwined, as stakeholders pressure policymakers into submission by using both carrot, i.e. providing financial and other support, and stick, i.e. forcing their hand by influencing public opinion. In Brussels, lobbying and corruption are often two sides of the same coin, the only difference being that one is legal while the other is not. Stringent legislation on the use and approval of pesticides is essential to meet the Farm to Fork targets. However, the renewal of approval of glyphosate and multiple neonicotinoids have highlighted that the quality of regulations is also determined by its implementation and application into practice. A lack of transparency in the decision-making process can give the impression of partiality and negligence, which ultimately hinders the effort to limit and reduce the negative effects of pesticides. The recently introduced Transparency Regulation alleviates some of these issues by further regulating the use of scientific studies in the approval process. Nevertheless, critics still fear that this Regulation will not adequately address the impartial and objective interpretation of these studies. Finally, the approval process only relates to active substances, and does not assess the impact of marketed plant protection products, which can lead to discrepancies on the member state level. To conclude, most challenges in harmonising the CAP and pesticide legislation with the Farm to Fork targets stem from undue influence from stakeholders, most notably the agricultural corporations, on policymakers. Recent changes to regulations on pesticides are a step in the right direction as they considerably increase transparency. Sadly, they do not fully alleviate existing shortcomings of the approval process, nor do they address issues with lobbying and corruption.

2 Implementation into law

The previous chapters might have given the impression that agricultural and environmental policymaking solely happens at the European level, but the reality is more nuanced. In this chapter I will therefore outline the role of both European institutions and member states in creating and enforcing these environmental and agricultural policies. With regards to the Farm to Fork Strategy, this duality in competences raises the question as to how its targets can be implemented into law.

2.1 Competences agricultural environmental policy in the European Union

It is becoming increasingly clear for scientists and policymakers that environmental and agricultural policy are inherently connected. At the European level, the division of these competences is demarcated by the principle of conferral of powers, meaning that "*powers which are not conferred to the Union by the Treaties are to remain with the member states*".[222] This means that the EU can only take action in a certain domains if members states have allowed it to, either explicitly or implicitly.[223] On top of that, EU institutions have to adhere to the subsidiarity and proportionality principles in using its competences.[224]

According to the subsidiarity principle, "*in areas which do not fall within its exclusive competence, the Union shall act only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States, either at central level or at regional and local level, but can rather, by reason of the scale or effects of the proposed action, be better achieved at Union level*"[225], whereas the proportionality principle notes that "*the content and form of Union action shall not exceed what is necessary to achieve the objectives of the Treaties*".[226] These principles apply to agricultural and environmental policy in particular, as both are shared competences.[227]

[222] GOVAERE, I., "To Give or to Grab: The Principle of Full, Crippled and Split Conferral of Powers Post-Lisbon", in CREMONA, M. (ed.) *Structural Principles in EU Exteral Relations Law*, Hart Publishing, 2018, 71-91.
[223] Article 5,2. TEU
[224] Article 5, 1. TEU
[225] article 5, 3. TEU and VAN HECKE, S., "The Principle of Subsidiarity: Ten Years of Application in the European Union", *Regional & Federal Studies*, 2003, Vol. 13, 55-80.
[226] Article 5, 4. TEU.
[227] article 4, 2, d) and e) TFEU

2.1.1 Environmental policy

With the Maastricht Treaty, environmental protection was officially made a EU policy in 1993 and has since then secured an increasingly central role in policymaking.[228] According to article 3, 3. TEU, the EU shall work towards a high level and quality of environmental protection, but what is more interesting is article 11 TFEU, which notes that environmental protection requirements should be integrated in all EU policy areas, including agriculture. This is also reflected in the principles set forth in the provisions of Title XX of the TFEU, such as the precautionary, preventative and polluter pays principles.[229]

In practice, the EU will often be competent to take measures relating to environmental protection because of the interdependent and transboundary character of ecosystems.[230] Member states, on the other hand, are tasked with the implementation and enforcement of these EU regulations. Some examples of this are the Habitats and Birds Directives, the Biodiversity Strategies, but also environmental policy integration in agriculture and the CAP in particular.

2.1.2 Agricultural policy

As mentioned, agriculture has long played a central role in the functioning of the EU. While it is a shared competence with member states, agriculture is extensively regulated on the European level. The EU is often better placed to ensure food security and, as article 38, 1. TFEU notes, because the internal market extends to agriculture and its products.[231] It does this in the CAP, whose objectives are formulated in article 39 TFEU, that despite the obligation to integrate sustainability primarily pursues social and economic gains.[232]

I have already explained that harmonising Farm to Fork with EU agricultural policy comes with several challenges.

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[228] EP, "Environment policy: general principles and basic framework", *Fact Sheets on the European Union*, 2021, www.europarl.europa.eu/ftu/pdf/en/FTU_2.5.1.pdf
[229] Article 191, 2. and 192, 5. TFEU
[230] AFFOLTER, S., "The Subsidiarity Principle in EU Environmental Law", *E-International Relations*, 26 March 2021, www.e-ir.info/2021/03/26/the-subsidiarity-principle-in-eu-environmental-law/
[231] See also article 26, 1. TFEU
[232] EP, "The common agricultural policy (CAP) and the Treaty", *Fact sheets on the European Union*, 2022, www.europarl.europa.eu/factsheets/en/sheet/103/the-common-agricultural-policy-cap-and-the-treaty

With the recent adoption of the new CAP it is particularly interesting to see how these challenges, i.e. influence of stakeholders and lack of transparency, have affected the environmental protection provisions of the policy. It is also of interest to see if and how Farm to Fork targets will be implemented in this new policy, both on the EU and member state level.

2.2 CAP 2023-2027

The new CAP will apply in the period between 2023 and 2027, and compared to the previous policies it brings several large changes. First of all, the new CAP aims to strengthen its social equality and labour protection mechanisms by introducing the redistribution of payments from large to smaller farms[233] and the coupling of payments to compliance with certain labour protection laws.[234] Additionally, it will aim to improve the efficiency and competitiveness of the EU food market by , *inter alia,* creating a financial reserve that can be used in the case of emergencies.[235]

A more interesting and long-awaited aspect of the CAP is its policy and ambitions regarding integrating environmental targets, especially since the previous CAP failed to meet its climate and biodiversity targets.[236] Much like its predecessors, it includes conditionality mechanisms that link payments to the compliance with the so called 'Statutory Managements Requirements' (hereafter: SMR), which include the Habitats Directive and Regulation 1107/2009, and 'Good Agricultural and Environmental Conditions' (hereafter: GAEC), which relate to the use of cover crops, crop rotation and maintenance of wetlands and permanent grasslands.[237]

[233] The previous CAP was not efficient in reducing income inequality among farmers, and in some areas even exacerbated it – GUTH, M., et al., "The Economic Sustainability of Farms under Common Agricultural Policy in the European Union Countries", *Agriculture*, 2020, Vol. 10, 34.
[234] Article 14 *juncto* Annex IV and article 29 Regulation (EU) 2021/2115 of the European Parliament and of the Council of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under the common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulations (EU) No 1305/2013 and (EU) No 1307/2013, *OJ* L 435, 6 December 2021, 1-186.
[235] European Commission, "Key reforms in the new CAP", *EC*, 2022, Key reforms in the new CAP (europa.eu)
[236] ECA, "Common Agricultural Policy and climate: Half of EU climate spending but farm emissions are not decreasing", *ECA Special report*, 2016, 16 and ECA, "Biodiversity on farmland: CAP contribution has not halted the decline", *ECA Special report*, 2020, 7.
[237] Article 12 *juncto* Annex III Regulation (EU) 2021/2115

Sadly, due to environmental and political developments[238], a majority of agriculture ministers pressured the EU to temporarily derogate from some of these standards.[239] Prior to this decision, farms of at least 10 hectares would have to devote a minimum share of 4 percent of land to non-productive features, as well as rotate its crops by 2023.[240] With the derogation in place, member states can lower these requirements during the year 2023, allowing farmers to produce crops as a way to ensure global food security.[241] Postponing green measures by another year will inevitably affect the feasibility of the Farm to Fork targets. It is therefore criticised by environmental organisations, especially since these green measures themselves are already underwhelming.[242,243]

2.2.1 Eco-schemes

A novel instrument that goes one step further than compliance, and instead stimulates farmers to voluntarily employ green methods, is eco-schemes. As a general rule, at least 25 percent of the Pillar I budget has to be allocated to these schemes, meaning they will become a central part of EU agri-environmental policy.[244] While eco-schemes do not impose legal obligations on farmers, they are still worth mentioning with regards to meeting Farm to Fork targets. According to article 31 of Regulation (EU) 2021/2115, member states are required to list agricultural practices that are eligible for financial support. These practices have to include at least two of the areas mentioned in the fourth paragraph of article 31, many of which directly relate to reducing agricultural inputs and promoting biodiversity.[245]

[238] Including the Russian invasion of Ukraine and record droughts in EU several member states, both of which are discussed in the chapter on food security.
[239] FOOTE, N., "Member states push to further loosen CAP environmental measures for 2023", *Euractiv*, 20 July 2022, Member states push to further loosen CAP environmental measures for 2023 – EURACTIV.com
[240] Article 12 *juncto* Annex III Regulation (EU) 2021/2115
[241] Crops typically used for animal consumption, including soy beans and maize, are excluded from the derogation - Commission Implementing Regulation (EU) 2022/1317 of 27 July 2022 providing for derogations from Regulation (EU) 2021/2115 of the European Parliament and of the Council as regards the application of the standards for good agricultural and environmental conditions of land (GAEC standards) 7 and 8 for claim year 2023, *OJ L* 199, 28 July 2022, 1-4.
[242] ASIN, E., "Derogations to CAP conditionality in 2023 are unacceptable", *BeeLife*, 2022, Derogations to CAP conditionality in 2023 are unacceptable (bee-life.eu)
[243] NEMCOVÁ, T., DHASKALI, M., CAIATI, S., CORRAL, E., "Pesticides in the new CAP: business as usual puts nature and human health at risk", *BirdLife Europe* and *EEB*, 2022, EEB-BirdLife-Briefing-Pesticides-July-2022.pdf
[244] Article 97 *juncto* Annex IX Regulation (EU) 2021/2115
[245] Some examples are reducing pesticide and fertiliser use, climate change mitigation and preventing soil degradation – Article 31, 4., (a), (d), (e), (f) Regulation (EU) 2021/2115.

Additionally, the Commission has published a list of specific practices that could be supported by this mechanism, including IPM and conversion and maintenance of organic farming.[246]

Eco-schemes provide certain opportunities as they complement the minimal protection of the SMR and GAEC by incentivising farmers to take additional environmental protection measures and by compensating them for potential losses. More importantly, they provide member states with a broad level of flexibility. The Regulation provides a framework but it is ultimately up to member states to decide which areas and practices are eligible for financial support, as they are often more qualified to respond to local and regional needs.

However, this flexibility is also a major vulnerability for effective environmental policy. Since member states can decide which areas and practices are eligible for support in their strategic plans, there is the risk that certain activities are excluded, even if these practices promote the CAP's environmental objectives.[247] On top of that, eco-schemes are a voluntary instrument, and while they provide incentives, there is no obligation for farmers to take advantage of them. Finally, it can be seen as a short term solution to a long term problem because the support they provide takes the form of an annual payment instead of long-term commitments.[248]

2.2.2 Agri-environmental and climate schemes

A similar mechanism are the agri-environmental and climate schemes (hereafter: AECS) of Pillar II. Contrary to the eco-schemes, these are not a novel instrument of the CAP but have been around for several decades, although there have been made a few changes with the new CAP. Under the AECS mechanism, farmers can also receive payments for environmental practices that go beyond the minimal requirements of, *inter alia*, the SMR and GAEC.[249] That being said, there are also differences with eco-schemes. The AECS commitments are undertaken for a period stretching several years[250], and payments are allocated via a granting procedure, meaning farmers are not entitled to aid if they meet the eligibility criteria, as is the case with

[246] Directorate-General for Agriculture and Rural Development, "List of potential agricultural practices that eco-schemes could support", *EC*, 2021, Commission publishes list of potential eco-schemes (europa.eu)
[247] MEREDITH, S., HART, K., "CAP 2021-27: Using the eco-scheme to maximise environmental and climate benefits", *IEEP*, 2019, (PDF) CAP 2021-27: (Using the eco-scheme to maximise environmental and climate benefits)
[248] Article 31, 7. Regulation (EU) 2021/2115.
[249] Article 70, 3. Regulation (EU) 2021/2115.
[250] article 70, 6. Regulation (EU) 2021/2115.

eco-schemes.[251] It is also worth noting that farmers will not receive payments for practices and commitments that already fall under the eco-schemes.[252] With the new CAP, at least 35 percent of the Pillar II funds have to be reserved for AECS, which is an increase of 5 percent compared to the previous CAP.[253] Again, the efficacy of this mechanism will depend on how member states choose to implement it, which brings me to the national CAP strategic plans.

2.2.3 CAP Strategic Plans

The most notable change the new CAP brings is undoubtably the national CAP strategic plan (hereafter: CSP) that allows member states more freedom and flexibility regarding the allocation of their respective CAP budgets. The EU now provides a framework under which member states can prioritise certain objectives of the CAP to a certain degree. As mentioned, the conditionality mechanism links payments with several minimal requirements from which member states cannot deviate, although it is still up to them to implement this mechanism, as well as set up an administrative penalty system in their CSP.[254] Additionally, these plans have to include several elements, listed in article 107 of Regulation 2021/2115, including an assessment of needs for each of the CAP objectives at the national and regional levels, the intervention strategy for each of these objectives, an overview of how the conditionality mechanism will be implemented, the eligibility conditions for eco-schemes and AECS payments as well as an analysis of how these interventions will contribute to reaching the CAP and Farm to Fork and Biodiversity Strategy objectives.

As per article 118 of Regulation 2021/2115, every member state had to submit their draft CSP by 1 January 2022 for approval from the Commission. Already in October of 2021 several member states signalled that they would not make this deadline due to the complexity of these plans.[255] Nine member states would end up submitting their drafts after January 1st, including Germany and Belgium.[256] Once the Commission

[251] RUNGE, T., "Implementation of Eco-schemes in Fifteen European Union Member States", *EuroChoices*, 2022, onlinelibrary.wiley.com/doi/full/10.1111/1746-692X.12352
[252] Article 70, 3, (d) Regulation (EU) 2021/2115.
[253] NÈGRE, F., "Second pillar of the CAP: rural development policy", *Fact Sheets on the European Union*, 2022, www.europarl.europa.eu/ftu/pdf/en/FTU_3.2.6.pdf
[254] Article 12, 1. And 2. Regulation (EU) 2021/2115
[255] FORTUNA, G., FOOTE, N., "EU member states struggling with tight deadline for 'CAP strategic plans", *Euractiv*, 14 October 2021, EU member states struggling with tight deadline for 'CAP strategic plans' – EURACTIV.com
[256] DAHM, J., PISTORIUS, M., FOOTE, N., "Nine member states including Germany missed first CAP deadline", *Euractiv*, 3 February 2022, Nine member states including Germany missed first CAP deadline – EURACTIV.com

received the proposal of each member state, it assesses them regarding their "*completeness, its consistency and coherence with the general principles of Union law, with this Regulation and the delegated and implementing acts adopted pursuant to it and with Regulation (EU) 2021/2115, its effective contribution to the achievement of the specific objectives set out in Article 6(1) and (2) and its impact on the proper functioning of the internal market and distortion of competition and on the level of administrative burden on beneficiaries and administration*"[257], as well as their contributions to the Farm to Fork and Biodiversity Strategies.[258] If the Commission believes a proposal to lack certain aspects, such as ambition, it can share its findings and request changes so the member state in question can address these shortcomings.[259] The failure to respond to this request could in theory lead to the rejection of the CSP by the Commission but the EU Commissioner for Agriculture, Janusz Wojciechowski, has indicated that this is "*unimaginable*".[260] Additionally, even if the Commission were to reject a CSP, it would only be able to do so based on legally binding acts, which the Farm to Fork and Biodiversity Strategies are not.[261]

It is worth noting that the Commission also considers the contributions of the CSP towards achieving the targets on climate change. It does this based on the provisions of article 100 of Regulation 2021/2115, according to which 100 percent of eco-schemes and AECS payments, 40 percent of expenditure for article 71 areas and 40 percent of basic income and complementary income support contribute to these climate targets. This may seem like the CAP contributes significantly to the EU climate objectives, but its efficacy will again depend on how it is implemented.

For reference, the ECA recently found that between 2014 and 2020, the EU grossly overstated its climate spending.[262] Instead of the reported 20 percent of its budget in this period, or 216 billion euros, it only spent around 13 percent on climate action.[263] This means the EU climate objectives were underfunded by 72 billion euros, of which 80 percent could be attributed to agriculture.[264]

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[257] Article 118, 2. Regulation (EU) 2021/2115.
[258] Recital 122 Preamble Regulation (EU) 2021/2115
[259] Article 118, 3. Regulation (EU) 2021/2115
[260] FOOTE, N., "Commissioner: Rejecting CAP plans on basis of Green Deal alignment 'unimaginable'", *Euractiv*, 1 July 2021, Commissioner: Rejecting CAP plans on basis of Green Deal alignment 'unimaginable' – EURACTIV.com
[261] Article 118, 4. Regulation (EU) 2021/2115
[262] SIMON, F., "EU spending on climate action 'overstated by €72 billion, auditors say", *Euractiv*, 30 May 2022, EU spending on climate action 'overstated' by €72 billion, auditors say – EURACTIV.com
[263] ECA, "Climate spending in the 2014-2020 EU budget: Not as high as reported", *ECA Special report,* 2022, 9, Special report 09/2022 - Climate spending in the 2014-2020 EU budget - Not as high as reported (europa.eu)
[264] *Ibid.*

What is even more worrying is that despite the 100 billion euros of CAP funds that were reportedly used for climate objectives, GHG emissions from the agriculture industry did not decrease.[265] These emissions also have repercussions for several Farm to Fork targets, including pesticide use. Climate change promotes pesticide resistance in pest populations and negatively affects crop yields.[266, 267] It goes to show that the sustainability of CAP measures have often been oversold, but also warns us to be wary of accepting the claims of member states regarding their implementation at face value. In that regard it is interesting to take a look at one of these proposed CSPs to assess its contributions to sustainable farming targets, in particular those of the Farm to Fork Strategy. I have chosen Flanders as an example, not only because it is my home region, but also because its CSP has been criticised by environmental organisations, as well as by the Commission.[268]

2.3 Agricultural Policy in Flanders

Unlike other EU member states, Belgium does not have one national, but two regional CSPs, one for Wallonia and another for Flanders. This somewhat odd arrangement reflects the Belgian division of powers, as agriculture is a regional competence.[269] An in-depth overview of the political and legal procedure for establishing the Flemish CSP goes beyond the scope of this chapter, but instead the focus will be on the contents of the plan itself, in particular pesticide use, as a way of highlighting the importance of ambitious implementation of CAP measures.

In this regard, a particularly interesting part of the CSP Flanders submitted is the chapter on its consistency and contributions to the Farm to Fork and Biodiversity Strategies. On the surface, it looks at least somewhat promising but a closer look reveals that this perception is somewhat misleading. First of all, the Flemish

[265] ECA, "Common Agricultural Policy and climate: Half of EU climate spending but farm emissions are not decreasing", *ECA Special report*, 2021, 16, Special Report 16/2021: (Common Agricultural Policy (CAP) and climate)
[266] MA, C-S., et al., "Climate warming promotes pesticide resistance through expanding overwintering range of a global pest", *Nature Communications*, 2021, Vol. 12, 5351.
[267] CHALLINOR, A.J., et al., "A meta-analysis of crop yield under climate change and adaptation", *Nature Climate Change*, 2014, Vol. 4, 287-291.
[268] MAES, I., "Na vernietigende kritiek op Vlaams landbouwbeleid: alle alarmbellen moeten afgaan bij Brouns en Demir", *Bond Beter Leefmilieu*, 15 June 2022, Bond Beter Leefmilieu
[269] Article 6, V, 1° BWHI juncto 39 GW

government did not include quantitative data in its assessment, meaning its concrete contributions to i.a. Farm to Fork targets remain vague.[270]

For example, it noted that there has been a sharp increase in farmers and farmland that make the switch to organic agriculture, a trend which will be continued under the new CAP.[271] What it failed to mention is that the current share of organic farmland is only 1.5 percent[272], which is expected to increase to only 1.77 percent by 2027 with the proposed CSP.[273] In other words, insultingly low and nowhere near the EU-wide 25 percent target the Commission had set forth.

Unsurprisingly, the same is true for meeting the targets on reducing pesticides. The CSP states that Flanders will continue to promote and invest in alternative methods that reduce pesticide use and its risks. However, with the exception of a few eco-schemes and AECS[274], it does not provide any quantitative information on if and how much these measures will contribute to the Farm to Fork targets. In its observation letter, the Commission implored Flanders to take further action to reduce pesticide use in agriculture, as its current plan lacks ambition, as well as clarity.[275] It echoed these remarks regarding Flanders' ambitions to reduce nutrient losses from fertilisers.[276] The CSP does indicate that its measures are likely to prevent an input of 35.000 tonnes of nitrogen by 2027 but it provides little evidence to support this, nor does it indicate how this contributes to the Farm to Fork targets.

Without any quantitative data it is impossible to assess to what extent the Flanders CSP is in line with the Farm to Fork and Biodiversity Strategies. Sadly, this lack of clarity and transparency does not appear to be a design flaw, but a feature of a plan that rejects the much needed sustainable transition. Flemish minister of agriculture Jo Brouns, a Christian Democrat with ties to the agriculture industry[277], has already indicated

[270] Departement Landbouw & Visserij, "Ontwerp Vlaams GLB Strategisch Plan 2023-2027 versie ingediend bij de Europese Commissie op 11 maart 2022", *DL&V*, 11 March 2022, glb_strategisch_plan_vlaanderen_v20220311.pdf
[271] Between 2006 and 2020 the area of organic farmland has increased by 180 percent – *Ibid.*
[272] TIMMERMANS, I., VAN BELLEGEM, L., "De biologische landbouw in 2021", *DL&V*, 2022, De biologische landbouw in 2021 | Landbouw & Visserij (vlaanderen.be)
[273] IFOAM, "Evaluation of support for organic farming in draft CAP Strategic Plans (2023-2027), *IFOAM Organics Europe*, 2022, IFOAMEU_CAP_SP_feedback_20220303_final.pdf (organicseurope.bio)
[274] According to indicator R. 24, 5.36 percent of Flemish farmland will be committed to the sustainable use of pesticides.
[275] European Commission, "Observations on the CAP Strategic Plan submitted by Belgium (Flanders)", *EC*, 2022, agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/obervation-letters_en
[276] *Ibid.*
[277] ANDRIES, S., "Boerenbond zul je niet horen klagen over nieuwe minister van Landbouw", *De Standaard*, 18 May 2022, www.standaard.be/cnt/dmf20220517_97332826 and ANDRIES, S., "CD&V en de Boerenbond, oude bondgenoten in een nieuwe wereld", *De Standaard*, 13 March 2021, www.standaard.be/cnt/dmf20210313_96975553

that amending the proposal is out of the question, and that the Commission should abandon its hopes for a quantitative analysis already.[278]

When it comes to the environmental aspect of agriculture, Regulation 2021/2115 sets a relatively low bar regarding its required minimal protections, but it left the door open for member states to include additional and ambitious measures in their national Strategic Plans so they could still meet the Farm to Fork targets. Flanders has not taken this opportunity and has instead put forth a vague CSP that lacks substantive measures. It is therefore an example of how the new CAP will ultimately fall short in ensuring a swift transition to sustainable agriculture.[279]

2.4 Sustainable Use of Plant-Protection Products Regulation

As part of the effort to reduce pesticides, the Farm to Fork Strategy makes mention of the need to revise the SUD.[280] With its introduction in 2009, this Directive, which is included in the CAP conditionality mechanism[281], aimed to "*establish a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides*".[282] To implement the Directive, member states had to draw up National Action Plans (hereafter: NAP) in which they indicated which measures they would take to achieve these goals.[283] These measures range from promoting safe usage of pesticides, to limiting and prohibiting their use in certain areas.[284] Additionally, member states had to set up a monitoring system to track trends in pesticide sales.[285]

The implementation of the SUD into national law got off to a slow start and is characterised by delays. Nearly two thirds of the member states submitted their NAPs past the deadline, which ultimately caused

[278] WINCKELMANS, W., "Vlaams minister van Landbouw wil beleid 'duiden', niet aanscherpen", *De Standaard*, 17 June 2022, www.standaard.be/cnt/dmf20220616_97830378
[279] Additionally, the majority of member states fail to adequately address environmental targets in their CSPs – CAIATI, S., NEMCOVÁ, T., "CAP Strategic Plans - are they likely to deliver on given promises?", *Birdlife Europe* and *EEB*, 2022, eeb.org/library/cap-strategic-plans-are-they-likely-to-deliver-on-given-promises/
[280] European Commission, "Farm to Fork Strategy", 2020.
[281] Article 12 *juncto* Annex III Regulation (EU) 2021/2115.
[282] Article 1 Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides, *OJ* L 309, 24 November 2009, 71-86.
[283] Article 4, 1. SUD
[284] Article 7 and 12 SUD.
[285] Article 15 SUD.

the Commission's report to be delayed by three years.[286] On top of that, the ECA found that the implementation and enforcement of the Directive, and especially the IPM rules, could be improved in several member states.[287] It is worth nothing that the SUD is included in the conditionality mechanism of the new CAP but it is questionable if this will increase compliancy with the Directive. This mechanism imposes administrative fines on farmers that violate these rules but it does not prohibit payments, nor does it fix the underlying issues of enforcement at the national level.

To respond to these shortcomings, as well as increase the chance of success for the Farm to Fork pesticide targets, the Commission published a proposal for a Sustainable Use of Plant-Protection Products Regulation (hereafter: SUR) after some delays on June 22nd 2022.[288] It notes in its proposal that it opted for a Regulation because the often transnational character of ecosystems requires strong action at the EU level, instead of inconsistent measures at the national level.[289] The SUR, which would replace the SUD, would set legally binding targets in line with those of Farm to Fork, including a reduction of synthetic pesticide use and risk by at least 50 percent in the EU by 2030.[290] Member states would be allowed to set lower targets in their NAPs, with a minimum of 35 percent, if their weighted intensity of use and risk of pesticides is lower than the EU average.[291] Much like CSPs, national targets would be reviewed by the Commission to ensure the EU-wide targets are met.[292]

According to the SUR, member states would have to draft a new NAP that includes the national reduction targets as well as information as to how it will be achieved, planned measures that support non-chemical methods and the link to relevant CSP measures that promote organic agriculture.[293] The SUR would also further regulate the use of synthetic pesticides in sensitive areas to reduce health and environmental risks.[294]

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[286] European Commission, "Report from the Commission to the European Parliament and the Council On the experience gained by Member States on the implementation of national targets established in their National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides", *EC*, 2020, food.ec.europa.eu/system/files/2020-05/pesticides_sud_report-act_2020_en.pdf
[287] ECA, "Sustainable use of plant protection products: limited progress in measuring and reducing risks", *ECA Special Report*, 2020, 5, www.eca.europa.eu/Lists/ECADocuments/SR20_05/SR_Pesticides_EN.pdf
[288] Proposal of the European Commission for a Regulation of the European Parliament and of the Council on the sustainable use of plant protection products and amending Regulation (EU) 2021/2115, *COM(2022)305*, 22 June 2022
[289] *Ibid.*
[290] Article 4, 1. SUR.
[291] Article 5 SUR.
[292] Article 6 SUR.
[293] Article 8, 1. SUR.
[294] Article 18 and 19 SUR.

2.5 Conclusion

Implementing Farm to Fork targets into law has proven to be a long and tedious process in which the Commission and member states do not always see eye to eye. Under the new CAP, which is a driving force in shaping EU agri-environmental policy, and the framework it provided, member states were given more flexibility and freedom to allocate parts of their budgets in their Strategic Plans. By introducing eco-schemes and fine-tuning AECS, sustainable farming practices, such as rotating crops and reducing pesticide use, are incentivised. At the same time, the CAP framework imposes certain minimal requirements regarding budget allocation to ensure a certain percentage of funding is used for green measures. These requirements set a fairly low bar for environmental protection but allow for member states to take additional, ambitious measures. In reality, the majority of Strategic Plans lack this ambition which severely jeopardises the feasibility of meeting the Farm to Fork targets by 2030.

To overcome this obstacle, the Commission made good on its promise to overhaul the SUD by introducing a proposal for a Regulation that would make the Farm to Fork pesticide reduction targets legally binding. Member states would have to set national reduction targets that contribute to an EU-wide reduction in the use and risks of pesticides by 50 percent by 2030. If this proposal were to be implemented into EU law, member states would have to rely on their CSPs to compensate farmers and to cover the costs of this transition. To conclude, the SUR would implement the Farm to Fork pesticide reduction into law, but its success would largely depend on environmentally ambitious national CAP Strategic Plans.

3 Food security

One of the main concerns about the Farm to Fork Strategy is the possible decline in agricultural output resulting in food insecurity.[295] It is a narrative that has gained traction, and while it is mainly being pushed by the agriculture industry to undermine the implementation of Farm to Fork targets into EU law, it should not be dismissed out of hand.[296]

3.1 Globalisation

In recent decades, globalisation has greatly increased the complexity of food production systems, as the food supply of nations became interconnected. This transnational agricultural system allowed for a greater variety in available food and promoted the movement of goods and technology .[297] Much like specialisation, for certain crops globalisation has led to the concentration of production in certain countries, which is mainly determined by the available production factors.[298] To give a few examples, 80 percent of the global almond supply comes from just a handful of counties in California[299], Brazil and the US combined produce 70 percent of all soy[300], and 84 percent of all palm oil comes from Indonesia and Malaysia.[301] This is reflected in the increase in global food trade, as states become more and more dependent on food imports and exports.[302] In the EU, the bulk of imports and exports happens between member states, although trade with third countries is becoming increasingly important.[303]

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[295] BECKMAN, J., IVANIC, M., JELLIFFE, J., BAQUEDANO, F., SCOTT, S., "Economic and Food Security Impacts of Agricultural Input Reduction Under the European Union Green Deal's Farm to Fork and Biodiversity Strategies", *Economic Research Service*, 2020, Vol. 30.

[296] SHANKAR, P., WIN, T., HEKMAN, L., "Exposed: How big farm lobbies undermine EU's green agriculture plan", *DW*, 19 October 2021, Exposed: How big farm lobbies undermine EU's green agriculture plan | Europe | News and current affairs from around the continent | DW | 19.10.2021

[297] BLACK, E., "Globalization of the Food Industry: Transnational Food Corporations, the Spread of Processed Food, and their Implications for Food Security and Nutrition", *SIT Digital Collections,* 2016.

[298] CAMPI, M., DUEÑAS, M., FAGIOLO, G., "How do countries specialize in agricultural production? A complex network analysis of the global agricultural product space", *Environmental Research Letters*, 2020, Vol. 15, 124006.

[299] Almond Board of California "2020 Almond Almanac", *California almonds*, 2020, 2020 (Almond Almanac)

[300] RITCHIE, H., ROSER, M., "Forests and Deforestation", *Our World In Data*, 2021, ourworldindata.org/soy

[301] *Ibid.*

[302] PUMA, M., BOSE, S., CHON, S.Y., COOK, B., "Assessing the evolving fragility of the global food system", *Environmental Research Letters*, 2015, Vol. 10, 024007.

[303] Eurostat, "Extra-EU trade in agricultural goods", *Eurostat*, 2022, Extra-EU trade in agricultural goods - Statistics Explained (europa.eu)

While the globalised food system has had several benefits, mostly socio-economic ones, it also puts global food security at risk. In general, it leads to a more robust system, as a decline in agricultural output due to a shock to the food system of one nation, such as floods or hurricanes, can simply be absorbed by the surplus in output of another nation.[304] However, and this is increasingly becoming an issue, this current system is vulnerable to systemic shocks that affect multiple nations at once.[305] The Covid-19 pandemic has highlighted the fragility of the food supply chains as it introduced stresses on multiple levels, including labour, processing, transport and most notably demand, as consumers started panic buying.[306] This has resulted in an increase of people suffering from hunger, as well over 10 percent of the world population currently lives in severe food insecurity.[307]

Despite the profound impact of the pandemic on food systems, there are much greater threats to global food security which are not often taken into the equation when evaluating Farm to Fork. As indicated in the first part of this work, climate change and biodiversity loss are, at least in part, caused by agriculture, and they both jeopardise food security. It is therefore relevant to first discuss what food security entails in the EU and how it could be threatened if Farm to Fork were not implemented, after which the short-term risks of the Strategy and its response will be covered.

3.2 Food security in the EU

Food security as a concept has had many different meanings, ranging from self-sufficiency in food production of states to the availability of food at the global, local or household level.[308] Since the FAO World Food Summit in 1996 where a consensus was reached on an internationally agreed definition, food security is understood to exist "*when all people, at all times, have physical and economic access to sufficient, safe*

[304] O'KANE, G., "What is the real cost of our food? Implications for the environment, society and public health", *Public Health Nutrition*, 2011, Vol. 15, 268-276.
[305] HAMMILTON, H., et al, "Exploring global food systems shocks, scenarios and outcomes", *Futures*, 2020, Vol. 123, 102601.
[306] OECD, "COVID-19 and food systems: Short- and long-term impacts", *OECD Food, Agriculture and Fisheries Papers,* Vol. 166 and SIM, K., CHUA, H.C., VIETA, E., FERNANDEZ, G., "The anatomy of panic buying related to the current COVID-19 pandemic", *Psychiatry Research*, 2020, Vol. 288, 113015.
[307] United Nations, "The Sustainable Development Goals Report 2021", *United Nations publications*, 2021, The Sustainable Development Goals (SDGs), 2021 | United Nations
[308] PINSTRUP-ANDERSEN, P., "Food security: definition and measurement", *Food Security*, 2009, Vol. 1, 5-7.

and nutritious food to meet their dietary needs and food preferences for an active and healthy life"[309] and is considered to be a human right.[310]

Paradoxically, this means that food insecurity does not necessarily equate to experiencing hunger or a lack of food. In fact, in developed nations there is a correlation between food insecurity and obesity in adults.[311] While this is a phenomenon that is poorly understood, there are several hypotheses that could explain it, some of which are also addressed in the Farm to Fork Strategy. Firstly, people living in poverty are more likely to consume low cost, energy-dense foods such as snacks and fast foods to meet their dietary needs.[312] This is paired with a decrease in expensive foods with a low energy-density, such as fruit and vegetables.[313] Secondly, financial stress can lead to an increase in food intake, as can the perception of food scarcity.[314] An increase in energy-dense food intake is associated with obesity and a decrease in food quality, which can eventually lead to food insecurity.[315]

The social and economic cost of poor eating habits can hardly be overstated. Obesity increases the risk of depression[316], cancer[317], heart diseases and diabetes.[318] In the EU, obesity is responsible for over 8 percent of the total healthcare expenditure and reduces GDP by over 3 percent on average, something to consider when assessing the impact of Farm to Fork.[319]

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[309] FAO, "Rome Declaration on World Food Security and World Food Summit Plan of Action : World Food Summit", 1996.
[310] OHCHR, "The Right to Adequate Food", *United Nations*, 2010, FactSheet34en.pdf (ohchr.org)
[311] DINOUR, L., DARA, B., YEH, M-C., "The Food Insecurity-Obesity Paradox: A Review of the Literature and the Role Food Stamps May Play", *Journal of the American Dietetic Association*, 2007, Vol. 107, 1952-1961, and MORADI, S., et al., "Food insecurity and adult weight abnormality risk: a systematic review and meta-analysis", *European Journal of Nutrition*, 2019, Vol. 58, 45-61.
[312] DREWNOWSKI, A., SPECTER, SE., "Poverty and obesity: the role of energy density and energy costs", *The American Journal of Clinical Nutrition,* 2004, Vol. 79, 6-16.
[313] KENDALL, A., OLSON, C., FRONGILLO, E., "Relationship of hunger and food insecurity to food availability and consumption", *Journal of the American Dietetic Association*, 1996, Vol. 96, 1019-1024.
[314] DHURANDHAR, E., "The food-insecurity obesity paradox: A resource scarcity hypothesis", *Physiology & Behavior*, 2016, Vol. 162, 88-92.
[315] DREWNOWSKI, A., SPECTER, SE., "Poverty and obesity: the role of energy density and energy costs", *The American Journal of Clinical Nutrition,* 2004, Vol. 79, 6-16.
[316] DA LUZ, F., HAY, P., TOUYZ, S., SAINSBURY, A., "Obesity with Comorbid Eating Disorders: Associated Health Risks and Treatment Approaches", *nutrients*, 2018, Vol. 10, 829.
[317] DEHAL, A., et al, "Body mass index and death rate of colorectal cancer among a national cohort of U.S. adults", *Nutrition and Cancer*, 2011, Vol. 63, 1218-1225.
[318] ECKEL, R., KRAUSS, R., "American Heart Association Call to Action: Obesity as a Major Risk Factor for Coronary Heart Disease" *AHA*, Vol. 97, 2099-2100.
[319] VUIK, S., et al, "Heavy Burden of Obesity: The Economics of Prevention, A quick guide for policy makers", Paris, OECD Publishing, 2019, Heavy-burden-of-obesity-Policy-Brief-2019.pdf (oecd.org)

In addition to a lack of access to adequate and healthy food, undernutrition is also a form of food insecurity. This occurs when a person does not have a sufficient intake of energy to meet their needs to remain in good health.[320] In 2020, 9.9 percent of the world population, 768 million people, suffered from undernourishment.[321] Because this number is much lower in the EU, at 2.5 percent of its population, and has been declining in recent years, undernutrition is seen as less of an issue compared to malnutrition.[322] Obesity on the other hand, is much more prevalent and has only been increasing, as half of all EU citizens are overweight, and 15 percent are considered to be obese.[323]

Consequently, the biggest part of ensuring food security in the EU is providing access to adequate, affordable healthy foods. Obesity numbers indicate that there are still shortcomings in this regard, as fruits and vegetables are not sufficiently available in some regions of the Union.[324]

3.3 Manufactured scarcity

There are many factors that have an effect on the degree of food security in a society, including agricultural inputs, climate, but also how outputs are being utilised. Two areas are particularly interesting, namely meat production and food waste, as both have an impact on pesticide use in the EU and even in third countries. As food is wasted, so are the agricultural inputs that were used to produce it, including fertiliser, water and pesticides.[325] Factory farming on the other hand, also leads to a general increase in pesticide use for several reasons, including the inefficient conversion of feed to meat.[326] Furthermore, they lead to a decrease in available food and are therefore detrimental to food security.

[320] MALETA, K., "Undernutrition", *Malawi Medical Journal*, 2006, Vol. 18, 189-205.
[321] FAO, "Europe and Central Asia – Regional Overview of Food Security and Nutrition 2021: Statistics and trends", Budapest, 2021, Europe and Central Asia – Regional Overview of Food Security and Nutrition 2021 (fao.org)
[322] GROSSO, G., MATEO, A., RANGELOV, N., BUZETI, T., BIRT, C., "Nutrition in the context of the Sustainable Development Goals", *European Journal of Public Health,* 2020, Vol. 30, i19-i23.
[323] Eurostat, "Body mass index (BMI) by sex, age and country of citizenship", *Eurostat,* 2021, Statistics | Eurostat (europa.eu)
[324] COCKX, L., FRANCKEN, N., PIETERS, H., "Food and nutrition security in the European Union: Overview and case studies", *Foodsecure*, 2015, Vol. 31.
[325] CONRAD, Z., NILES, M., NEHER, D., ROY, E. , TICHENOR, N., JAHNS, L., "Relationship between food waste, diet quality, and environmental sustainability", *PLoS ONE*, 2018, Vol. 13, 4.
[326] RÖÖS, E., SUNDBERG, C., TIDAKER, P., STRID, I., HANSSON, P-A., "Can carbon footprint serve as an indicator of the environmental impact of meat production?", *Ecological Indicators*, 2013, Vol. 24, 573-581.

3.3.1 Food loss and waste

Because of its ethical, economic and environmental implications, addressing food waste and loss is considered to be key in transitioning to a sustainable society.[327] Since its inclusion in 2015 in the Sustainable Development Goals, or SDGs, the global issue of food waste has received an increase in attention.[328] The UN set forth the goal in SDG 12.3 to halve food waste by 2030 on the retail and consumer levels while also reducing food loss at the supply and production level, a target that is also endorsed in the Farm to Fork Strategy and the Circular Economy Action Plan.

According to the FAO, around 14 percent of all food is lost in the production process and supply chain, mostly due to climate, a lack of proper storage and inadequate harvesting and handling techniques.[329] An additional 17 percent is wasted at the retail and consumer level, most of which can be attributed to households.[330] This means that roughly a third of all food is lost throughout the food chain, including the agricultural inputs needed to produce it. Naturally, not all food loss and waste can and should be prevented, but through policy and legislation a significant amount of this food could be saved.[331, 332, 333]

In the European Union, it is estimated that 88 million tonnes of food are lost or wasted, which accounts for roughly 20 percent of all food produced within the Union.[334] Although in recent years, this number has been called into question as it supposedly does not take into account all food that is lost in the production chain, it is still indicative of the significance of food waste and loss in the EU.[335] Addressing it would therefore go a long way in reducing food insecurity.

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[327] European Commission, "Farm to Fork Strategy", 2020.
[328] See SDG 12.3 - United Nations, "The Sustainable Development Goals Report 2021", *United Nations publications*, 2021, The-Sustainable-Development-Goals-Report-2021.pdf (un.org)
[329] FAO, "The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction", Rome, FAO, 2019, www.fao.org/3/ca6030en/ca6030en.pdf
[330] UNEP, "Food Waste Index Report 2021", Nairobi, UNEP, 2021, www.unep.org/resources/report/unep-food-waste-index-report-2021
[331] Some food waste is linked to food safety - KASZA, G., SZABO-BODI, B., LAKNER, Z., IZSO, T., "Balancing the desire to decrease food waste with requirements of food safety", *Trends in Food Science & Technology*, 2019, Vol. 84, 74-76.
[332] An example of such legislation are Good Samaritan laws which makes it easier for food producers and retailers to donate excess foods to the needy through e.g. food banks.
[333] LIPINSKI, B., et al, "Reducing Food Loss And Waste", *World Resources Institute* and *UNEP*, 2013, reducing_food_loss_and_waste.(org)
[334] STENMARCK, A., JENSEN, C., QUESTED, T., MOATES, G., "Estimates of European food waste levels", *FUSIONS EEAB,* 2016, Estimates of European food waste levels final report_210316 (eu-fusions.org)
[335] CALDEIRA, C., DE LAURENTIIS, V., GHOSE, A., CORRADO, S., SALA, S., "Grown and thrown: Exploring approaches to estimate food waste in EU countries", *Resources, Conservation and Recycling,* 2021, Vol. 168, 105426.

3.3.2 Meat

Reducing meat consumption on the other hand, could also play a significant role in feeding a growing global population. Because of the inefficiency of meat production, plant matter is converted to animal matter at a ratio of ten to one, the majority of produce used in this process is simply lost.[336] The inefficiency of meat production is also reflected in land use, as 80 percent of the world's agricultural land is currently used to either raise livestock or produce its feed.[337] At the same time, meat only provides 15 percent of all calories, which indicates that reducing its intake could lead to an increase in available food, and a subsequent decrease in agricultural inputs.[338]

In the European Union, this number is slightly below average, as 71 percent of EU farmland is used to graze livestock or produce feed.[339] The impact of grazing on food security is significantly less compared to intensive livestock farming, but this type of farming produces only a fraction of all meat.[340] In fact, almost two thirds of all EU cropland is used to produce feed for livestock, despite only accounting for 12 to 17 percent of energy intake and 29 to 41 percent of protein intake in adults on average.[341]

Secondly, transitioning from a meat-heavy diet to a predominantly plant-based diet has several long-term benefits for food security, however, they will be discussed below as they pertain to the cost of not implementing the Farm to Fork Strategy.

3.4 Business as usual

Before going over the potential consequences of implementing Farm to Fork targets, it is imperative to look into the alternative, i.e. a farming system that is characterised by incremental change rather than radical

[336] GODFRAY, C., et al, "Food Security: The Challenge of Feeding 9 Billion People", *Science*, 2010, Vol. 327, 812-818.
[337] RITCHIE, H., "Forests and Deforestation", *Our World In Data*, 2017, How much of the world's land would we need in order to feed the global population with the average diet of a given country? - Our World in Data
[338] STOKSTAD, E., "Could Less meat Mean More Food?", *Science*, 2010, Vol. 327, 801-811.
[339] GREENPEACE, "Feeding The Problem: The Dangerous Intensification Of Animal Farming In Europe", *Greenpeace European Unit*, 2019, feeding-the-problem-dangerous-intensification-of-animal-farming-in-europe(greenpeace.org)
[340] *Ibid.*
[341] COCKING,C., WALTON, J., KEHOE, L., CASHMAN, K., FLYNN, A., "The role of meat in the European diet: current state of knowledge on dietary recommendations, intakes and contribution to energy and nutrient intakes and status", *Nutrition Research Reviews,* 2020, Vol. 33, 1-9.

change. While this current system provides in most needs of European citizens, it jeopardises long-term food security, public health and biodiversity.

3.4.1 Climate Change

Agriculture is responsible for over a quarter of anthropogenic greenhouse gas emissions (hereafter: GHG emissions), of which over half can be attributed to meat and dairy production.[342] In short, it is one of the driving forces behind climate change. According to the most recent IPCC report, GHG emissions have only increased in the last decade, at an annual rate of 1.3 percent, despite regional and international initiatives to decrease them, such as the Paris Agreement.[343] Climate change is already affecting crop yields in most continents and will increasingly do so as the earth keeps warming.[344]

In recent years, extreme weather events, such as floods and heat waves, have wreaked havoc on the European continent, resulting in crop failures and several billion euros in damages.[345] The frequency and severity of these weather events is very likely to increase due to climate change.[346] They are also linked to the stagnating yields of certain crops in the EU since the 1990s despite technological advancements in the agricultural sector.[347]

These isolated weather events are relatively insignificant in affecting food security but if they occur simultaneously they can destabilise the entire global food system.[348] Industrialised agriculture is a key driver behind climate change, which in turn jeopardises food security in the European Union. It is worth noting that we are currently on a trajectory that could trigger tipping points and subsequent feedback loops within the next few decades, at which point humans will have little influence over the future climate.[349] All too

[342] POORE, J., NEMECEK, T., "Reducing food's environmental impacts through producers and consumers", *Science*, 2018, Vol. 360, 987-992.
[343] SKEA, J.., et al., "Climate Change 2022: Mitigation of Climate Change", *IPCC*, 2022, IPCC_AR6_WGIIIFullReport.pdf
[344] RAY, D., et al, "Climate change has likely already affected global food production", *PLoS ONE*, 2019, Vol. 14, 1-18.
[345] GUERREIRO, S., DAWSON, R., KILSBY, C., LEWIS, E., FORD, A., "Future heat-waves, droughts and floods in 571 European cities", *Environmental Research Letters*, Vol. 13, 034009.
[346] TEULING, A., "A hot future for European droughts", *Nature Climate Change,* 2018, Vol. 8, 364-365.
[347] MOORE, F., LOBELL, D., "The fingerprint of climate trends on European crop yields", *PNAS*, 2015, Vol. 112, 2670-2675.
[348] HAMMILTON, H., et al, "Exploring global food systems shocks, scenarios and outcomes", *Futures*, 2020, Vol. 123, 102601.
[349] STEFFEN, W., et al., "Trajectories of the Earth System in the Anthropocene", *PNAS*, 2018, Vol. 115, 8252-8259.

often the idea of widespread famines and mass migration in the near future due to climate change are dismissed as alarmist, but they are very real possibilities.[350]

On top of that, climate change is expected to exacerbate the current global biodiversity crisis, as habitat loss and fragmentation continue to increase.[351] This brings me to the second long-term threat food security is facing, biodiversity loss.

3.4.2 Biodiversity Loss

Since the dawn of modern civilisation, humans have had an impact on habitat loss resulting in species extinction[352], and while extinction is seen as a common and natural process, the rate at which it occurs has increased significantly. Current extinction rates are estimated to be 1,000 times higher than the natural extinction rate, and are likely to further increase to a factor of 10,000 in the future.[353] If this trend continues, a sixth mass extinction event could be underway which would understandably be disastrous for European food security.[354]

Biodiversity provides ecosystem services which play a key role in sustaining agricultural systems.[355] These services, which are described as "*benefits that people receive from ecosystems*"[356], are estimated to have an annual global value of well over 50 trillion euros.[357] In many ways the productivity of food systems is dependent on these ecosystem services, which include pollination of crops, natural pest control and maintaining soil fertility.[358] At the same time, the continuity of these services is put at risk by modern

[350] NEW, M., LIVERMAN, D., SCHRODER, H., ANDERSON, K., ": Four degrees and beyond: the potential for a global temperature increase of four degrees and its implications", *Royal Society*, 2011, Vol. 369, 6-19, Introduction: Four degrees and beyond: the potential for a global temperature increase of four degrees and its implications on JSTOR
[351] MANTYKA-PRINGLE, C., et al, "Climate change modifies risk of global biodiversity loss due to land-cover change", *Biological Conservation*, Vol. 187, 2015, 103-111.
[352] Ibid.
[353] DE VOS, J., JOPPA, L., GITTLEMAN, J., STEPHENS, P. , PIMM, S., "Estimating the normal background rate of species extinction", *Conservation Biology*, 2015, Vol. 29, 452-462.
[354] BARNOSKY, A., et al, "Has the Earth's sixth mass extinction already arrived?" *Nature*, 2011, Vol. 471, 51-57.
[355] ALTIERI, M., "The ecological role of biodiversity in agroecosystems", *Agriculture, Ecosystems and the Environment*, 1999, Vol. 74 19-31.
[356] BENNET, E., PETERSON, G., GORDON, L., "Understanding relationships among multiple ecosystems services", *Ecology Letters*, 2009, Vol. 12, 1394-1404.
[357] CONSTANZA, R., et al, "The value of the world's ecosystem services and natural capital", *Nature*, 1997, Vol. 387, 253-260.
[358] ZHANG, W., RICKETTS, T., KREMEN, C., CARNEY, K., SWINTON, S., "Ecosystem services and dis-services to agriculture", *Ecological Economics*, 2007, Vol. 64, 253-260.

agriculture, which is one of the leading causes of habitat loss, soil degradation and nutrient pollution.[359, 360] Pesticides in particular alter habitats, including Natura 2000 sites, and negatively affect animal populations[361]. For example, they are thought to be one of the stressors causing the increasing die-off of European honey bee (*Apis mellifera)* colonies[362], which are essential pollinators.[363]

On European farmland, biodiversity has been steadily declining despite initiatives to halt this trend.[364] Furthermore, intensive farming methods have also impacted other European ecosystems, including forests and grasslands.[365] Because of its role in agriculture, biodiversity loss is seen as major threat to European food security.[366]

3.5 Risks to Food Security of Farm to Fork

Despite the benefits of implementing the Farm to Fork and Biodiversity Strategies, there are also some concerns, specifically regarding food security.[367] The fear is that the reduction of pesticide and fertiliser use, and the setting aside of productive farmland in a system that has become reliant on them will lead to lower agricultural yields and consequent price increases. For farmers this could mean a decrease in income, which explains why they are wary of employing these ecological farming methods.[368]

[359] BANKS-LEITE, C., EWERS, R.M., FOLKARD-TAPP, H., FRASER, A., "Countering the effects of habitat loss, fragmentation, and degradation through habitat restoration", *One Earth*, 2020, Vol. 3, 672-676.
[360] SAKADEVAN, K., NGUYEN, M.-L., "Livestock Production and Its Impact on Nutrient Pollution and Greenhouse Gas Emissions", *Advances in Agronomy*, 2017, Vol. 141, 147-184.
[361] OLMEDA, C., et al., "Farming for Natura 2000: Guidance on how to support Natura 2000 farming systems to achieve conservation objectives, based on Member States good practice experiences", *Publications Office of the European Union*, 2018, FARMING FOR NATURA 2000-final guidance.pdf (europa.eu)
[362] A phenomenon which is called CCD, short for Colony Collapse Disorder - WATSON, K., STALLINS, A., "Honey Bees and Colony Collapse Disorder: A Pluralistic Reframing", *Geography Compass*, 2016, Vol. 10, 222-236.
[363] POTTS, S., et al., "Status and trends of European pollinators. Key findings of the STEP project", *Pensoft Publishers*, 2015, Status and trends of European pollinators. (Key findings of the STEP project)
[364] ECA, "Biodiversity on farmland: CAP contribution has not halted the decline", *ECA Special Report* 2020, SR 13 2020: Biodiversity on farmland: CAP contribution has not halted the decline
[365] *Ibid.*
[366] MORAGUES-FAUS, A., SONNINO, R., MARSDEN, T., "Exploring European food system vulnerabilities: Towards integrated food security governance", *Environmental Science and Policy,* 2017, Vol. 75, 184-215.
[367] O'NEILL, P., "Impact assessments on Farm to Fork strategy", *Irish Farmers Journal*, 16 February 2022, Impact assessments on Farm to Fork strategy (16 February 2022)
[368] GIEL BOEY, "Van-boer-tot-bordstrategie (Farm to Fork)", *Boerenbond*, 1 October 2021, Van-boer-tot-bordstrategie (Farm to Fork) | Boerenbond

At the same time, these concerns are reinforced and pushed by agricultural corporations that stand to lose billions if the measures of both strategies are implemented.[369]

3.5.1 Pesticide Reduction

At the centre of the debate on integrating ecology and food production while still ensuring food security in the EU lies the proposed pesticide reduction. Since pesticides are a cost-effective way of increasing yields of monocultures, ditching them would naturally affect the productivity of this industrialised system. The Wageningen study, which was commissioned by Croplife, indicates that losses in food production are highly dependent on the location and the type of crops being cultivated.[370] It found that perennials would be more affected by the proposed reduction than annual crops would. Between different annual crops there are also differences, as beets would hardly be affected, while tomato productivity would drop by almost 20 percent in some cases. A second and third study, conducted by the USDA[371] and the JRC[372], also looked into the impacts of the input reduction under the Farm to Fork Strategy and came to a similar conclusion.

3.5.2 Fertiliser Reduction

Reducing fertiliser application rates are a second aspect of the proposed measures that could lead to a significant decline in crop productivity. Fertilisers are considered to be essential in sustaining monocultures, and a reduction of 20 percent by the end of this decade could negatively affect crop yields.

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[369] HOLLAND, N., " Agribusiness lobby against EU Farm to Fork strategy amplified by Ukraine war", *CEO*, 17 March 2022, Agribusiness lobby against EU Farm to Fork strategy amplified by Ukraine war | Corporate Europe Observatory

[370] One the main three studies that are referred to by opponents of the F2F Strategy - BREMMER, J., et al, "Impact Assessment of EC 2030 Green Deal Targets for Sustainable Crop Production", *Wageningen Economic Research*, 2021, edepot.wur.nl/558517

[371] BECKMAN, J., IVANIC, M., JELLIFFE, J., BAQUEDANO, F., SCOTT, S., "Economic and Food Security Impacts of Agricultural Input Reduction Under the European Union Green Deal's Farm to Fork and Biodiversity Strategies", *Economic Research Service*, 2020, Vol. 30.

[372] HURLE-BARREIRO, J., et al., "Modelling environmental and climate ambition in the agricultural sector with the CAPRI model: Exploring the potential effects of selected Farm to Fork and Biodiversity strategies targets in the framework of the 2030 Climate targets and the post 2020 Common Agricultural Policy", *Publications Office of the European Union*, 2021.

3.5.3 Expanding high diversity landscape features

As part of the Biodiversity Strategy, the Commission set out to provide more space for nature by converting at least 10 percent of farmland into high diversity landscape features, such as ponds and non-productive trees.[373] Productive crops will likely be replaced by non-productive species in these areas, which could lead to a decline in food production.

3.5.4 Conclusions of impact assessments

One of the obstacles in rallying member states behind the Farm to Fork Strategy is the lack of clarity regarding its impacts. Despite its promises, the Commission has yet to publish a comprehensive impact assessment of the Strategy, as the JRC study does not take all Farm to Fork measures into account.[374] At the same time, there have been published several studies that support the narrative pushed by the agriculture industry. These studies assessed the impacts of the individual measures and of their combined implementation, and concluded that food prices would likely increase, farmers' incomes would be negatively affected, and most importantly, food production would decline. This decline ranges from 5 to 20 percent if all three targets, i.e. reducing pesticides and fertilisers, and replacing farmland in favour of high diversity landscape features, were to be adopted by member states.[375]

Despite this being a significant decrease, it would barely affect food security in the EU according to the USDA. That being said, the price increase that follows would affect other regions of the world and could lead to an additional 22 million food-insecure people by 2030.[376]

[373] European Commission, Directorate-General for Environment "EU biodiversity strategy for 2030: bringing nature back into our lives", *Publications Office of the European Union*, 2021.
[374] FORTUNA, G., FOOTE, N., "EU Agri Commissioner dangles promise of 'comprehensive' Farm to Fork Impact Assessment", *Euractiv*, 23 September 2021, EU Agri Commissioner dangles promise of 'comprehensive' Farm to Fork impact assessment – EURACTIV.com
[375] The Wageningen study estimates a loss of 10 to 20 percent and the USDA predicted a 12 percent loss. The JRC predicted a loss of 5 to 15 percent.
[376] BECKMAN, J., IVANIC, M., JELLIFFE, J., BAQUEDANO, F., SCOTT, S., "Economic and Food Security Impacts of Agricultural Input Reduction Under the European Union Green Deal's Farm to Fork and Biodiversity Strategies", *Economic Research Service*, 2020, Vol. 30.

3.6 Farm to Fork response

Many of the potential negative impacts have already been addressed in the Strategy, either directly or indirectly, but this is largely ignored by critics due to the lack of comprehensive impact assessments. Current studies only assess the impacts of an agricultural input reduction without considering the consequences of implementing other aspects of the Farm to Fork Strategy. This again amplifies the need to look at its implementation from a holistic, and not a partial point of view.

Despite repeated promises of the Commission to publish such a comprehensive impact assessment that supports the holistic vision of the Farm to Fork Strategy, it has yet to produce one, which has corroded support in the European Parliament over the past two years.[377] Nevertheless, it is still relevant to discuss the measures set forth in the Strategy that, at least in part, mitigate the financial and social risks of reducing agricultural inputs.

3.6.1 Food security

With regards to food security in the EU, the Farm to Fork Strategy contains multiple measures and mechanisms to ensure the stability and security of its food production system. Firstly, transitioning to alternative food production models that are more resistant to environmental changes increases food security in the long run. The reality is that the climate is already changing and it is affecting food production systems, especially monocultures.[378] Secondly, the Commission has set forth the goal to reduce consumer and retail food loss and waste by 50 percent by 2030.[379] As roughly 70 percent[380] of waste occurs at these two levels, the implementation of this measure into law would significantly increase food security in the EU, and would counteract the potential food losses at the production level that result from a decline in agricultural input use.[381] As part of this measure, the Commission plans to revise the Waste Framework

[377] Farm Europe, "THE FARM TO FORK: IN NEED OF A NEW POLITICAL CONSENSUS The Farm to Fork: in need of a new political concensus", *Farm Europe*, 11 April 2020, www.farm-europe.eu/news/the-farm-to-fork-in-need-of-a-new-political-consensus/
[378] LEVIA, D., et al., "Homogenization of the terrestrial water cycle", *Nature Geoscience*, 2020, Vol. 13, 656-658.
[379] European Commission, "Farm to Fork Strategy", 2020.
[380] STENMARCK, A., JENSEN, C., QUESTED, T., MOATES, G., "Estimates of European food waste levels", *FUSIONS EEAB,* 2016, Estimates of European food waste levels final report 210316 (eu-fusions.org)
[381] Since 20 percent of food is wasted or lost in the EU, a 50 percent reduction at these two levels could result in an increase of available food of roughly 7 percent.

Directive[382] in 2023.[383] The Strategy also repeatedly highlighted the need to reduce meat production and consumption by shifting to a plant-based diet. These, however, remain suggestions, and not concrete reduction targets . As mentioned, meat production requires a lot of energy, resulting in a net loss of food, meaning that shifting subsidies away from animal agriculture can increase food security in the EU. Finally, the EU has established the European food security crisis preparedness and response mechanism, short for EFSCM, which is made up of public and private actors, as well as experts on food security.[384] If an event occurred that could threaten EU food security, its actors can convene to contribute to a response by coordinating the action of member states.[385]

3.6.2 Income losses

The second main concern regarding the implementation of the pesticide and other agricultural input reduction targets, and the decline in productivity that could follow, is the loss of income that farmers could face. This could consequently lead to an increase of food prices that affects both consumers and trade, something critics argue is not adequately addressed in the Farm to Fork Strategy.[386, 387]

Even if this argument was based on comprehensive impact assessments instead of partial ones, it would still ignore the current reality of food production within the European Union, as the stability of farmers' incomes is already heavily supported by CAP payments.[388]

According to the Strategy, farmers will be financially supported by these CAP payments to transition to alternative, sustainable agricultural practices. Whether these payments are sufficient to even out a possible income loss will, at least in part, depend on the CSPs member states put forth. Efficient allocation of subsidies is also of importance, as nearly half of subsidies, roughly 26 billion euros annually, were misspent

[382] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, *OJ* L 312, 22 November 2008, 3-30.
[383] European Commission, "Environmental impact of waste management – revision of EU waste framework", *EC*, 2022, Environmental impact of waste management – revision of EU waste framework (europa.eu)
[384] European Commission, "Ensuring global food supply and food security", *EC*, 2022, Contingency plan (europa.eu)
[385] FOOTE, N., "Commission reaffirms commitment to EU's green goals in first food security meeting", *Euractiv*, 10 March 2022, Commission reaffirms commitment to EU's green goals in first food security meeting – EURACTIV.com
[386] DAHM, J., "Lawmakers, stakeholders mull over food production impact of EU green goals", *Euractiv*, 8 February 2022, Lawmakers, stakeholders mull over food production impact of EU green goals – EURACTIV.com
[387] FERRER, B., "Industry weighs in on European Parliament's efforts to revamp Farm to Fork Strategy", *FoodIngredientsFirst,* 22 October 2021, Industry weighs in on European Parliament's efforts to revamp Farm to Fork Strategy (foodingredientsfirst.com)
[388] In the EU, subsidies make up between 20 and 40 percent in member states, with an average of 36 percent, of the income of farmers – European Commission, AgroSynergie, "Evaluation of the impact of the CAP measures on the general objective 'viable food production'", *EC*, 2018.

by member states under the previous CAP, resulting in an increase in income inequality within the agriculture sector.[389] Nevertheless, the JRC study indicates that reducing agricultural inputs will generally, with some exceptions, lead to a decline in agricultural incomes and increase food prices for consumers.[390] Again, the Commission shot itself in the foot by not presenting a comprehensive impact assessment, as the conclusions regarding the financial impact of the Strategy do not account for waste reduction, environmental stressors and ecosystem services.

3.7 Recent geopolitical developments

2022 has had a rough start for global food security, with Russia invading Ukraine, record droughts battering virtually every continent, including the Western United States[391] and Europe[392], and heat waves scorching large parts of India and Pakistan.[393] These developments, which will continue to have profound impacts on the stability of the monoculture food systems, have made it painfully clear that reform is urgently needed. Sadly, they are also being used to push short-term, unsustainable solutions that increase production without tackling the underlying issues.[394]

3.7.1 Russian invasion of Ukraine

The first cracks in the foundation of the globalised monoculture food system began to show when Russia invaded Ukraine in late February of 2022.[395] The war has disrupted the food chain for both nations, which are major producers and exporters of several important crops. In fact, Ukraine is responsible for the global export of over 40 percent of sunflower oil, 9 percent of wheat and 16 percent of corn.[396]

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[389] SCOWN, M., BRADY, M., NICHOLAS, K., "Billions in Misspent EU Agricultural Subsidies Could Support the Sustainable Development Goals", *One Earth*, 2020, Vol. 3, 237-250.
[390] HURLE-BARREIRO, J., et al., "Modelling environmental and climate ambition in the agricultural sector with the CAPRI model: Exploring the potential effects of selected Farm to Fork and Biodiversity strategies targets in the framework of the 2030 Climate targets and the post 2020 Common Agricultural Policy", *Publications Office of the European Union*, 2021.
[391] DUGINSKI, P., WIGGLESWORTH, A., "With water running out, California faces grim summer of dangerous heat, extreme drought", *Los Angeles Times*, 4 May 2022.
[392] MAZOUE, A., "France's unprecedented drought shows climate change is 'spiraling out of control'", *France 24,* 11 May 2022.
[393] WITZE, A., "Extreme heatwaves: surprising lessons from the record warmth", *Nature*, 4 August 2022.
[394] FOOTE, N., "Timmermans: Scaremongering on food security 'dishonest, irresponsible'", *Euractiv,* 28 April 2022.
[395] PSAROPOULOS, J., "Timeline: Week one of Russia's invasion of Ukraine", *Al Jazeera,* 2 March 2022.
[396] RITCHIE, H., "How could the war in Ukraine impact global food supplies?", *Our World in Data*, 24 March 2022, How could the war in Ukraine impact global food supplies? - Our World in Data

When trade came to a halt, the prices of these crops skyrocketed globally, sparking a fear of food shortages in poorer nations.[397] To add insult to injury, the invasion has caused Russia to curb its exports of fertilisers, resulting in a price increase of up to 200 percent for nitrogen fertilisers.[398] As agricultural inputs become more expensive, so do food products, further worsening the looming global food security crisis.

For opponents of the Farm to Fork Strategy this crisis comes at an opportune time. The fear of food shortages is employed by the agricultural sector to highlight the need to lift environmental protection measures to increase food production in the EU, a policy which is sadly supported by some European heads of state. French president Emmanuel Macron called for a review of the Farm to Fork objectives, citing that in light of the war in Ukraine, "*Europe cannot afford to produce less*".[399] What this stance fails to address is the significant biodiversity loss that could follow an increase in agricultural production.[400]

Proponents of the Strategy on the other hand, argue that this crisis is a reason to strengthen support for the transition to a sustainable food production model.[401] They argue that at a time where access to synthetic fertilisers and pesticides is severely hampered, member states and farmers should seize the opportunity to reduce their use and switch to an organic alternative.[402,403]

3.7.2 Heatwaves and droughts

The looming food security crisis caused by the Russian invasion of Ukraine is exacerbated by extreme weather events across the globe. Temperatures hit record highs as India and Pakistan were hit by a heatwave that began in April and lasted for months.[404] India was expected to fill the gap in the wheat export

[397] WAX, E., GALINDO, G., "5 reasons war in Ukraine is a gut punch to the global food system", *Politico*, 15 March 2022.
[398] BUTLER, S., "Surge in fertiliser prices from Russia-Ukraine war adds to pressure on UK farmers", *The Guardian*, 8 March 2022, Surge in fertiliser prices from Russia-Ukraine war adds to pressure on UK farmers | The Guardian
[399] STRUNA, H., "Macron wants to 'adapt' EU Farm to Fork to the post-Ukraine war world", *Euractiv*, 18 March 2022, Macron wants to 'adapt' EU Farm to Fork to the post-Ukraine war world – EURACTIV.com
[400] AMOS, R., "Assessing the Impact of the Habitats Directive: A Case Study of Europe's Plants", *Journal of Environmental Law*, 2021, Vol. 33, 365-393. See also: MACE, G., "Whose conservation?", *Science*, 2014, Vol. 345, 1558-1560.
[401] FOOTE, N., "Timmermans: Scaremongering on food security 'dishonest, irresponsible'", *Euractiv,* 28 April 2022, Timmermans: Scaremongering on food security 'dishonest, irresponsible' – EURACTIV.com
[402] FAO, "Impact of the Ukraine-Russia conflict on global food security and related matters under the mandate of the Food and Agriculture Organization of the United Nations (FAO)", *FAO*, 2022.
[403] ALFONSI, F., et al., "Food Security in light of Russia's war in Ukraine and Strengthening the Farm to Fork Strategy", *The Greens/EFA*, 9 March 2022, COM Ukraine F2F def.docx (greens-efa-service.eu)
[404] WITZE, A., "Extreme heatwaves: surprising lessons from the record warmth", *Nature*, 4 August 2022.

market the Ukraine war had created[405], but after crop losses due to heat and subsequent increasing domestic wheat prices, the Indian government banned wheat exports to secure its national food supply.[406]

At the same time, several regions are facing unprecedented droughts. Multiple EU member states, including France, Portugal, Belgium and Romania, have seen an abnormal lack of precipitation in the months leading up to the summer of 2022.[407] This, combined with a summer that is expected to be dry and hot[408], will undoubtedly lead to crop losses and relative food price increases.[409]

With a rapidly changing climate, the frequency and intensity of these extremes are only expected to increase.[410] According to the head of the UNCCD, radical changes and solutions are required to mitigate droughts and desertification in Europe.[411]

3.8 Conclusion

The disruption of food markets as a result of the Ukraine war and global droughts have highlighted the need for European food sovereignty. For Farm to Fork critics this means indefinitely postponing its objectives and increasing monoculture food production, using the projected 5 to 20 percent decline of Farm to Fork to justify this position. What this argument fails to address is the underlying reason of the need for Ukrainian and Russian crops. Nearly two thirds of cereals in the EU are used to feed livestock, so a collective shift towards a plant-based diet could increase European food sovereignty without having to neglect environmental targets.[412]

[405] BHARDWAJ, M., "India acts to seize gap in wheat export market left by Ukraine war", *Reuters*, March 16 2022, EXCLUSIVE India acts to seize gap in wheat export market left by Ukraine war | Reuters
[406] YASIR, S., KIM, V., "India bans most wheat exports, adding to concerns of global food insecurity.", *The New York Times*, 14 May 2022, www.nytimes.com/2022/05/14/world/asia/india-wheat-export-ban.html
[407] LECLUYSE, L., "Nauwelijks regen sinds oktober: extreme droogte in Portugal houdt aan", *vrt NWS*, 21 February 2022, www.vrt.be/vrtnws/nl/2022/02/21/extreme-droogte-in-portugal-houdt-aan/
[408] TORETI, A., et al., "Droughts in Europe April 2022", *Publications Office of the European Union*, 2022.
[409] FOOTE, N., "Severe drought could cancel out gains in EU food production", *Euractiv*, 18 July 2022, Severe drought could cancel out gains in EU food production – EURACTIV.com
[410] SKEA, J.., et al., "Climate Change 2022: Mitigation of Climate Change", *IPCC*, 2022.
[411] UNCCD, "Drought in Numbers 2022 – restoration for readiness and resilience", *UNCCD,* 2022.
[412] European Commission, "Cereals, oilseeds, protein crops and rice", *EC*, 2022, Cereals (europa.eu)

One could also argue that the Farm to Fork objectives are exactly what is needed in times of uncertainty. Monocultures are significantly more vulnerable to ecological changes than alternative, more diverse models, and the reality is that such changes will only increase in frequency and intensity as the globe heats up.[413] Propping up a system of agriculture that is already on life support by increasing land use for food production is a counterproductive and short-term solution.[414] Furthermore, climate change will put additional strain on ecosystems that are already being affected by agricultural inputs, most notably pesticides and fertilisers. Finally, the Strategy also contains provisions to make up for the potential loss of reduced yields. A binding food waste reduction of 50 percent would significantly increase available food, as roughly 20 percent of food in the EU is either lost or wasted.

[413] LEVIA, D., et al., "Homogenization of the terrestrial water cycle", *Nature Geoscience*, 2020, Vol. 13, 656-658.
[414] DASGUPTA, S., ROBINSON, E., "Attributing changes in food insecurity to a changing climate", *Scientific Reports*, 2022, Vol. 12, 4709.

4 The State and Future of European Biodiversity

The previous chapters of this thesis have generally painted a grim picture of the state of global biodiversity. Habitats are rapidly deteriorating in quality and abundance, leading to a consequent decline of species diversity .[415] At the same time, certain prominent species are making a comeback on the European continent and are thriving despite the many challenges they are facing. Keystone species that were previously on the brink of extinction, such as the European bison (*Bison bonanus)*[416], Eurasian grey wolf (*Canis lupus lupus)*[417] and Iberian lynx (*Lynx pardinus*)[418], are being successfully reintroduced in their native ranges, benefiting local ecosystems.[419] Effective legislation has played a crucial role in the success of these endeavours, meaning its evaluating can give invaluable insights in reducing and even reversing biodiversity loss.[420] This raises several questions regarding the effects of the implementation of Farm to Fork and Biodiversity Strategy targets on biodiversity. Because the current trends of biodiversity decline on the European continent have already been briefly covered in the previous chapter, this chapter will start off by focussing on agrobiodiversity, as well as the impacts of agriculture on the state of protected European ecosystems as a whole.

4.1 Agrobiodiversity

Over the millennia, food production and agriculture have altered and transformed natural habitats on the European continent, ultimately affecting biodiversity in one way or another.[421] The industrialisation of agriculture has accelerated this trend, as traditional methods were replaced by intensive farming, which tends to support less biodiversity.[422]

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[415] BROOKS, T., et al., "Habitat Loss and Extinction in the Hotspots of Biodiversity", *Conservation Biology*, 2002, Vol. 16, 909-923 and HAMILTON, A., "Species diversity or biodiversity?", *Journal of Environmental Management*, 2005, Vol. 75, 89-92

[416] TOKARSKA, M., PERTOLDI, C., KOWALCZYK, R., KAJETAN, P., "Genetic status of the European bison *Bison bonasus* after extinction in the wild and subsequent recovery", *Mammal Review*, 2011, Vol. 41, 151-162.

[417] CHAPRON, G., et al., "Recovery of large carnivores in Europe's modern human-dominated landscapes" *Science*, 2014, Vol. 346, 1517-1519.

[418] RUEDA, C., JIMÉNEZ, J., JESÚS PALACIOS, M., MARGALIDA, A., "Exploratory and territorial behavior in a reintroduced population of Iberian lynx", *Scientific Reports*, 2021, Vol. 11, 14148.

[419] The reintroduction occurs both naturally and by human intervention.

[420] CHAPRON, G., et al., "Recovery of large carnivores in Europe's modern human-dominated landscapes" *Science*, 2014, Vol. 346, 1517-1519.

[421] SMITH, B., ZEDER, M., "The onset of the Anthropocene", *Anthropocene*, 2013, Vol. 4, 8-13.

[422] DUDLEY, N., ALEXANDER, S., "Agriculture and Biodiversity: a review", *Biodiversity*, 2017, Vol. 18, 45-49.

Regardless of this shift and the risks of intensive farming, agriculture still plays a central role in sustaining biodiversity as nearly 40 percent of land in the EU is used to produce food.[423]

This agrobiodiversity, which can be described as "*the variety and variability of living organisms that contribute to food and agriculture in the broadest sense, and the knowledge associated with them*"[424], not only contributes to food security, but also to the quality of adjacent natural areas.[425]

Legislative action to protect this agrobiodiversity, including CAP measures, have proven to be unsuccessful, as the steady decline of farmland species has not been halted.[426] This should come as no surprise, seeing that the industrialisation of agriculture has only increased in the EU, most notably in the Eastern European member states.[427] According to the EU Farmland Bird Index, common farmland bird populations dropped by 34 percent between 1990 and 2017.[428] In that same time period, the European Grassland Index indicates that common butterfly populations declined by almost 40 percent.[429] Although this trend has stabilised since 2013, it is still cause for concern and an indication of the loss of quality of grasslands.[430] Flanders has already lost 30 percent of its indigenous butterfly species, and an additional 28 percent are currently facing extinction in the region.[431] Insect biomass in German nature reserves has declined by almost 80 percent between 1989 and 2013, a decline that can largely be attributed to the excessive use of agricultural inputs.[432] When it comes to environmental health, insect populations are considered to be canaries in a coalmine because they provide essential ecosystem services, such as providing food for other trophic levels,

[423] Eurostat, "Land use statistics", *Eurostat*, 2021, Land use statistics - Statistics Explained (europa.eu)
[424] JACKSON, L.E., PASCUAL, U., HODGKIN, T., "Utilizing and conserving agrobiodiversity in agricultural landscapes", *Agriculture, Ecosystems & Environment*, 2007, Vol. 121, 196-210.
[425] KAHANE, R., et al., "Agrobiodiversity for food security, health and income", *Agronomy for Sustainable Development*, 2013, Vol. 13, 671-693 and QUALSET, C., MCGUIRE, P., WARBURTON, M., "'Agrobiodiversity' key to agricultural productivity", *California Agriculture*, 1995, 45-49.
[426] ECA, "Biodiversity on farmland: CAP contribution has not halted the decline", *ECA Special Report,* 2020, 7, SR 13 2020: Biodiversity on farmland: CAP contribution has not halted the decline
[427] WASCHER, D., "Identifying and managing the conflicts between agriculture and biodiversity conservation in Europe – A review", *Agriculture Ecosystems & Environment*, 2008, Vol. 124, 60-71.
[428] Eurostat, "Common bird indices, EU, 1990 – 2017" , *Eurostat*, 2020, File:Common bird indices, EU, 1990–2017.png - Statistics Explained (europa.eu)
[429] EEA, "Grassland butterflies – population index, 1990-2017", *EEA*, 2020, Grassland butterflies - population index, 1990-2017 — European Environment Agency (europa.eu)
[430] ECA, "Biodiversity on farmland: CAP contribution has not halted the decline", *ECA Special Report,* 2020, 7.
[431] WARREN, M., et al., "The decline of butterflies in Europe: Problems, significance, and possible solutions", *PNAS*, 2021, Vol. 118.
[432] VOGEL, G., "Where have all the insects gone?"*, Science*, 2017, Vol. 356, 576-579.

and pollinating crops.[433,434] This alarming decline in recent years, which is likely to continue due to climate change, indicates that European agrobiodiversity is in bad shape, especially in areas of intensive agriculture.[435] Additionally, these agricultural methods not only affect farmland biodiversity, but also hurt biodiversity in protected natural areas, including the Natura 2000 network.

4.2 Natura 2000 and agriculture

Natura 2000 protected areas, whose legal status will be discussed below, are directly and indirectly affected by agriculture. These natural areas cover almost 20 percent[436] of the total EU land surface, but despite their protected status they are not exempt from human activities as long as these activities have no negative impact on the protected species.[437] This means that forestry, recreational activities, hunting and agriculture can still be allowed in Natura 2000 sites. In fact, agricultural ecosystems make up 40 percent[438] of these sites, which again highlights the importance of agriculture to biodiversity, especially in areas where most land is already developed, as well as the need for stringent legislation to minimise its harmful effects on these protected habitats.[439]

In view of the declining state of Natura 2000 sites, it seems that current legislation, or at least its enforcement, still contains gaps that hinder effective protection. The EEA found in its 'State of nature in the EU' report that 36 percent of the sites protected under the Habitats Directive have a bad conservation status.[440] An additional 45 percent have a poor conservation status, and only 15 percent are reported to have a good conservation status.[441]

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[433] The loss of insect biomass is linked to declining bird populations – GOULSON, D., "The insect apocalypse, and why it matters", *Current Biology*, 2019, Vol. 29, 961-971.
[434] JANKIELSOHN, A., "The Importance of Insects in Agricultural Ecosystems", *Advances in Entomology*, 2018, Vol. 6, 62-73.
[435] WARREN, R., PRICE, J., GRAHAM, E., FORSTENHAUESLER, N., VANDERWAL, J., "The projected effect on insects, vertebrates, and plants of limiting global warming to 1.5°C rather than 2°C", *Science*, 2018, Vol. 360, 791-795.
[436] Depending on the member state this ranges from 9 to 38 percent – European Commission, "Frequently asked questions on Natura 2000", *European Commission*, F.A.Q. - Environment - European Commission (europa.eu)
[437] TSIAFOULI, M., et al., "Human Activities in Natura 2000 Sites: A Highly Diversified Conservation Network", *Environmental management,* 2013, Vol. 51, 1025-1033.
[438] European Commission, "Frequently asked questions on Natura 2000", *European Commission*.
[439] MÖCKEL, S., "Natura 2000-sites: Legal requirements for agricultural and forestry land-use", *Nature Conservation*, 2022, Vol. 48, 161-184.
[440] NAUMANN, S., et al., "State of nature in the EU: Results from reporting under the nature directives 2013-2018", *EEA Report*, 2020 Vol. 10, State of nature in the EU — European Environment Agency (europa.eu)
[441] *Ibid.*

Intensive agriculture, both onsite and offsite, is cited as the main driver of this decline, meaning that reducing agricultural inputs may increase the efficacy of EU biodiversity law.[442,443]

4.3 EU Biodiversity legislation

The European Union has a plethora of legal instruments that aim to preserve biodiversity in one way or another. Discussing regulations on wildlife trade, invasive alien species and conservation efforts in zoos, to give a few examples, would go beyond the scope of this chapter.[444] Instead, the focus will be on the Nature Directives, i.e. the Habitats Directive[445] and the Birds Directive[446], as they play a central role in protecting endangered species as well as establishing and protecting Natura 2000 sites.

4.3.1 Nature Directives

The Birds Directive, adopted in 1979, and the Habitats Directive, adopted in 1992, collectively form the Nature Directives. Both of these instruments have put relatively similar mechanisms in place to promote the protection of vulnerable species, often endemic to Europe, and habitats.[447] The main difference between the two is their scope, as the Birds Directive "*relates to the conservation of all species of naturally occurring birds in the wild state in the European territory of the member states*"[448], whereas the Habitats Directive is designed to "*maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest*".[449] This protection is twofold, through varying levels of species protection as well as the establishment of Special Areas of Conservation and Special Protection Areas that combined form the aforementioned Natura 2000 sites.[450]

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[442] EEA, "EEA Signals 2021: Europe's nature", *EEA*, 2021, EEA Signalen 2021 - Europees Milieuagentschap and CHRISTIANSEN, T., ROUILLARD, J., "Water and agriculture: towards sustainable solutions", *EEA Report*, 2020, Vol. 17 Water and agriculture: towards sustainable solutions — European Environment Agency (europa.eu)

[443] This could change in the coming decades as climate will significantly affect the health of protected natural areas – NILA, M.U.S., et al., "Predicting the effectiveness of protected areas of Natura 2000 under climate change", *Ecological Progresses*, 2019, Vol. 8, 13.

[444] European Commission, "Nature and Biodiversity Law", *European Commission*, Nature and biodiversity law - Environment - European Commission (europa.eu)

[445] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, *OJ* L 206, 22 July 1992, 7-50.

[446] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, *OJ* L 20, 26 January 2010, 7-25.

[447] SUNDSETH, K., "The EU Birds and Habitats Directives", *European Commission*, 2014, en.pdf (europa.eu)

[448] Article 1 Birds Directive.

[449] Article 2 Habitats Directive.

[450] BERESFORD, A., et al., "The Contribution of the EU Nature Directives to the CBD and Other Multilateral Environmental Agreements", *Conservation Letters*, 2016, Vol. 9, 479-488.

The Annexes to the Directive determine which species fall under what protection regime. Members states are required to implement these regimes and failure to do so can result in liability.[451] To give a brief summary, habitats listed in Annex I and habitats of the species listed in Annex II of the Habitats Directive are to be designated as Special Areas of Conservation.[452] The most suitable habitats of bird species listed in Annex I of the Birds Directive, as well as those of regularly occurring migratory bird species that are not listed in Annex I, should be designated as Special Protection Areas[453]. Secondly, the exploitation wild birds and species listed in Annex IV and V of the Habitats Directive, regardless of their location, is either managed or prohibited.[454] The concrete interpretation and application of the conservation measures that apply to protected species and areas goes beyond the scope of this chapter. Instead, I will focus on the interaction between the reduction targets of the Farm to Fork Strategy and one particular gap in the Nature Directives.

4.3.1.1 Taxonomic bias of the Nature Directives

At the time of their implementation, the Nature Directives signified a shift away from anthropocentrism to a more ecocentric view of biodiversity law. The exploitation of nature for man's needs began to make way for the protection of species and habitats for their intrinsic value.[455] Still, these Directives are not a panacea for all issues affecting biodiversity in the EU, something which is also reflected in the largely unfavourable status of protected sites.[456] A critique that is sometimes voiced in this regard is the species-based approach of the Nature Directives instead of a more holistic ecosystem approach.[457]

The species that are listed only make up a fraction of the total EU biodiversity, meaning that the majority of species, including those threatened by extinction, do not fall under the protection regime of the Directives.[458] On top of this, certain taxonomic groups are disproportionally represented, while others are

[451] SCHOUKENS, H., BASTMEIJER, K., "Species protection in the European Union: how strict is strict?" in BORN, C-H., CLIQUET, A., SCHOUKENS, H., MISONNE, D., VAN HOORICK G., (eds.), *The Habitats Directive in its EU Environmental Law Context: European Nature's Best Hope?,* Oxford, Routledge, 2014.
[452] Article 3 Habitats Directive.
[453] Article 4 Birds Directive.
[454] SUNDSETH, K., "The EU Birds and Habitats Directives", *European Commission*, 2014, en.pdf (europa.eu)
[455] SUNDSETH, K., "The Habitats Directive: Celebrating 20 years of protecting biodiversity in Europe", *European Commission*, 2012, untitled (europa.eu)
[456] NAUMANN, S., et al., "State of nature in the EU: Results from reporting under the nature directives 2013-2018", *EEA Report*, 2020 Vol. 10.
[457] AMOS, R., "Assessing the Impact of the Habitats Directive: A Case Study of Europe's Plants", *Journal of Environmental Law*, 2021, Vol. 33, 365-393. See also: MACE, G., "Whose conservation?", *Science*, 2014, Vol. 345, 1558-1560.
[458] According to the IUCN there are over 120,000 species on the European continent, of which 22.7 percent are threatened with extinction. At the same time, roughly 1,500 species are granted protection under the Nature Directives – IUCN, "Europe: The European Red List", *IUCN Red List*, 2021, www.iucnredlist.org/regions/europe

barely included in the Annexes to the Habitats Directive. This phenomenon, also called taxonomic bias, is well documented in biodiversity research and conservation instruments.[459] An example of this is the overrepresentation of research into vertebrates. Among vertebrates the same can be said for mammals and birds.[460] Granted, it is easier to garner financial and public support for charismatic species, such as wolves and raptors, than it is for unpopular species, like arachnids.[461] Sadly this overlooks the conservation status of these species, as well as their ecological value in their ecosystems.[462]

A quick glance at the Annexes to the Nature Directives indicates that these taxonomic biases also affects the listing and protection of vulnerable species. The beneficial role of insect and the precarious state of their populations has already been discussed, yet only 0.1 percent of European insect species are protected under the Habitats Directive.[463,464] Fungi are not even mentioned at all.[465] At the same time, 38 percent[466] of bird species are listed in Annex I of the Birds Directive, despite only 18 percent[467] being threatened with extinction, and for mammals this is as high as 64 percent.[468,469]

With certain taxa being overrepresented in biodiversity legislation the question arises if this bias also negatively affects populations of underrepresented species. Limited research seems to suggest that Natura 2000 sites also provide significant benefits for species for which the area was not specifically designated.[470] The available studies found that this phenomenon, which is known as the umbrella effect, indicate that the

[459] DONALDSON, M., et al., "Taxonomic bias and international biodiversity conservation research", *FACETS*, 2016, Vol. 1, 105-113.
[460] CLARK, A., MAY, R., "Taxonomic Bias in Conservation Research", *Science*, 2002, Vol. 297, 191-192.
[461] TROUDET, J., GRANDCOLAS, P., BLIN, A., VIGNES-LEBBE, R., LEGENDRE, F., "Taxonomic bias in biodiversity data and societal preferences", *Scientific Reports*, 2017, Vol. 7, 9132.
[462] NYFFELER, M., BENZ, P., "Spiders in natural pest control: A review", *Journal of Applied Entomology*, 1987, Vol. 103, 321-339.
[463] LEANDRO, C., JAY-ROBERT, P., VERGNES, A., "Bias and perspectives in insect conservation: A European scale analysis", *Biological Conservation*, 2017, Vol. 215, 213-224.
[464] For reference, 9 percent of bees, 22 percent of beetles and 30 percent of grasshoppers are threatened with extinction in the EU – IUCN, "European Red List", *European Commission*, European Redlist – Environment (EC)
[465] AMOS, R., "Assessing the Impact of the Habitats Directive: A Case Study of Europe's Plants", *Journal of Environmental Law*, 2021, Vol. 33, 365-393.
[466] MAMMIDES, C., "European Union's conservation efforts are taxonomically biased", *Biodiversity and Conservation*, 2019, Vol. 28, 1291-1296.
[467] IUCN, "European Red List", *European Commission,* European Redlist - Environment – (European Commission)
[468] NAUMANN, S., et al., "State of nature in the EU: Results from reporting under the nature directives 2013-2018", *EEA Report*, 2020 Vol. 10
[469] Projects aimed at the conservation of mammal and bird species were also more likely to receive funds from the LIFE programme than those focused on species from different taxa - MAMMIDES, C., "European Union's conservation efforts are taxonomically biased", *Biodiversity and Conservation*, 2019, Vol. 28, 1291-1296.
[470] VAN DER SLUIS, et al., "How much Biodiversity is in Natura 2000? The "Umbrella Effect" of the European Natura 2000 protected area network", *Alterra Wageningen UR*, 2016, Technical Report_binnenwerk_V4 (wur.nl)

taxonomic bias of the Nature Directives has a limited effect in practice.[471] However, research on this phenomenon is very limited in scope or only focused on areas that are characterised by traditional farming.[472,473] If anything, it has confirmed the research gap on certain species as a result of taxonomic bias.[474] Furthermore, the umbrella effect relates to the increased prevalence of unlisted species in Natura 2000 areas over unprotected areas, but it is not an indication of the overall trends of the health and numbers of underrepresented species. In other words, they enjoy a greater protection within these areas but this does not speak to the adequacy of this protection.

By most metrics the Nature Directives have not been able to halt biodiversity loss, even within the Natura 2000 network, and it is exactly in this regard that the Farm to Fork Strategy can help narrow this legal gap by providing much need additional protection, most notably to underrepresented species.[475]

4.3.1.2 Farm to Fork and Nature Directives

The added value of Farm to Fork to the Nature Directives can be illustrated by looking at its benefits to insect populations, and this for various reasons. As mentioned, insect species are understudied, underrepresented and underprotected in biodiversity law. Additionally, they are the foundation of many ecosystems as they provide essential services that benefit plants, animals and fungi alike[476], including pollination, decomposition and food web support.[477] Their decline could therefore lead to trophic cascades and even ecosystem collapse.[478,479] In other words, the stability of ecosystems is highly dependent on

[471] *Ibid.*
[472] Van Der Sluis *et al.* focused on butterfly species, which are themselves overrepresented in the Annexes to the Habitats Directives, as well as in the allocation of LIFE funds - MAMMOLA, S., et al., "Towards a taxonomically unbiased European Union biodiversity strategy for 2030", *Proceedings of the Royal Society: Biological Sciences*, 2020, Vol. 287.
[473] MORÁN-LÓPEZ, R., CORTÉS GAÑÁN, E., UCEDA TOLOSA, O., SÁNCHEZ GUZMÁN, J.M., "The umbrella effect of Natura 2000 annex species spreads over multiple taxonomic groups, conservation attributes and organizational levels", *Animal Conservation*, 2020, Vol. 23, 407-419.
[474] At the global level 90 percent of insect species has not been named, let alone researched – VAN DER SLUIJS, "Insect decline, an emerging global environmental risk", *Current Opinion in Environmental Sustainability*, 2020, Vol. 46, 39-42.
[475] Over half of the trap locations used to determine the loss of insect biomass were located within Natura 2000 areas – HALLMAN, C., et al., "More than 75 percent decline over 27 years in total flying insect biomass in protected areas", *PLoS ONE,* 2017, Vol. 12.
[476] YANG, L., GRATTON, C., "Insects as drivers of ecosystem processes", *Current Opinion in Insect Science*, 2014, Vol. 2, 26-32.
[477] VAN DER SLUIJS, "Insect decline, an emerging global environmental risk", *Current Opinion in Environmental Sustainability*, 2020, Vol. 46, 39-42.
[478] WAGNER, D., "Insect Declines in the Anthropocene", *Annual Review of Entomology*, 2020, Vol. 65, 457-480.
[479] GOULSON, D., "The insect apocalypse, and why it matters", *Current Biology,* 2019, Vol. 29, 961-971.

healthy insect populations. Finally, insects are particularly affected by industrialised agriculture and its excessive use of inputs. Habitat loss as a result of intensive agriculture, pesticide and fertiliser use and climate change are consistently cited as the greatest threats to European, as well as global insect populations.[480,481] The unfavourable conservation status of most protected areas indicate that the Nature Directives are ill-equipped to adequately address these threats.

To start off, the Farm to Fork Strategy contains provisions that could noticeably reduce the effects of intensification of agriculture. When done right, increasing the share of EU agricultural land under organic farming to 25 percent by 2030 could provide significantly more the spaces that support biodiversity.[482] By replacing monocultures with polycultures and by applying the core principles of agroecology, such as rotating crops, enhancing natural pest control and reducing off-farm inputs, agriculture could become an asset to biodiversity again, instead of the burden it is now.[483,484] It is also worth noting that the aim of the Biodiversity Strategy to set aside 10 percent of EU farmland for high diversity landscape features would notably benefit wildlife by providing buffers against agricultural inputs as well as breeding grounds for a variety of species.[485]

The two Farm to Fork measures that would arguably have the most consequential effect on insect species are the 50 percent reduction of pesticide use as well as cutting nutrient losses in half by reducing fertiliser use by an estimated 20 percent. The negative impacts of both of these practices have already been outlined in the first part as well as the previous chapters, but it is still relevant to point that these measures would also benefit unprotected species, thus reducing the taxonomic bias that plagues the Nature Directives. Furthermore, reducing pesticide use would in part mitigate the effects of the research gap regarding their toxicity to non-target species.[486]

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[480] NAUMANN, S., et al., "State of nature in the EU: Results from reporting under the nature directives 2013-2018", *EEA Report*, 2020 Vol. 10.
[481] SÁNCHEZ-BAYO, F., WYCKHUYS, K., "Worldwide decline of entomofauna: A review of its drivers", *Biological Conservation*, 2019, Vol. 232, 8-27 and WAGNER, D., et al., "Insect decline in the Anthropocene: Death by a thousand cuts", *PNAS*, 2021, Vol. 118.
[482] REGANOLD, J., WACHTER, J., "Organic agriculture in the twenty-first century", *Nature Plants*, 2016, Vol. 2, 15221.
[483] WEZEL, A., et al., "Agroecological principles and elements and their implication for transitioning to sustainable food systems. A review", *Agronomy for Sustainable Development*, 2020, Vol. 40, 40.
[484] ALTIERI, M., NICHOLLS, C.I., "Agroecology Scaling Up for Food Sovereignty and Resiliency", *Sustainable Agriculture Reviews*, 2012, Vol. 11, 1-29.
[485] MERCKX, T., et al., "Optimizing the biodiversity gain from agri-environment schemes", *Agriculture, Ecosystems & Environment*, 2009, Vol. 130, 177-182.
[486] HABEL, J.C., SAMWAYS, M., SCHMITT, T., "Mitigating the precipitous decline of terrestrial European Insects: Requirements for a new strategy", *Biodiversity and Conservation*, 2019, Vol. 28, 1343-1360.

Finally, halting biodiversity loss without addressing climate change is near impossible.[487] Sadly, because of the transboundary nature of climate change, solutions are not often integrated in national and regional biodiversity law.[488] Nevertheless, when it comes to the Nature Directives scholars argue that this mismatch is a matter of interpretation, as the provisions could also apply to climate change mitigation.[489] The conservation measures of article 6 of the Habitats Directive, for example, could prove useful in reducing GHG emissions from agriculture at the European level.[490] At this point in time this is not yet the case which is where Farm to Fork comes into play. The JRC estimates that implementing the four main targets[491] of the Farm to Fork and Biodiversity Strategies would reduce GHG emissions in agriculture by 20.3 to 28.9 percent, depending on environmental and climate ambition of the CAP.[492] However, a significant portion of these reductions is leaked to third countries via imports. This highlights the importance to also take the effects on third countries into account, as the success of the Strategy highly depends on the rate at which biodiversity loss is exported.

[487] HABIBULLAH, M.S., DIN, B.H., TAN, S-H., ZAHID, H., "Impact of climate change on biodiversity loss: global evidence", *Environmental Science and Pollution Research*, 2022, Vol. 29, 1073-1086.
[488] TROUWBORST, A., "International Nature Conservation Law and the Adaptation of Biodiversity to Climate Change: a Mismatch", *Journal of Environmental Law*, 2009, Vol. 21, 419-442
[489] TROUWBORST, A., "Conserving European Biodiversity in a Changing Climate: The Bern Convention, the European Union Birds and Habitats Directives and the Adaptation of Nature to Climate Change", *The Review of European, Comparative & International Environmental Law*, 2011, Vol. 20, 62-77.
[490] SQUINTANI, L., "Balancing nature and economic interests in the European Union: On the concept of mitigation under the Habitats Directive", *The Review of European, Comparative & International Environmental Law*, 2019, Vol. 29, 129-137.
[491] Reducing pesticides and fertiliser use, setting aside 10 percent of agricultural land and increasing organic farming.
[492] HURLE-BARREIRO, J., et al., "Modelling environmental and climate ambition in the agricultural sector with the CAPRI model: Exploring the potential effects of selected Farm to Fork and Biodiversity strategies targets in the framework of the 2030 Climate targets and the post 2020 Common Agricultural Policy", *Publications Office of the European Union*, 2021.

4.4 Exporting biodiversity loss

Historically, Western societies have a long record of exporting biodiversity loss and environmental destruction to untouched or underdeveloped areas. European settlers slaughtered tens of millions of American bison to the point of near extinction and fur traders decimated sea otter populations in the Northern Pacific in the 18th and 19th century.[493,494] In recent decades, globalisation has been increasingly responsible for habitat degradation in the global south, meaning that biodiversity loss has an increasingly international dimension.[495] The international trade of agricultural products in particular is considered to be a threat to species globally, and EU member states consistently rank high among those that export biodiversity loss.[496,497] Examples of such practices are the import of Brazilian beef and soy, making up 25 to 40 and 41 percent[498] respectively of the total EU beef and soy imports, and Indonesian palm oil.[499] Both have been linked to widespread deforestation[500], even to the point where parts of the Amazon rainforest are no longer a carbon sink.[501]

As discussed in the previous chapter on food security, the implementation of the Farm to Fork reduction targets would in all likelihood disrupt the EU food production process to a certain degree, resulting in yield losses in certain sectors. To make up for this loss, member states are likely to either export less, or increase imports from third countries. In their reports, both the JRC and the USDA found that the export of cereals, pork and poultry would decline, while the import of beef and soy increased.[502] Despite provisions to ensure

[493] FREESE, C., et al., "*Second chance for the plains bison", Biological Conservation*, 2007, Vol. 136, 175-184.
[494] JACKSON, J., et al., "Historical Overfishing and the Recent Collapse of Coastal Ecosystems", *Science*, 2001, Vol. 293, 629-637.
[495] LENZEN, M., et al., "International trade drives biodiversity threats in developing nations", *Nature*, 2012 Vol. 486, 109-112.
[496] *Ibid.*
[497] CHAUDHARY, A., KASTNER, T., "Land use biodiversity impacts embodied in international food trade", *Global Environmental Change*, 2016, Vol. 38, 195-204.
[498] RAJÃO, R., et al., "The rotten apples of Brazil's agribusiness", *Science*, 2020, Vol. 369, 246-248.
[499] RIFIN, A., FERYANTO, HERAWATI, "Assessing the impact of limiting Indonesian palm oil exports to the European Union", *Journal of Economic Structures*, 2020, Vol. 9, 26.
[500] 70 to 80 percent of Amazon deforestation between 1996 and 2006 can be attributed to cattle farming. In Indonesia, palm oil production was responsible for one third of deforestation between 2000 and 2019 – NEPSTAD, D., et al., "Interactions among Amazon land use, forests and climate: prospects for a near-term forest tipping point", *The Royal Society Publishing B*, 2008, Vol. 363, 1737-1746 and GAVEAU, D., et al., "Slowing deforestation in Indonesia follows declining oil palm expansion and lower oil prices", *PLoS ONE*, 2022, Vol. 17.
[501] HARRIS, N., et al., "Global maps of twenty-first century forest carbon fluxes", *Nature Climate Change*, 2021, Vol. 11, 234-240.
[502] HURLE-BARREIRO, J., et al., "Modelling environmental and climate ambition in the agricultural sector with the CAPRI model: Exploring the potential effects of selected Farm to Fork and Biodiversity strategies targets in the framework of the 2030 Climate targets and the post 2020 Common Agricultural Policy", *Publications Office of the*

sustainability, these imports will inevitably come at a price for biodiversity of export states. The yet to be ratified EU-Mercosur trade agreement[503] for example, under which the trade of agricultural goods between the EU and South American Mercosur members is promoted, does contain provisions to ensure sustainable sourcing, but research indicates that a significant portion of imports is currently still linked to illegal deforestation.[504,505] The Commission's proposal to fight global deforestation contains provisions to combat this but according to critics it "*contains more holes than a Swiss cheese*".[506] Simply put, Farm to Fork has the potential to reduce European biodiversity loss but part of this loss is exported to third countries.[507]

To conclude, these findings essentially highlight that halting global biodiversity loss without addressing and adjusting the average European diet, as well as replacing the industrial agricultural system, is difficult to say the least. Replacing animal protein with plant protein by using crops as food instead of feed can eliminate the need to import certain agricultural goods, such as soy, altogether.[508] Sadly, due to the controversial nature[509] of regulating meat, this aspect of the Farm to Fork Strategy remains too vague.[510]

European Union, 2021 and BECKMAN, J., IVANIC, M., JELLIFFE, J., BAQUEDANO, F., SCOTT, S., "Economic and Food Security Impacts of Agricultural Input Reduction Under the European Union Green Deal's Farm to Fork and Biodiversity Strategies", *Economic Research Service*, 2020, Vol. 30.

[503] European Commission, "New EU-Mercosur trade agreement : The agreement in principle", *EC*, 2019.

[504] KEHOE, et al., "Inclusion, Transparency, and Enforcement: How the EU-Mercosur Trade Agreement Fails the Sustainability Test", *One Earth*, 2020, Vol. 3, 268-272.

[505] Besides illegal deforestation it has also been linked to Indigenous rights violations and slave labour - RAJÃO, R., et al., "The rotten apples of Brazil's agribusiness", *Science*, 2020, Vol. 369, 246-24.

[506] Environment ministers of several member states noted that the scope of the proposal is too narrow – ROMANO, V., "Ministers back draft EU anti-deforestation law derided as 'Swiss cheese' by campaigners", *Euractiv*, 30 June 2022, Ministers back draft EU anti-deforestation law derided as 'Swiss cheese' by campaigners – EURACTIV.com

[507] CRENNA, E., SINKKO, T., SALA, S., "Biodiversity impacts due to food consumption in Europe", *Journal of Cleaner Production*, 2019, Vol. 227, 378-397.

[508] KARLSSON, J., PARODI, A., VAN ZANTEN, H., HANSSON, P-A., RÖÖS, E., "Halting European Union soybean feed imports favours ruminants over pigs and poultry", *Nature Food*, 2020, Vol. 2, 38-46.

[509] GODFRAY, C., et al., "Meat consumption, health, and the environment", *Science*, 2018, Vol. 361.

[510] FOOTE, N., "Farm to Fork strategy softens stance on meat but backs alternative proteins", *Euractiv*, 22 May 2020, Farm to Fork strategy softens stance on meat but backs alternative proteins – EURACTIV.com

4.5 Conclusion

The industrialisation of agriculture over the past decades has had a profound impact on European fauna, flora and fungi. Efforts of EU legislators to protect endangered species and habitats have proven unfruitful for many species. This can in part be attributed to the lack of legal protection for certain taxonomic categories, most notably insects. Protected areas remain too fragmented and continue to suffer from intensive farming methods. The implementation of the Farm to Fork Strategy would go a long way in mitigating the main threats to biodiversity in the EU, which are habitat loss, climate change and excessive use of agricultural inputs. Sustainable, organic farming and reducing pesticide and fertiliser use can provide buffers for protected areas and breeding grounds for endangered species. This in turn allows for carbon sequestration, resulting in a significant reduction of GHG emissions, although some of these emissions are essentially leaked to third countries. This also highlights the need for international cooperation on ecosystem protection. Without proper oversight and a change in the Western diet the increase in imports as a result of crop yield losses could lead to the export of biodiversity loss to underdeveloped nations. In other words, the Farm to Fork Strategy is certainly a step in the right direction but it should not be treated as a silver bullet.

5 Alternative systems

To make sure history does not repeat itself it is particularly relevant to look at failures and successes of historic examples of agricultural transitions, as these could give an indication as to what the stumbling blocks could be for the Farm to Fork Strategy. I will therefore start off by giving a brief overview of the recent Sri Lankan shift towards organic agriculture and why it so failed miserably. To end on a more positive note, certain aspects of the Cuban food production model will be discussed. This model is a testament to the resilience of traditional agriculture, and can despite its flaws be used as a blueprint to guide European agriculture to sustainability.

5.1 Sri Lanka

Sri Lanka has a long history of regulating the sale of pesticides, not as a measure to protect nature but to combat the suicide epidemic the country was facing.[511] The former president, Gotabaya Rajapaksa, decided to take this one giant step further in 2019 by promising a total shift towards organic agriculture if he were elected, a promise he delivered on when he became president in 2021.[512] The official reasoning behind this policy was the prevention of health and environmental risks, although it was just as likely meant to reduce government spending.[513] Unlike Farm to Fork, Rajapaksa banned all imports of chemical fertilisers and pesticides in one fell swoop, forcing farmers to switch to organic agriculture.[514]

The national production of organic inputs could not keep up with demand, which ultimately resulted in significant crop yield losses.[515] Declining food exports and increased food prices ultimately led the government to soften its stance but by that point the damage was done.[516]

Proponents of the industrial agricultural system argue that the crisis Sri Lanka currently faces is a direct result of organic agriculture. Reducing synthetic fertiliser and pesticide use while ensuring food security is

[511] WEERASINGHE, M., et al., "Emerging pesticides responsible for suicide in rural Sri Lanka following the 2008–2014 pesticide bans", *BMC Public Health*, 2020, Vol. 20, 780.
[512] DE GUZMAN, C., "The Crisis in Sri Lanka Rekindles Debate Over Organic Farming", *Time*, 13 July 2022, How Organic Farming Worsened Sri Lanka's Economic and Political Crisis | Time
[513] The measure would could save up $400 million in government subsidies – BEILLARD, M., "Sri Lanka Restricts and Bans the Import of Fertilizers and Agrochemicals", *USDA,* 2021
[514] DE GUZMAN, C., "The Crisis in Sri Lanka Rekindles Debate Over Organic Farming", *Time*, 13 July 2022.
[515] TORRELLA, K., "Sri Lanka's organic farming disaster, explained", *Vox*, 15 July 2022, Sri Lanka Vox
[516] *Ibid.*

a pipe dream, according to them.[517] The reality, however, is a lot more nuanced. Sri Lankan agriculture, which heavily relied on synthetic inputs[518], simply was not ready to fully go organic overnight as farmers lacked resources and knowledge.[519] On top of that, its food supply chain had already been destabilised by the Covid-19 pandemic.[520] In short, the crisis should be seen as a policy failure and not as evidence of shortcomings of organic farming.[521]

To equate Sri Lanka's ban on synthetic agricultural inputs with the reduction targets of Farm to Fork is short sighted and disingenuous. The EU plans to provide farmers with time, financial support and resources to make sure the transition does not destabilise Europe's food supply, whereas the Sri Lankan government forced its farmers to switch overnight, leaving them to fend for themselves. Furthermore, European farmers will still be able to use synthetic fertilisers and pesticides after the implementation of the Strategies, as these are meant to curb excessive use of inputs. Finally, the Sri Lankan experiment has shown that it is difficult to sustain the productivity of monocultures without falling back on synthetic inputs. If the EU wants Farm to Fork to be successful, it would have to stimulate the use of alternative agricultural methods.

5.2 Cuba

Unlike Sri Lanka, Cuba has managed to successfully integrate sustainability in their agricultural practices. Over a very short period over time it went from a country that was widely known for its sugarcane monocultures, to one that integrated polycultures, crop rotation and agroforestry in its food production.[522,523] Nevertheless, stating that when it comes agriculture Cuba is an organic utopia would be

[517] NORDHAUS, T., SHAH, S., "In Sri Lanka, Organic Farming Went Catastrophically Wrong", *Foreign Policy*, 5 March 2022, Sri Lanka's Organic Farming Experiment Went Catastrophically Wrong (foreignpolicy)
[518] PRIYADARSHANA, T., "Sri Lanka's hasty agrochemical ban", *Science*, 2021, Vol. 374, 1209.
[519] MALKHANTHI, P., "Outlook of Present Organic Agriculture Policies and Future Needs in Sri Lanka", *SGGW*, 2021, Vol. 21, 55-72 and MALKHANTHI, S.H.P, "Farmer's attitude towards organic agriculture: a case of rural Sri Lanka", *Serbian Journal of Agricultural Sciences*, 2020, Vol. 69, 12-19.
[520] SINGH, N., et al., "Food Insecurity Among Farmers in Rural Sri Lanka and the Perceived Impacts of COVID-19", *Current Developments in Nutrition*, 2021, Vol. 5, 248.
[521] KAHN, D., WOLMAN, J., WOELLERT, L., "Is organic farming to blame for Sri Lanka's crisis?", *Politico*, 19 July 2022, Is organic farming to blame for Sri Lanka's crisis?- POLITICO
[522] In the 1980s over half of Cuba's cultivated land was used for sugarcane – ROSSET, P., BENJAMIN, M., "Cuba's nationwide conversion to organic agriculture", *Capitalism Nature Socialism*, 1994, Vol. 5, 79-97.
[523] ALTIERI, M., FUNES-MONZOTE, F., "The Paradox of Cuban Agriculture", 2012*, Monthly Review*, Vol. 63.

an oversimplification, as like any system it still has flaws. Like all Caribbean nations[524], Cuba imports a significant share of its food, leading to a low degree of food sovereignty.[525]

Up until the fall of the USSR in the 1990s Cuba relied heavily on the financial aid and imports, including food, oil and agricultural inputs, from the Soviets.[526] The economic and food crisis that followed was exacerbated by the US embargo and sanctions that also affected trade with third countries.[527] The reduction in available agricultural inputs and machinery forced Cuban farmers to transition from industrial monocultures to an alternative, more sustainable system in a very short period of time. Much like in Sri Lanka, the productivity of farmland fell considerably in the years following this shift but successful policies, such as reforming state farms to cooperatives, financial aid to farmers and investing in education[528], caused it to bounce back relatively quickly.[529] Some crop yields actually increased, despite the reduction in agrochemicals and lack of industrialised equipment. On top of that, the agroecological farms were found to be more resistant to environmental changes and extreme weather events than monocultures.[530]

A particularly interesting practice the Cubans adopted to combat food insecurity is urban agriculture. Food is produced in or near cities to increase access for those that need it the most as well as reduce overall food miles.[531] These urban farms, which rely on animal manure and household organic waste, are relatively productive and provide cities with a large share of produce, in the case of Havana up to 70 percent.[532] To conclude, despite its many flaws, the Cuban agricultural model shows us what the Farm to Fork Strategy needs: flexibility and perseverance in the face of adversity.

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[524] EWING-CHOW, D., "Five Overlooked Facts About Caribbean Food Security", *Forbes*, 20 February 2019, (forbes).
[525] ALVAREZ, J., "The Issue of Food Security in Cuba", *University of Florida*, 2004, (ufl.edu)
[526] With the fall of the USSR, imports of grain and oil dropped by 50 percent, while pesticide and fertiliser imports dropped by 80 percent - ROSSET, P., BENJAMIN, M., "Cuba's nationwide conversion to organic agriculture", *Capitalism Nature Socialism*, 1994, Vol. 5, 79-97 and WALTERS, R., "Soviet Economic Aid to Cuba: 1959-1964", *International Affairs*, 1966, 74.
[527] BELL, J., "Violation of international law and doomed US policy: An analysis of the Cuban democracy act", *Miami Inter-Am. L. Rev*., 1993, 77-129.
[528] ZEPEDA, L., "Cuban Agriculture: A Green and Red Revolution", *Choices*, 2003, 1.
[529] ALTIERI, M., FUNES-MONZOTE, F., "The Paradox of Cuban Agriculture", 2012, *Monthly Review*, Vol. 63.
[530] ROSSET, P. et al, "The Campesino-to-Campesino agroecology movement of ANAP in Cuba: social process methodology in the construction of sustainable peasant agriculture and food sovereignty", *The Journal of Peasant Studies*, 2011, 161-191-.
[531] ALTIERI, M., et al., "The greening of the "barrios": Urban agriculture for food security in Cuba", *Agriculture and Human Values*, 1999, Vol. 16, 131-140.
[532] *Ibid.*

6 Conclusion

Over the past few decades, the industrialisation of agriculture has been a blessing and a curse. It has allowed for human society to proliferate by increasing crop yields and providing a steady global food supply, but it did so at the expensive of environmental stability. European farmlands have become green deserts, and attempts to reverse this trend have largely failed. With the ambition to change this, the Commission introduced its flagship Farm to Fork Strategy, a comprehensive plan that aims to reduce the environmental impacts of monoculture farming.

In this thesis I have tried to find an answer as to what the challenges are in implementing the Strategy, and what its impacts are on biodiversity and food security. The main focus throughout this work was on the reduction of pesticides in agriculture, but because of the holistic nature of food production it is impossible to ignore other aspects of this system. As I have already concluded each chapter with an answer to its respective research question, I will use this opportunity to try and convey my personal view on this topic, as it not a purely legal issue, but also a political and social one.

The importance and urgency of fully implementing the Farm to Fork Strategy can hardly be overstated. Ecosystems, many upon which food production relies, are on the verge of collapse. Biodiversity loss and climate change are without a doubt the biggest threats modern human civilisation has faced[533], and it is time to start treating them as such. Intensive agriculture is still one of the driving forces behind anthropogenic climate change, habitat loss and species decline, which is exactly why an overhaul of this system is urgently needed.[534]

Opponents of the Farm to Fork Strategy, most notably the agricultural industry and its lobby, continue to push back against this green transition, arguing that we should instead rely on new technologies to reduce agricultural inputs and increase yields. However, hoping for market driven solutions and breakthrough technologies that may or may not be invented in the next few decades is reckless and foolish, especially when the fate of thousands of species hangs in the balance, including our own. They also argue that reducing agricultural inputs will disrupt the food production system and jeopardise European food security.

[533] NEW, M., LIVERMAN, D., SCHRODER, H., ANDERSON, K., ": Four degrees and beyond: the potential for a global temperature increase of four degrees and its implications", *Royal Society*, 2011, Vol. 369, 6-19 and ALTIERI, M., "The ecological role of biodiversity in agroecosystems", Agriculture, Ecosystems and the Environment, 1999, Vol. 74 19-31.

[534] RAVEN, P., WAGNER, D., "Agricultural intensification and climate change are rapidly decreasing insect biodiversity", *PNAS*, 2021, Vol. 118.

By all accounts, implementing Farm to Fork will lead to a marginal decline in crop yields and economic stability, but this decline pales in comparison to the crop failures that are increasingly likely to occur as the climate continues to change and ecosystems continue to degrade.[535] The industrialised model is simply not equipped to deal with the environmental changes Europe is currently experiencing, which highlights the need to fall back on traditional farming methods that are able to cope with these changes.[536]

That being said, Farm to Fork is certainly not an all-encompassing solution. While it tackles the most destructive aspects of monoculture farming, such as excessive pesticide use, it does not dismantle it as a whole. At the same time, it largely ignores the devastating impacts of animal agriculture on food security and biodiversity. Meeting the dietary needs of the increasing global population will not only require us to change the way we produce food, but also the way we consume it.

[535] CAPARAS, M., et al., "Increasing risks of crop failure and water scarcity in global breadbaskets by 2030", *Environmental Research Letters*, 2021, Vol. 16, 10.
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