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Corso di laurea magistrale/Second Cycle Degree (MSc)

in Food and Health

Farm to Fork: the Role of Rule-making in Shaping
Sustainable Food Systems

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ABSTRACT

This thesis investigates the regulatory and policy frameworks that underpin the European Union's Farm to Fork Strategy, which aims to create sustainable food systems. Amidst rising environmental concerns and an urgent need for sustainable practices, this study investigates how regulatory measures might form food systems that are both sustainable and resilient. The study is based on the European Green Deal and examines the current state of food policy in the EU, examining its compatibility with broader sustainability objectives. The thesis begins with a comprehensive analysis of the European food business, emphasizing the industry's ongoing issues as well as the Farm to Fork Strategy's transformative potential. It describes the specific regulatory rules targeted at improving sustainable food production, processing, and consumption and assesses their compatibility with other EU policies. The study's focus is on the projected legislative framework for sustainable food systems, which is investigated in depth through an examination of the upcoming proposals. The thesis evaluates the projected effects of these rules on food safety, environmental sustainability, and trade patterns. The discussion synthesizes findings from a comprehensive literature study and legislative analysis, answering research questions and contrasting the findings with existing theoretical frameworks. Finally, the thesis summarizes the important findings, discusses the potential consequences of the proposed regulatory framework on the EU and global food markets, and makes recommendations for policymakers, stakeholders, and future study areas. The report admits its limitations and proposes areas for further research to improve the effectiveness of regulatory frameworks in creating sustainable food systems.

Keywords : Sustainable Food , Farm to Fork, Green Deal

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CHAPTER I

INTRODUCTION

1. Preliminary considerations

In today's world of increasing environmental deterioration and growing socioeconomic inequality, the quest for sustainability has become more than just a catchphrase; it is an urgent global necessity (Monarrez, 2022). In the vast boundaries of the European Union (EU), the European Commission stands out as a key player in promoting sustainability programs, especially in the ever-evolving field of food production, processing, and consumption (Giannou, 2022). The present thesis undertakes a thorough investigation of the requirements of the sustainable food system framework, as recommended by the European Commission. The objective is to reveal the framework's complex meaning, address the associated obstacles, and shed light on its extensive consequences for the course of food systems in the future.

In a time of unparalleled environmental disruption and societal inequality, the necessity of sustainability becomes critical. Ecosystems around the world are in grave danger due to environmental degradation brought on by industrialization, deforestation, and the unrelenting exploitation of natural resources. At the same time, socioeconomic gaps keep growing, making poverty, inequality, and food insecurity worse everywhere in the world. Zurek et al. (2018) argue that sustainability stands out as a ray of hope in this context, providing a comprehensive framework for balancing human activity with that of the environment while also promoting social justice and economic prosperity.

The European Commission is a leading pioneer in the field of sustainability, operating within the vast borders of the European Union (Giannou, 2022). Equipped with both legislative and executive authority, the Commission is a key player in the development and execution of policies that support social cohesion, economic resilience, and environmental stewardship. The European Commission is determined to promote sustainable practices, prevent environmental damage, and protect public health, with a special emphasis on the complex relationship between food production, processing, and consumption. Developing a framework for a sustainable food system is central to the European Commission's sustainability strategy (Davies, 2020). This framework, which covers the full range of food production, distribution, and consumption, aims to transform the way that we produce, prepare, and eat food. To build a resilient and equitable food system that can face the challenges of the twenty-first century, the sustainable food system framework encourages ecologically friendly agricultural methods, lowers food waste, and improves food safety standards.

The European Commission's framework for a sustainable food system is extremely important in several ways (Voelker et al., 2022). First and foremost, it protects the environment by providing a means of reducing the negative effects of climate change, biodiversity loss, and resource depletion. Second, it prioritizes the production of safe and nutrient-dense food while simultaneously lowering exposure to dangerous chemicals and toxins, addressing urgent public health problems. Thirdly, it promotes economic success by giving farmers, producers, and business owners who are involved in innovative and sustainable food production additional options. Additionally, it alleviates poverty and food insecurity by guaranteeing that all societal sectors have access to nutritious and reasonably priced food. This fosters social fairness. The framework for a sustainable food system has many advantages, but there are significant obstacles in its way of implementation (Rayner et al., 2008). The most significant of these difficulties is the ingrained inertia of conventional farming systems, which are frequently rooted in intensive farming techniques and monocultures supported by subsidies. Adoption of sustainable methods is also severely hampered by the complexity of international supply networks and the spread of industrialized food production systems (Purnhagen & Wesseler, 2020). The shift to a more sustainable food system is further complicated by consumer preferences, vested interests, and legislative hurdles.

The European Commission's sustainable food system framework has a significant impact on how food systems will develop globally in the future (Brunori et al., 2017). It provides a model for rethinking the relationship between people and food, encouraging a more symbiotic and regenerative approach to agriculture and nutrition by sparking a paradigm shift towards sustainability. Furthermore, it emphasizes how the environmental, social, and economic facets of sustainability are interrelated, emphasizing the necessity of comprehensive and integrated solutions. In the end, future generations stand to benefit from a more resilient, just, and wealthy future if a sustainable food system is successfully implemented. At the center of the current conversation about food systems is the necessity of sustainability, which presents a convincing picture of a more peaceful and resilient future. The European Commission stands out as a leader in sustainability within the EU, supporting programs meant to develop a framework for a sustainable food system (Bentia, 2021). The imperative of sustainability is a beacon of hope as the EU negotiates the complex problems of the twenty-first century, showing the way towards a more just, resilient, and prosperous future for all.

2. Purpose of the thesis

The primary objective of this thesis is to conduct a critical analysis of the importance of a sustainable food system framework promoted by the European Commission. Through an examination of the underlying motivations driving the Commission's emphasis on sustainability and an

exploration of the initiatives it has undertaken, this study aims to elucidate the potential benefits and challenges associated with transitioning towards a more sustainable food system within the EU.

3. Importance of a Sustainable Food System Framework by the European Commission

The European Commission's advocacy for a framework for a sustainable food system is supported by several imperatives, such as the need to protect the environment, advance public health, and strengthen economic resilience (Galli et al., 2018). Gaining an understanding of this framework's importance is essential to appreciating its extensive effects on important areas including food security, environmental sustainability, and social well-being in the EU. A more comprehensive approach to food production, distribution, and consumption that considers the planet's long-term health as well as the welfare of present and future generations has gained popularity in recent years (Zaharia, et al. 2021) This realization has been spurred by various issues, such as worries about biodiversity loss, climate change, and the negative health effects of poor diets.

Environmental conservation is one of the main imperatives guiding the advocacy for a framework for a sustainable food system. The modern industrial food system is extremely resource-intensive, requiring large amounts of water, chemicals, and fossil fuels (Eliasson et al. 2022). Widespread environmental damage has resulted in soil erosion, water pollution, deforestation, and greenhouse gas emissions. This can lessen the worst effects of climate change and lessen the environmental footprint by switching to a more sustainable food system. Another major priority guiding the support for a framework for a sustainable food system is the promotion of public health. Zurek et al. (2018) argues that overreliance on processed foods heavy in sugar, salt, and harmful fats characterizes the present food system and contributes to the growth of diet-related disorders such as obesity, diabetes, and cardiovascular disease. Encouragement of a diet high in fruits, vegetables, whole grains, and proteins sourced sustainably will lead to better public health and less strain on healthcare services.

Increasing economic resilience is a key need that is propelling the push for a framework of a sustainable food system (Galli et al., 2020). Because of its high degree of centralization and reliance on international supply networks, the modern industrial food system is susceptible to disruptions from things like pandemics, unstable political systems, and harsh weather. This can lessen the reliance on imported food and boost local economies by supporting diversified, resilient, and adaptable local and regional food systems. In the EU, adopting a framework for a sustainable food system will have a significant impact on societal well-being, environmental sustainability, and food security (Allen et al, 2018). Fostering sustainable agricultural methods like organic farming, regenerative agriculture, and agroecology can enhance soil health, preserve biodiversity, and minimize the usage of hazardous chemicals. According to De Schutter et al. (2020), the long-term sustainability of marine ecosystems

and the means of subsistence for coastal people can be guaranteed by supporting sustainable fishing methods including quota systems, habitat preservation, and selective harvesting.

It is imperative to not only sustainable manufacturing practices but also sustainable consumption patterns (Guarnaccia et al. 2020). This entails encouraging plant-based diets, cutting down on food waste, and encouraging the production of seasonal and local foods. Customers can lessen the food system's environmental impact and enhance their health by choosing healthier and more environmentally friendly foods. Adopting a paradigm for a sustainable food system has significant social ramifications (Hebinck et al. 2021). It guarantees that everyone in society has access to inexpensive, healthful food by advocating for gender parity, fair labor practices, and social justice within the food system. Building resilient communities and fostering community-led projects like farmers' markets, food cooperatives, and community gardens would improve social cohesion. The European Commission's support for a framework for a sustainable food system is based on several imperatives, such as the need to protect the environment, advance public health, and strengthen economic resilience (Allen et al, 2018). This can increase social well-being, safeguard the environment, and promote food security both inside and outside of the EU by supporting sustainable farming, fishing, and consumption trends.

4. Research Questions and Objectives

1. Research Questions

1. What are the underlying motivations behind the European Commission's emphasis on promoting a sustainable food system?
2. How do the policies and strategies outlined by the Commission contribute to addressing the challenges confronting the European food industry?
3. To what extent are the initiatives proposed by the Commission aligned with broader EU objectives for sustainability and environmental stewardship?
4. What are the potential barriers and opportunities associated with the implementation of sustainable food system frameworks within the EU?

2. Research Objectives

1. Investigate the underlying motivations driving the European Commission's emphasis on promoting a sustainable food system within the EU.
2. Assess and analyze how the policies and strategies outlined by the European Commission contribute to mitigating the challenges faced by the European food industry, with a focus on sustainability initiatives.

3. Evaluate the extent to which the initiatives proposed by the European Commission align with broader EU objectives for sustainability and environmental stewardship, examining their coherence and effectiveness in achieving overarching goals.
4. Identify the potential barriers and opportunities associated with the implementation of sustainable food system frameworks within the EU context, considering factors such as regulatory constraints, technological advancements, stakeholder engagement, and market dynamics.

5. Overview of the Thesis Structure

Introduction

The introduction states the goal and highlights the need to look into the sustainable food system framework that the European Commission is pushing. The study introduces questions that include the following: Why is the European Commission emphasizing the promotion of a sustainable food system? In what ways do the strategies and policies delineated by the Commission aid in tackling the issues that face the European food industry? How well do the Commission's proposed measures match the larger EU goals for environmental stewardship and sustainability? What opportunities and possible obstacles are connected to the EU's adoption of frameworks for a sustainable food system? Examine the underlying motivations for the European Commission's emphasis on promoting a sustainable food system within the EU. Determine the potential opportunities and barriers associated with the implementation of sustainable food system frameworks within the EU, taking into account factors like regulations. Assess and analyze how the policies and strategies outlined by the European Commission contribute to mitigating the challenges faced by the European food industry, with a focus on sustainability initiatives. Determine the extent to which the initiatives proposed by the European Commission align with broader EU objectives for sustainability and environmental stewardship offers the direction for the research and a framework for the thesis.

Background and Context

This section gives a thorough overview of the food business in Europe Union while highlighting its difficulties and the pressing need for sustainable measures. With an emphasis on the European Commission's role in forming sustainable food systems, it addresses the European Green Deal and its sustainability goals. It also looks at the status of food laws in the EU today, emphasizing the Farm-to-Fork Strategy and its rules for sustainable food production, processing, and eating. An examination of how these initiatives interact with other EU policies and laws provides background information for the framework that for this study.

The Proposed Legislative Framework for Sustainable Food Systems

An in-depth study of the upcoming legislative proposal for sustainable food systems in the EU is done in this section. Expected effects on trade, environmental sustainability, and food safety are evaluated along with possible implementation issues and recommended fixes. This section provides insights into the regulatory environment influencing the future of food systems in the EU by analyzing the proposed framework.

Challenges in Achieving a Sustainable Food System

This section examines the primary obstacles to the EU's adoption of sustainable food practices. Barriers related to the economy, society, and environment are examined, offering a comprehensive perspective of the difficulties encountered in the shift to a sustainable food system. Policy proposals are given to overcome these obstacles and open the door for more successful sustainability initiatives within the EU.

Discussion

The results of the legislative analysis and literature review are summarized in this section. By using the data that has been collected and contrasting it with previously published works and theoretical frameworks, it responds to the research questions. This part provides a thorough grasp of the complexity underlying sustainable food systems in the EU by critically examining the findings and outlining areas that warrant additional research and policy development.

Conclusions and Recommendations

The study's main conclusions are outlined in this section, with particular attention paid to how the suggested framework would affect the EU and international food markets. There are recommendations for future research projects, stakeholders, and policymakers that offer practical insights to advance sustainable food system initiatives. Furthermore, the study's weaknesses are examined, identifying opportunities for enhancement and additional research.

Following this methodical framework, the thesis seeks to offer a comprehensive analysis of the significance, difficulties, and consequences of the European Commission's sustainable food system framework. The thesis envisages to impact future policymaking efforts in the EU and beyond by adding to the conversation on sustainable food systems, ultimately working towards a more resilient and sustainable food future.

CHAPTER II

BACKGROUND AND CONTEXT

1. Overview of the European Food Industry and Its Challenges

The European food sector provides a wide range of items that suit the tastes and preferences of its people, making it a vital component of the region's economy and cultural identity (European Commission, 2022). From the production of agricultural products to their processing, distribution, and consumption, this business involves a wide range of players and endeavors. But beneath the surface is a complicated environment full of chances and difficulties that influence its course for the present and the future (Santeramo et al. 2018). Fundamentally, the European food business must contend with the challenges of maintaining food sustainability and security in the face of growing demands from resource shortages, environmental degradation, and climate change (European Parliament and Council of the European Union, 2019). The food sector faces challenges in producing more food while reducing its environmental impact and protecting natural resources, as the world's population continues to rise (Trienekens & Zuurbier, 2018). A major challenge to agricultural production is climate change, as altered weather patterns, harsh weather, and rising temperatures have an impact on cattle health and crop yields. Environmental problems are further exacerbated by the intensive farming techniques that are common throughout much of Europe, which lead to soil erosion, water pollution, and biodiversity loss (European Commission, 2023). The European food business has challenges related to public health, including obesity, hunger, and foodborne infections, in addition to environmental concerns (Boqvist, Söderqvist & Vågsholm, 2018). The region has seen an increase in diet-related illnesses and health disparities as a result of the predominance of highly processed foods, excessive amounts of sugar, salt, and fat in diets, and sedentary lifestyles. Moreover, additional difficulties about food safety, traceability, and authenticity have been brought about by the globalization of food supply chains (European Commission, 2024). Stricter regulatory monitoring and improved quality control procedures are required as a result of incidents of food fraud, contamination, and product recalls that have damaged public faith in the safety and integrity of food items (Boqvist, Söderqvist & Vågsholm, 2018). The food business in Europe is also facing shifting customer demands and preferences, which are being driven by increasing socio-cultural trends, technology breakthroughs, and a greater consciousness of ethical and sustainable issues (European Parliament and Council of the European Union, 2019). Organic, locally sourced, ethically, and environmentally produced products are in high demand. Food firms are being forced to modify their product lines and business strategies to meet this demand.

Furthermore, the production, distribution, and consumption of food have all changed as a result of the growth of e-commerce and digitization, which has both potential and challenges for established

food firms (European Commission, 2024). Digital technologies facilitate enhanced efficiency, transparency, and connectivity throughout the food supply chain, so enabling businesses to optimize their operations and expand into new markets (Grinberga-Zalite & Zvirbule, 2022). However, they also bring with them new hazards that need to be managed and regulated, like market monopolization, cybersecurity threats, and data privacy issues. With these obstacles in mind, the European food industry is going through a period of innovation and change as players try to solve urgent problems and take advantage of new opportunities. Governments, business associations, and civil society groups are working together to create and carry out plans and programs that will promote a food system that is more resilient, sustainable, and inclusive (Arenas-Jal et al., 2020).

The European Green Deal is a major program of the European Union (EU) aimed at making the EU's economy more robust and sustainable (European Commission, 2023). The Farm-to-Fork Strategy, which aims to improve dietary habits, decrease food waste, and promote sustainable food production throughout the EU, is at the center of this program. The EU wants to fulfill its long-term sustainability goals and promote positive change throughout the food supply chain by establishing ambitious targets, offering financial incentives, and supporting policies (Ververis et al., 2020). The Farm-to-Fork Strategy has several important components, such as goals to cut back on pesticide use, boost organic farming, raise standards for animal welfare, and encourage the consumption of sustainably produced food (European Commission, 2023). In addition to these steps, initiatives are being made to improve food labeling, fortify food safety laws, and promote innovation in food production and processing technology (Reisch, Eberle & Lorek, 2013). Moreover, there exists a close alignment between the Farm-to-Fork Strategy and other EU policies and projects, including the Circular Economy Action Plan, the EU Biodiversity Strategy, and the Common Agricultural Policy (CAP).

The EU aims to develop a more comprehensive and successful strategy for tackling the issues confronting the food industry by incorporating sustainability concepts into several policy areas and encouraging synergies across many sectors (European Parliament and Council of the European Union, 2019). The European food business confronts a wide range of difficulties, from shifting consumer tastes and technology disruptions to environmental sustainability and public health issues (Reisch, Eberle & Lorek, 2013). But, as stakeholders come together to create a more resilient, egalitarian, and sustainable food system for the future, it also offers chances for creativity, teamwork, and change. Through the adoption of sustainability, transparency, and inclusivity as guiding principles, the European food industry may effectively confront current obstacles and emerge from them with greater strength and resilience in the future.

2. The European Green Deal and Its Goals for Sustainability

The primary objective of the European Green Deal, which was introduced by the European Commission in December 2019, is to make the economy of the European Union more sustainable (European Commission, 2022). Fundamentally, the Green Deal aims to promote economic growth, social fairness, and technological innovation while concurrently addressing the urgent problems of resource depletion, environmental degradation, and climate change. The ambitious targets for sustainability across a range of sectors, including energy, transportation, industry, agriculture, and buildings, are at the heart of the European Green Deal (Boix-Fayos & de Vente, 2023). The main aim of these goals is to attain climate neutrality by 2050, which means that net greenhouse gas emissions will be reduced to zero. Decarbonizing the EU economy to lower greenhouse gas emissions by at least 55% by 2030 relative to 1990 levels is one of the main tenets of the European Green Deal (Eckert & Kovalevska, 2021). To prioritize renewable energy sources, energy efficiency, and low-carbon technology, this calls for a thorough redesign of the energy infrastructure, transportation networks, and industrial processes.

Furthermore, the preservation and restoration of the natural environment which includes sustainable land use practices, ecosystem restoration, and biodiversity conservation are prioritized highly in the European Green Deal (Sikora, 2021). This includes programs to support sustainable forestry, stop deforestation, and rebuild damaged ecosystems. It also involves actions to lower pollution, enhance biodiversity in both urban and rural regions, and improve the quality of the air and water. The European Green Deal's objectives in the field of agriculture are to increase the resilience of food systems to climate change, lower greenhouse gas emissions from agriculture, and promote sustainable farming methods (Tutak, Brodny & Bindzár, 2021). Initiatives to promote agroecology, organic farming, and precision agriculture are included, along with steps to enhance soil health, water management, and agricultural biodiversity preservation.

Furthermore, by promoting resource efficiency, waste reduction, and circular economy concepts, the European Green Deal aims to foster sustainable patterns of production and consumption (Tutak, Brodny & Bindzár, 2021). This entails campaigns to support eco-design, product recycling and reuse, and the shift to a circular economy model that reduces waste and maximizes resource efficiency. The European Green Deal aims to promote social inclusivity and economic prosperity in addition to environmental goals (European Commission, 2022). This will be achieved, in part, by implementing programs that will support vulnerable communities, create green jobs, and guarantee a fair transition for workers and regions affected by the shift to a low-carbon economy.

In general, the European Green Deal is an ambitious and all-encompassing sustainability plan that aims to reshape the EU economy and society according to the values of social justice, environmental

preservation, and economic growth (Hereu-Morales, Segarra & Valderrama, 2024). With the help of financial resources, technical innovation, and political will, the Green Deal seeks to hasten Europe's transition to a future that is more robust and sustainable for all of its residents.

3. **The European Commission's Influence on the Development of Sustainable Food Systems**

The European Commission, with its powers over legislation, regulation, and policy-making, is a key player in the development of sustainable food systems in the European Union (EU) (European Commission, 2022). In its capacity as the EU's executive body, the Commission is in charge of developing and carrying out programs that support inclusivity, resilience, and sustainability throughout the whole food supply chain (European Commission, 2022). The creation and execution of agricultural and food policies is one of the main ways that the European Commission affects sustainable food systems.

A vast array of topics are covered by these policies, such as market control, food safety, environmental preservation, agricultural support, and rural development goals (Paleari, 2022). The Commission aims to encourage and support sustainable practices across the agriculture and food sectors by establishing guidelines, funding, and standards (European Commission, 2020). The Commission is essential in arranging and promoting collaboration between EU member states, other relevant parties, and foreign allies to tackle shared issues and realize goals for sustainable food systems (Shevchenko et al., 2021). This includes campaigns to encourage the exchange of best practices, capacity building, and information as well as conversations and efforts to reach consensus among a variety of stakeholders.

The Commission has introduced several programs and tactics in recent years with the express goal of encouraging sustainability in the food industry (European Commission, 2023). For instance, the European Union's food system will become more robust, sustainable, and fair thanks to the implementation of the Farm to Fork Strategy, which was included in the European Green Deal. This plan includes several actions, such as cutting back on the use of pesticides, expanding organic farming, raising the bar for animal care, and encouraging the consumption of sustainably produced food.

In addition, the Commission is essential in guaranteeing that EU laws and rules concerning food production, processing, labeling, and safety are in line with sustainable goals and principles (European Commission, 2019). To make sure that laws and policies effectively promote sustainability while also defending the interests of consumers and the general public's health, this entails carrying out impact studies, stakeholder consultations, and regulatory reviews (Schunz, 2022).

Furthermore, the Commission funds sustainable food systems research and innovation through its financial initiatives, including Horizon Europe (European Commission, 2024). The Commission seeks to create and implement innovative practices, business models, and technology that can support a more resilient and sustainable food system through funding research, pilot projects, and demonstration efforts (Koundouri et al, 2021). The European Commission plays a pivotal role in forming sustainable food systems inside the EU by utilizing its institutional capabilities, financial resources, and regulatory authority to promote progress along the whole food supply chain (Hereu-Morales, Segarra & Valderrama, 2024). The Commission is a key player in advancing social justice, environmental conservation, and economic growth in the food industry through its partnerships, policies, and projects. This helps to ensure the long-term sustainability and resilience of European food systems and agriculture.

4. The Current State of Food Legislation in the EU

The European Union (EU) upholds a strong framework of food laws intended to guarantee the integrity, safety, and quality of food goods flowing between its member states as of the last update in January 2022 (Pettoello-Mantovani & Olivieri, 2022). Aspects of the food supply chain such as production, processing, distribution, labeling, and marketing are all covered by this legislation. Here below are the basic components of the current state of food legislation in the EU.

1. **General Food Law:** Known as the General Food Law, Regulation (EC) No 178/2002 serves as the cornerstone of EU food law (European Commission, 2022). It lays forth guidelines and standards for risk assessment, traceability, transparency, and food safety across the whole food chain. Additionally, it established the European Food Safety Authority (EFSA), whose job it is to offer expert scientific advice on hazards associated with food.
2. **Food Hygiene Regulation:** General hygiene standards for food enterprises, such as restaurants, food processing facilities, and transportation, are outlined in Regulation (EC) No 853/2004 ((European Commission, 2023). It provides guidelines for preventing contamination, upholding hygienic standards, and guaranteeing food product safety.
3. **Food Information to consumers:** Food labeling is regulated by Regulation (EU) No 1169/2011, which also gives consumers easily readable, accurate, and comprehensible information on the food they buy (Van der Meulen, 2013). Among other things, it requires allergies, nutrition facts, ingredients, and country of origin to be labeled
4. **Food Additives:** Regulation (EC) No 1333/2008 establishes provisions for the use of food additives, including maximum allowable levels, approved compounds, and labeling specifications (European Commission, 2019).

5. Genetically Modified Organisms (GMOs): Authorization, labeling, and traceability of genetically modified food and feed are governed by EU regulations on GMOs. Procedures for the purposeful release of genetically modified organisms (GMOs) into the environment and their commercialization are established by Directive 2001/18/EC and Regulation (EC) No 1829/2003, respectively ((European Commission, 2019).

6. Novel Foods: Food products that were not widely consumed in the EU before May 1997 that are included on one of the categories listed in the Regulation are referred to as novel foods, and Regulation (EU) 2015/2283 controls their authorization and marketing. It lays forth the standards for labeling innovative foods and safety evaluation processes.

7. Organic Farming: In the EU, Regulation (EU) 2018/848 establishes provisions for organic farming and the labeling of organic goods ((European Commission, 2024). It lays down standards for organic agricultural methods, the conditions for organic operators to become certified, and how organic emblems should be used on food packaging.

8. Food Contact Materials: Materials and objects (such as containers, kitchenware, and packaging) that are meant to come into contact with food must meet the standards set forth by Regulation (EC) No 1935/2004. It guarantees that these materials are produced hygienically and do not transfer dangerous elements to food (Van der Meulen, 2009).

5. Description and Goals of the Farm-to-Fork Strategy

In a comprehensive effort to make the food system of the European Union more resilient, sustainable, and fair, the Farm-to-Fork Strategy was introduced as part of the European Green Deal (European Commission, 2020). The Farm-to-Fork Strategy, which was unveiled by the European Commission in May 2020, consists of a multitude of policies and initiatives aimed at tackling the multiple issues confronting the food system, ranging from social justice and public health to environmental sustainability and food security (Monarrez Lachhein, 2022). The Farm-to-Fork Strategy's primary objectives can be summed up as follows:

1. Encouraging Sustainable Food Production: The policy seeks to limit adverse effects on ecosystems, biodiversity, and natural resources by promoting ecologically and socially responsible farming techniques (European Commission, 2020). This includes actions to expand organic farming, decrease the use of fertilizer and pesticides, improve soil health, and increase biodiversity on farms.

2. Improving Food Safety and Quality: Throughout the supply chain, the plan aims to maintain the high caliber and integrity of food items while fortifying regulations governing food safety (Wessler, 2022). This entails taking steps to strengthen food fraud and contamination prevention, enforce

labeling regulations, and improve traceability, all of which increase customer trust and confidence in the safety and authenticity of food.

3. Reducing Food Waste: Reducing food losses and waste at every point of the food supply chain, from production and processing to distribution and consumption, is one of the main goals of the Farm-to-Fork Strategy (European Commission, 2020). This includes programs to encourage the redistribution of excess food, enhance methods for storing and transporting food, and increase consumer and company understanding of the significance of minimizing food waste.

4. Encouraging Sustainable and Healthful Diets: The strategy attempts to encourage sustainable and healthful dietary practices that enhance environmental sustainability and public health (Reinhardt, 2023). This entails both steps to decrease the consumption of unhealthy and harmful foods, such as processed foods, sugary drinks, and animal products with large environmental footprints, and steps to promote the consumption of nutrient-dense, seasonally appropriate, and locally sourced foods.

5. Supporting Fair and Resilient Food Systems: The goal of the Farm-to-Fork Strategy is to promote resilient and fair food systems that give everyone in society equal access to wholesome food that is appropriate for their culture (European Commission, 2022). This includes programs to address food poverty and social injustices regarding food access and affordability, as well as actions to help small-scale farmers, encourage short food supply chains, and guarantee decent salaries and working conditions for food workers (Giannou, 2022). The Farm-to-Fork Strategy is an ambitious and comprehensive plan to change the EU food system through the values of inclusion, resilience, and sustainability (Schebesta, 2023). To establish a food system that is more environmentally sustainable, socially fair, and resilient to shocks and disruptions in the future, the approach addresses the interconnected problems of environmental degradation, food poverty, public health, and social inequality.

6. Specific Provisions Related To Sustainable Food Production, Processing, and Consumption

A key element of the European Green Deal, the Farm-to-Fork Strategy delineates certain measures and initiatives intended to advance sustainability along the entire food supply chain, from cultivation to consumption (Galli et al., 2020). A more robust and ecologically friendly food system is the main objective of these provisions, which include a variety of sustainable food production, processing, and consumption topics. The following are some important clauses:

1. Reducing Pesticide Use: The strategy aims to cut chemical pesticide use and danger by 50% by 2030 (European Commission, 2022). This entails supporting integrated pest management (IPM)

techniques, urging the application of substitute pest management strategies, and providing financial incentives for the adoption of agroecological techniques that reduce dependency on chemical inputs.

2. Expanding Organic Farming: By 2030, the policy hopes to see 25% of agricultural land dedicated to organic farming (European Commission, 2021). This entails offering financial aid, technical support, and access to organic certification as well as other incentives and support to farmers who decide to switch to organic farming methods.

3. Raising Animal Welfare Standards: Part of the strategy is raising the bar for animal welfare in livestock farming by promoting alternative production methods that put animal welfare first, like pasture-based and free-range systems, and by creating new welfare indicators and enforcing current laws.

4. Encouraging Sustainable Fishing and Aquaculture: The plan contains clauses that encourage sustainable fishing and aquaculture methods, like establishing fishing limits based on science, cutting back on by-catch and discards, and encouraging environmentally friendly aquaculture techniques.

5. Improving Food Processing and Packaging: The plan calls for actions to support environmentally friendly packaging materials, cut back on the use of single-use plastics, and encourage the installation of energy-saving equipment in food processing facilities (European Commission, 2023).

6. Promoting Sustainable Food Consumption: The strategy attempts to encourage consumers to adopt wholesome and sustainable eating habits, such as cutting back on meat intake, consuming more plant-based foods, and selecting locally sourced, seasonally appropriate, and minimally processed foods. This entails educating people about the advantages of sustainable diets for their health and the environment and arming them with the knowledge and resources they need to make wise food decisions.

7. Reducing Food Waste: The plan calls for cutting back on losses and waste of food at every point of the food supply chain, from distribution and consumption to production and processing (European Commission, 2023). This includes establishing goals to cut down on food waste, enhancing procedures for food transportation and storage, encouraging the redistribution of excess food, and educating both customers and companies on the significance of doing away with food waste.

8. Encouraging Short Food Supply Chains: The plan calls for the establishment of community-supported agriculture (CSA) programs, local markets, and farmers' markets as ways to encourage short food supply chains. This entails offering farmers and small-scale food producers that sell their goods directly to customers or through regional distribution networks financial support, technical assistance, and regulatory incentives (European Commission, 2024).

By addressing important issues like pesticide use, organic farming, animal welfare, sustainable fishing, food processing, packaging, consumption patterns, and food waste. The provisions and

actions outlined in the Farm-to-Fork Strategy seek to promote sustainability throughout the food supply chain, from production to consumption (Movilla-Pateiro et al., 2023). The EU aims to address the requirements of current and future generations by enacting these policies that will strengthen the food system and make it more environmentally and socially just.

7. Alignment with Other EU Policies and Regulations

The Farm-to-Fork Strategy reflects the interdependence of sustainability goals across several sectors and domains by being closely coordinated with other EU policies and regulations (European Commission, 2022). The goal of the Farm-to-Fork Strategy is to maximize the impact of sustainability programs inside the European Union (EU) by integrating them with and strengthening current ones (Armstrong, 2021). This is how it complies with other important EU policies and regulations:

1. Agricultural Policy of the Commons (CAP): The goals of the CAP, which are to assure food security, support sustainable farming methods, and support successful agricultural output, are in line with the Farm-to-Fork Strategy (Jørgensen, 2015). According to the European Commission, (2020) on the Farm-to-Fork Strategy supports the CAP's efforts to advance sustainable agriculture and rural development by providing farmers with incentives to adopt ecologically and socially responsible farming practices, such as cutting back on pesticide use, growing organic farming, and raising standards for animal welfare.

2. EU Biodiversity Strategy: The Farm-to-Fork Strategy and the EU Biodiversity Strategy share a common goal of stopping the loss of biodiversity and restoring ecosystems by 2030 (European Commission, 2023). The EU Biodiversity Strategy's objectives for biodiversity conservation are aided by the Farm-to-Fork Strategy, which promotes sustainable agricultural methods that boost biodiversity, safeguard natural ecosystems, and repair degraded landscapes.

3. Circular Economy Action Plan: Resource efficiency, waste reduction, and the shift to a circular economy model are the goals of the EU Circular Economy Action Plan, which is supported by the Farm-to-Fork Strategy (European Commission, 2022). The EU's circular economy objectives are furthered by the Farm-to-Fork Strategy, which also promotes the use of renewable resources in food production and processing and reduces food waste (Stojanović et al., 2015)

The Farm-to-Fork Strategy is in line with the goals of the European Union's climate policy, which includes the pledge to attain climate neutrality by the year 2050 (European Parliament and Council of the European Union, 2019). The Farm-to-Fork Strategy supports the EU's efforts to combat climate change and adapt to its effects by increasing the use of renewable energy sources in food

production and processing, lowering greenhouse gas emissions from agriculture, and promoting sustainable land use practices.

4. EU Health Policy: The Farm-to-Fork Strategy helps achieve the goals of EU health policy, which include encouraging sustainable and healthful eating habits among Europeans (European Parliament and Council of the European Union, 2019). The Farm-to-Fork Strategy lowers the prevalence of diet-related diseases in the EU population and improves public health outcomes by promoting the use of wholesome, sustainably produced, and locally sourced foods (Monarrez Lachhein, 2022). The EU's dedication to advancing sustainability in several policy areas, such as agriculture, the environment, the economy, health, and climate change, is demonstrated by the Farm-to-Fork Strategy. The Farm-to-Fork Strategy seeks to provide a more cohesive and integrated approach to solving the complex issues facing the EU food system and accelerating the shift towards a more resilient and sustainable future by coordinating with and strengthening current policies and regulations.

CHAPTER III

THE PROPOSED LEGISLATIVE FRAMEWORK FOR SUSTAINABLE FOOD SYSTEMS

1. Detailed Analysis of Forthcoming Legislative Proposal -A Comprehensive Analysis of the EU's Future Sustainable Food Systems Law

European Union (EU) regulators are developing a sustainable food system framework. This program is important to the European Green Deal and Farm to Fork Strategy, which aim to create a sustainable, healthy, and resilient EU food system. This research section exploits the projected legislative proposal's goals, breadth, and essential elements, focusing on sustainability, health and nutrition, economic viability, and resilience.

2. Goals

The proposed EU sustainable food system legislation addresses environmental, health, economic, and resilience issues. These goals are broadly classified as:

Ecological sustainability

The legal framework promotes environmentally friendly farming techniques to mitigate climate change, preserve biodiversity, and reduce environmental degradation (Giannou, 2022). This involves promoting environmentally friendly farming methods that boost agriculture's natural resource (European Commission, 2020). Diversifying crops, agroforestry, conservation agriculture, and organic farming are strategies. These practises improve soil, water, and ecosystem resilience.

Reduce Carbon Footprint

The framework prioritizes reducing food production, processing, and distribution carbon emissions. This involves encouraging energy-efficient technologies, minimizing greenhouse gas emissions, and increasing agricultural renewable energy use (European Commission, 2020). Precision agriculture technology, which optimize input use and reduce emissions, and farm renewable energy initiatives like solar panels and biogas generation are encouraged.

Access to Nutritious Food

Healthy food must be accessible and affordable to improve population health. The framework promotes healthy, environmentally friendly diets (European Parliament and Council of the European

Union, 2019). It supports urban agriculture, food delivery networks, and plant-based diets, which have lesser environmental impacts.

Reduce Harmful Substances

The framework reduces food contaminants by regulating pesticides, fertilizers, and other chemicals, improving food safety and public health (European Parliament and Council of the European Union, 2019). This Policy promotes bio-based fertilizers and pesticides, strict food residue limits, and integrated pest management (IPM).

Promoting Economic Viability for Farmers and Food Businesses

Fair earnings and competitiveness for farmers and food enterprises are supported by the law (Pettoello-Mantovani & Olivieri, 2022). This involves supporting food SMEs with financial incentives, market access, and support. It emphasizes on direct subsidies for sustainable practices, enhanced market infrastructure, cooperatives that boost small farmers' bargaining power and market access.

Developing Rurally

Promoting rural development and ensuring agriculture and food policy boost rural economies are essential goals. Support rural economic diversification and infrastructure and service improvements (Tutak Brodny, & Bindzár, 2021). Investments may include broadband internet, transport infrastructure, and community development programs to promote local food processing and tourism.

Resilience and Crisis Preparedness

The food system must be more resilient to climate change, pandemics, and market disturbances. The architecture aspires to create a food system that can resist shocks and stay functional. The strategies employed include early warning systems, strategic food stockpiles, and climate-adaptive agriculture.

Security of Supply Chain

Enhancing food supply chain security and resilience to assure food availability during emergencies and interruptions is crucial (European Commission, 2022). the focus is on promoting local and regional food systems, diversifying supply sources, and adopting effective traceability systems to swiftly identify and address supply chain problems.

3. Key Components

The sustainable food system legislative framework should have several critical components to fulfil its goals, they include:

More stringent regulations

The framework may restrict pesticides, fertilizers, and other agricultural inputs to decrease environmental and health impacts and promote safer, more sustainable alternatives (European Commission, 2022). Set pesticide maximum residue levels (MRLs), prohibit high-risk chemicals, and promote eco-friendly inputs through regulatory approvals and market incentives.

Enforcement and Compliance

Strong enforcement will be needed to ensure compliance with these regulations. Regular inspections, monitoring, and non-compliance penalties are included (European Commission, 2021). Digital technology may be used for real-time monitoring and reporting, improving police efficiency and transparency.

Incentivize Sustainable Practices with Financial Support

Subsidies, grants, and low-interest loans will help farmers and food producers adopt sustainable techniques (European Commission, 2022). These incentives reduce the cost of being green. Farmers could get compensation for ecosystem services (PES) for carbon sequestration and biodiversity conservation.

Awarding Best Practices

Programs will compensate farmers and producers for sustainability best practices. Recognition and certification programmes emphasize sustainable agriculture excellence (European Parliament and Council of the European Union, 2019). Market premiums for certification programs may encourage farmers to adopt sustainable practices.

Enhancements to Food Labeling and Transparency Standards

Consumers will be informed about food's environmental and nutritional impacts by improved labelling. This empowers consumers to make educated choices and promotes sustainable products (European Parliament and Council of the European Union, 2019). Labelling can include carbon footprint, water usage, and nutritional composition, helping people choose items that match their beliefs and health goals.

Supply Chain Transparency

Increased food supply chain transparency will assist customers comprehend food origins and production. Traceability systems track items from farm to fork (European Commission, 2023). Blockchain may provide data integrity and transparency, creating consumer trust and revealing supply chain dynamics.

Waste reduction in the Circular Economy

Focus is on reducing food system waste from production to consumption. This includes food waste reduction, resource efficiency, and recycling and reuse programs (European Commission, 2024). Food waste reduction education, packaging improvements, and excess food transfer networks are supported by this policy.

Recover Resources

Reusing resources like organic waste for composting and biogas production can help create a circular food economy (European Parliament and Council of the European Union, 2019). Investments in organic waste collection and processing infrastructure and incentives for enterprises that use recovered resources can accelerate the circular economy.

Increased funding for research and innovation

Research and development funding will boost sustainable agriculture and food technology innovation. This includes creating new farming technologies, crop varieties, and food processing systems (European Commission, 2022). Climate-resilient crops, alternative proteins, and precision agriculture technologies that lessen environmental effect may receive funding.

Collaborative Research

Sharing research between public, corporate, and academic entities will boost innovation and sustainability (European Commission, 2023). Knowledge sharing platforms, joint research collaborations, and public-private partnerships can accelerate technology adoption.

4. Anticipated Impacts on Food Safety, Environment, and Trade

The following are the anticipated impacts on food security, environment and trade.

Decreased Chemical Use

Food safety should improve as stronger pesticide and fertilizer laws reduce consumption (European Commission, 2020). The framework improves food safety by reducing chemical residues, which represent a health concern. Reduced chemical exposure is expected to lessen foodborne illnesses and chronic diseases connected to pesticide residues (European Commission, 2021). Cleaner, greener pesticides and fertilizers may be required by stricter legislation. IPM and organic farming, which use natural predators, biopesticides, and organic fertilizers, will be promoted. Food items will have less chemical burden and as a result will enhance soil health and biodiversity.

Improved Traceability

The new framework will prioritize traceability to ensure food safety and authenticity from farm to fork. Food will be tracked throughout manufacturing, processing, and distribution via these systems (European Parliament and Council of the European Union, 2019). Tracing a food safety issue like contamination or recall swiftly and accurately is crucial. Advanced technologies like blockchain and IoT devices will aid traceability. These technologies can record a product's supply chain indefinitely, providing transparency and accountability. Knowing that each stage of their food's journey is monitored and documented would reassure consumers.

Environment

The framework's focus on sustainable farming will help conserve biodiversity. Monoculture farming, habitat degradation, and pesticide use are common in traditional agriculture, which harms biodiversity (European Commission, 2021). The framework promotes crop diversity, agroforestry, and habitat protection to balance and strengthen ecosystems. Planting many crops helps preserve soil health, decrease pest outbreaks, and support more animals. Adding trees and shrubs to agricultural landscapes creates habitats for diverse species and improves ecosystem services like carbon sequestration and soil stabilization.

Mitigating Climate Change

The framework aims to reduce agriculture and food sector greenhouse gas emissions to meet EU climate commitments. Agriculture produces methane and nitrous oxide, powerful greenhouse pollutants (European Commission, 2022). The framework promotes carbon separation, methane reduction, and energy efficiency to prevent climate change. Encourage no-till farming, cover cropping, and forestry to sequester carbon. These methods store atmospheric carbon in soils and

biomass. Improved feed efficiency and methane capture technology will also be pushed. Farms using solar and wind power will lower their carbon footprint.

Efficiency of Resources

Better water and soil management will improve utilization and conservation. A precision farming framework will encourage the use of technology to optimize water, fertilizer, and pesticide use (European Commission, 2022). Precision farming uses soil moisture sensors, GPS-guided equipment, and data analytics to apply inputs at the right moment and reduce waste and environmental effect. Drip irrigation and rainwater gathering will improve water efficiency and reduce freshwater use. Crop rotation, cover cropping, and minimal tillage avoid soil erosion and deterioration.

Trade

As producers adjust to new norms and requirements, sustainable practises may disrupt the internal market. In the long run, it will create a more competitive and sustainable agriculture industry that can meet demand for sustainable products (European Parliament and Council of the European Union, 2019). Sustainable production improves soil health, lowers input costs, and increases climate change resilience, boosting economic viability (Stojanović et al., 2021). Sustainable food options will undoubtedly rise in the EU's internal market. This change will meet consumer demand for healthy, eco-friendly products. Sustainable sourcing will be prioritized in retail, food processing supply chains, and transforming the market.

External Trade

Higher sustainability criteria may make imports difficult for non-EU countries, which must follow EU regulations to enter the market (European Commission, 2023). New trade agreements and standard alignment with international partners may be needed to improve trade relations. The EU may lead sustainable food systems worldwide, influencing standards. To meet strict EU standards, non-EU exporters must implement sustainable practices. Exporters upgrading production technologies to maintain market access may improve global agricultural practices. The EU may also promote and train trading partners to adopt sustainable practices, promoting global cooperation.

Nutrition and Health

The framework's emphasis on healthy, sustainable diets will improve public health (European Commission, 2023). The framework will battle obesity, diabetes, and cardiovascular illnesses by making nutritious meals affordable and accessible. Plant-based diets rich in fruits, vegetables, whole

grains, and legumes improve health and minimize chronic disease risk. Pesticides and antibiotics can be reduced to improve food safety and public health. Reduced exposure to these medications reduces hormonal disturbances and antibiotic resistance.

Better Food Security

All EU citizens should have access to enough, safe, and healthy food. The framework will improve food security by creating a robust food system that can endure climate change, pandemics, and market upheavals (European Commission, 2023). Stronger supply chains, storage and distribution facilities, and local food systems are needed. Improved local and regional food systems will lessen dependence on long supply networks and increase food self-sufficiency. CSA and urban gardening projects will be promoted to increase local food production and availability.

Supporting Farmers and Food Businesses

Through equitable incomes and competitiveness, the framework supports farmers and food enterprises' economic sustainability (European Parliament and Council of the European Union, 2019). Financial incentives including subsidies, grants, and low-interest loans will encourage sustainable behaviours (SgROI & Musso, 2022). These incentives will reduce the expenses of moving to more sustainable techniques, keeping farmers and food producers economically viable. Food SMEs will be supported to improve market competitiveness. These programs may provide technical assistance, market access, and innovation and value addition. The framework will promote food sector diversity and vitality by helping SMEs.

Rural Development

The framework prioritizes rural development. The framework supports rural economic diversification and improves infrastructure and services to boost rural economies (European Commission, 2023). Broadband internet connection, transport infrastructure, and community development programs will help rural businesses and inhabitants. The framework will promote local food processing and agri-tourism, promoting rural economic prospects. Diversity of income streams and reduced reliance on conventional agriculture will make rural communities more adaptable to economic and environmental shocks.

Resilience

Crisis resilience in the food system is crucial. The architecture aspires to create a food system that can resist shocks and stay functional (European Commission, 2020). This includes creating early

warning systems, strategic food reserves, and climate-adaptive farming techniques. Farmers will receive timely weather and insect warnings to take precautions. Strategic food storage will avert shortages and price rises during emergencies. Drought-resistant crops and varied farming methods improve climate resilience.

Securing Supply Chain

Food supply chains must be secure and resilient to ensure uninterrupted access during emergencies and disturbances (Vittuari, 2016). The framework will support local and regional food systems, diversify supply sources, and develop effective traceability mechanisms to swiftly identify and address disturbances (European Parliament and Council of the European Union, 2019). Local food systems will promote food self-sufficiency and reduce supply chain dependence. By sourcing more food locally, the EU can reduce global supply chain disruptions. Tracking systems will help identify damaged items and respond to food safety events quickly.

Circular Economy

The framework promotes waste reduction from production to consumption in the food chain. Increasing food waste reduction, resource efficiency, and recycling and reuse will help sustain the food system (Monarrez Lachhein, 2022). Retailers and customers may be incentivized to prevent food waste, food distribution networks may be upgraded to redistribute extra food, and educational initiatives may raise awareness. Resource efficiency programs reduce environmental impact and improve sustainability by using water, electricity, and fertilizers efficiently.

Resource Recovery

Reusing resources like organic waste for composting and biogas will help create a circular food economy (Wesseler, 2022). These activities will benefit from organic waste collecting and processing facilities. The framework will minimize waste and offer economic opportunities by turning organic waste into compost and biogas. Biogas generation reduces fossil fuel use and composting improves soil health and fertility.

R&D and innovation

Research and development funding will boost sustainable agriculture and food technology innovation. This includes creating new farming technologies, crop varieties, and food processing systems (Ververis et al., 2020). Climate-resilient crops, alternative proteins, and precision agriculture technologies that maximise efficiency and minimise impact will be funded. Research will address

agricultural issues such pest and disease management, water scarcity, and climate change adaptation. By funding research and innovation, the EU will advance food system-changing technologies and practices.

Collaboration Research

Sharing research between public, corporate, and academic entities will boost innovation and sustainability (Trienekens & Zuurbier, 2018). Knowledge sharing platforms, joint research collaborations, and public-private partnerships will accelerate technology adoption. Collaborative research will combine resources and skills, encouraging innovation and speedy translation of research findings into solutions. The framework will foster innovation and progress by bringing together players from different industries.

5. Implementation Challenges and Potential Solutions

There are numerous implementation challenges that include the following.

Economic Costs

The transition to sustainable agriculture is costly for farmers and food producers (European Commission, 2023). These expenditures come from new technology, farming practices, and strict environmental and safety laws. These financial demands may be especially difficult for small farmers and SMEs, which have fewer cash reserves and profit margins than major agribusinesses. Sustainable methods often entail upfront infrastructure and training investments that may not produce immediate economic results. Buying specialist equipment and inputs for organic or precision agriculture may strain finances. Farmers may experience short-term output drops while they adapt to new methods and practices, adding to their financial stress.

Monitoring and Compliance

The EU's different agricultural landscapes make it difficult to enforce new restrictions. European farming systems range from extensive industrial agriculture in Western Europe to smallholder farms in Eastern Europe (European Commission, 2022). Diversity makes it hard to apply a single sustainability strategy. Effective monitoring and enforcement are needed to ensure stakeholders follow the new standards. This requires a solid infrastructure for inspections, data gathering, and reporting. However, regional government, resource availability, and administrative capacity might affect enforcement. It's also difficult to prevent and address non-compliance fairly and effectively among member states.

Market Acceptance

The new law's effectiveness depends on consumer acceptance of sustainably produced food. Consumer prices may rise due to higher production costs from sustainable methods. Higher food prices may prevent consumers, especially low-income ones, from buying sustainable products (European Commission, 2023). Without consumer support, sustainable food markets may fail to grow, undermining the framework. Price, convenience, and sustainability affect consumer behavior. Consumers may not comprehend or appreciate sustainable food systems. This awareness gap may delay consumer choices for a sustainable food economy.

Technological Gaps

A major issue is the gap between existing agriculture methods and sustainable ones. Many technologies are not sustainable, thus innovative, cost-effective solutions are needed. Significant research and innovation are needed to develop and scale these technologies (European Commission, 2020). Lack of infrastructure, technical competence, and financial resources can also slow technology adoption. Farmers, especially in developing regions, may struggle to adopt precision farming, computerized monitoring systems, and renewable energy sources.

Potential Solutions

Potential solutions to the above challenges include the following:

Financial Support

Farmers and food producers need substantial financial support to move to sustainable practices. Farmers can benefit from subsidies and grants that decrease their financial burden and promote sustainable practices. New equipment, eco-friendly technology, and organic farming can be funded via subsidies and grants. Low-interest loans can help farmers invest in sustainable practices without immediate financial pressure. These loans can be adapted to particular farms, making them accessible to smallholders and SMEs. Tax rebates or deductions for sustainable agriculture investments might encourage farmers to go green. Renewable energy installations, soil conservation, and organic certification fees can be deducted.

Education and Training

Implementing sustainable practices requires education and training: Comprehensive farmer and food producer training may bridge knowledge gaps and help accept new technology and processes.

Best Practices in Sustainable Agriculture: Training programs should address crop rotation, IPM, conservation tillage, and organic farming.

New Technologies: Farmers should learn about precision agriculture equipment, computerized irrigation systems, and renewable energy alternatives to improve sustainability. Farmers must comprehend and follow new requirements. Training can explain regulatory standards, reporting methods, and compliance initiatives.

The educational initiatives can be given through workshops, online courses, field demonstrations, and extension services. Collaboration with agricultural universities, research institutions, and industry specialists improves program quality and reach.

Public Awareness Campaigns

Consumer acceptance and support for sustainable food systems require public awareness initiatives. These efforts should inform customers on the environmental, health, and economic benefits of sustainable activities. Strategies that work include:

Media campaigns: Spreading sustainable agriculture's benefits via television, radio, print, and social media. These advertising can be more convincing by featuring farmer and customer success stories. Clear food labeling that demonstrates sustainability can help consumers choose. Certification programs that verify and promote sustainable practices can increase customer trust and demand for sustainable foods. Events, workshops, and farmers' markets can connect customers to sustainable farming and its benefits. These contacts can strengthen consumer-producer bonds.

R&D and innovation

Research and innovation are essential to close technology gaps and provide affordable sustainable farming methods. Giving universities and research institutions extra money to study sustainable agriculture. New crop varieties, irrigation systems, soil health monitoring instruments, and insect management strategies could benefit from this investment. Public research organizations and private firms working together can speed technology development and commercialization. Academic research and industry resources can be combined in these partnerships. Startups and entrepreneurs can get support from sustainable agriculture innovation hubs and incubators to develop and scale their technologies. Hubs can provide money, mentorship, and networking.

International Cooperation

Harmonizing environmental standards and facilitating trade requires international cooperation. The EU can strengthen its sustainability aims worldwide by cooperating with global partners. Speaking

to non-EU nations to unify sustainability norms and practices. Alignment simplifies commerce, reduces barriers, and ensures imported products meet EU sustainability standards. Sustainable trade agreements can improve global sustainability. Sustainable farming, reduced tariffs on sustainable products, and technical assistance to help trading partners meet EU criteria can be included in this agreement. Helping poor nations improve agricultural sustainability. Financial help, technology transfer, and training can improve local sustainable agriculture capabilities.

Conclusion

EU sustainable food system legislation is a crucial step toward a more sustainable, resilient, and healthful food system. The framework seeks to develop a food system that satisfies current and future demands by addressing sustainability, health and nutrition, economic viability, and resilience. Sustainable practices are difficult to adopt, but financial backing, education, public awareness, research, and international cooperation are necessary. The predicted food safety, environmental protection, and economic resilience benefits make this legislative endeavour crucial. The EU's sustainable food system will improve citizens' health and contribute to global environmental and climatic efforts. The EU can create a global benchmark for sustainable food systems by managing economic costs, ensuring compliance and monitoring, achieving market acceptance, and bridging technological gaps. Governments, business stakeholders, research institutions, and consumers must work together to achieve these ambitious goals. The EU's legal framework will inspire other regions to establish sustainable food systems, promoting a healthier, more resilient future.

CHAPTER IV

CHALLENGES IN ACHIEVING A SUSTAINABLE FOOD SYSTEM

1. Identification of Main Barriers to Sustainable Food Practices within the EU

There are numerous economic, social, and environmental barriers to achieving sustainability in food systems. These barriers not only impede progress toward sustainability, but they also worsen current issues such as food shortages, environmental degradation, and social inequities. This section will examine the economic, social, and environmental challenges to food system sustainability, as well as potential solutions.

Economic Barriers

One of the biggest economic barriers to food system sustainability is the prevalence of conventional agricultural techniques that are motivated by economic incentives. Conventional agriculture, which is distinguished by extensive use of synthetic inputs, monocropping, and mechanization, frequently prioritizes short-term profits over long-term viability (European Commission, 2020). Farmers are encouraged to increase yields while minimizing expenditures, resulting in overexploitation of natural resources, soil deterioration, and environmental contamination.

Furthermore, agricultural subsidies and support policies frequently prioritize large-scale industrial farming over small-scale and sustainable agriculture (Trienekens & Zuurbier, 2018). Subsidies for commodity crop and livestock feed production contribute to overproduction, market distortions, and environmental damage (European Commission, 2022). Changing agricultural subsidies to support sustainable techniques like organic farming, agroecology, and regenerative agriculture could help overcome this economic barrier and promote more ecologically friendly food production methods.

Furthermore, the globalization of the food system and trade agreements can create economic impediments to sustainability (Wesseler, 2022). Trade agreements that stress market liberalization and free trade may impede domestic efforts to promote sustainability by enabling the entry of low-cost, ecologically damaging food goods (European Commission, 2023). To guarantee a level playing field for sustainable food producers, this economic barrier must be addressed in a careful balance between trade liberalization and the maintenance of environmental and social standards.

Social Barriers

Consumer behavior, cultural values, and socioeconomic inequality are all examples of social barriers to sustainability in food systems. While there is an increasing awareness and desire for sustainable

food items, price, convenience, and lack of awareness frequently limit consumer options. Many consumers choose economy and convenience above sustainability, making it difficult for sustainable food producers to compete in the market.

In addition, societal inequalities and inequities in resource access compound the obstacles of attaining food system sustainability (European Commission, 2022). Marginalized communities, such as low-income families and indigenous peoples, frequently encounter challenges to acquiring nutritious and sustainably produced food. Addressing socioeconomic inequalities and ensuring fair access to food resources are critical for fostering sustainability and social justice in food systems (European Parliament and Council, 2019).

Furthermore, power dynamics in the food system, such as corporate consolidation and concentration, can create societal impediments to sustainability. Agribusiness giants and international firms frequently wield substantial power in food production, distribution, and marketing, influencing consumer preferences and market dynamics (Ververis et al., 2020). Empowering small-scale farmers, encouraging food sovereignty, and developing community-based food systems are critical to resisting corporate control and achieving social fairness in food systems.

Environmental Barriers

Given the vital importance of protecting natural resources and ecosystems, environmental barriers to food system sustainability may be the most serious. Conventional agricultural practices such as deforestation, monocropping, and excessive pesticide use cause soil degradation, water pollution, and biodiversity loss (European Commission, 2023). These practices harm not only the environment, but also the long-term viability of agricultural produce.

Climate change also presents a huge environmental challenge to food system sustainability. Rising temperatures, shifting precipitation patterns, and extreme weather events reduce agricultural output, jeopardize food security, and worsen environmental vulnerabilities (Santeramo et al. 2018). Adapting to climate change and strengthening food systems necessitates innovative technologies, sustainable land management methods, and strong policy frameworks.

Furthermore, food waste is a substantial environmental barrier to the sustainability of food systems. Approximately one-third of all food produced worldwide is lost or discarded, causing greenhouse gas emissions, resource depletion, and environmental deterioration (European Commission, 2020). Combating food waste necessitates coordinated actions across the whole food supply chain, from production and distribution to consumption and disposal.

Strategies for Overcoming Barriers

A variety of measures can be used to address the economic, social, and environmental barriers to food system sustainability. According to the European Commission (2023), agriculture laws and subsidies must be reformed to encourage sustainable farming techniques and reward environmental care. According to SgROI and Musso (2022), transferring subsidies to agroecology, organic agriculture, preservation farming, and the execution of green environment service schedules will benefit farmers who utilize sustainable land management.

Second, increasing consumer awareness and education about the environmental, social, and health benefits of sustainable food can increase demand for sustainable products and promote more responsible consumption habits (Schebesta, 2023). This will involve public knowledge motions, training centers in schools and the wider community. This program aims to enhance local and seasonal food uptake.

Key players that include governments, farmers, civil society organizations, consumers, and multinationals should establish a rapport and collaborations to foster systemic changes that will aid in more sustainable food systems. Working together, sharing knowledge and resources, and utilizing collective expertise and influence can help us overcome sustainability challenges and develop a resilient, equitable, and environmentally sustainable food system.

To achieve food system sustainability, a complex set of economic, social, and environmental challenges must be addressed (Arenas-Jal et al., 2020). The difficulties are many and interwoven, ranging from traditional farming methods and regulatory complications to consumer behavior and climate change. However, by implementing laws and initiatives that promote sustainable farming methods, raising consumer awareness and education, and encouraging stakeholder engagement, we can overcome these challenges and create a more sustainable and resilient food system for the future.

CHAPTER V

DISCUSSION

1. Synthesis of Findings from the Literature Review and Legislative Analysis

The literature research and legislative analysis show that a complex interplay of economic, social, and environmental variables impedes the EU's transition to sustainable food systems.

Economic Factors

The economic impediments mentioned are mostly concerned with financial limits, market dynamics, and the structure of existing subsidies. Majority farmers are always afraid to execute sustained food production due to high costs of production. Changes in the market affects farmers decisions since they create income disruptions that makes farmers to fail to realize food sustainability.

Social Factors

Despite growing awareness, many consumers still lack a clear understanding of the environmental and social ramifications of their food choices. Cultural preferences frequently favor particular types of food that may not be compatible with sustainable practices, and major knowledge gaps exist between consumers and producers regarding the benefits and implementation of sustainable methods.

Environmental Factors

Climate change, biodiversity loss, and resource depletion are all major environmental issues. Unsustainable agricultural methods exacerbate these concerns, creating a vicious cycle that decreases food system resilience. Climate change effects, such as increased frequency of extreme weather events, exacerbate agricultural production and sustainability.

Responses to the Research Questions Based on Gathered Data

The collected statistics provide extensive insights into the underlying factors behind the European Commission's emphasis on developing a sustainable food system. The Commission's policies and strategies help to address the difficulties facing the European food industry.

Underlying Motivations

By 2050, the European Union is to become a climate-neutral continent thanks to the European Green Deal. Policies that promote sustainable farming practices such as organic agriculture, precision

farming, and agroecology are critical for reducing emissions, increasing biodiversity, and improving soil health. Environmental studies demonstrate that sustainable agriculture approaches can increase soil carbon absorption, reduce greenhouse gas emissions by up to 30%, and reduce pesticide use by 50%. All these benefits can help the Green Deal achieve its environmental and climate change objectives. The Green Deal's "Farm to Fork" initiative seeks to create an equitable, healthy, and environmentally sustainable food system (Wesseler, 2022). It seeks to promote better diets, lessen food waste, and increase the sustainability of food production. Reducing the usage of artificial fertilizers and pesticides is one of the measures. Research indicates that switching to organic farming and minimizing chemical inputs can greatly reduce pollution in the environment and enhance the quality of the soil and water.

Maintaining and enhancing biodiversity is essential to the long-term viability of farming and the food chain. The European Commission stresses the significance of putting into practice sustainable land management techniques, safeguarding pollinators, and maintaining natural habitats. (Arias-Navarro et al. 2018).

Two of the most essential parts of the European Commission's policy are to assist rural communities and ensure that farmers receive fair pay. To ensure social justice and economic resilience, policies should assist small-scale farmers and food producers, promote fair trade, and improve working conditions. Economic data show that, while SMEs in the food business have numerous challenges, they are critical to local economies and rural employment.

Promoting a sustainable food system aligns with public health goals because it encourages the development and consumption of healthier food options. Population health can be enhanced by reducing the use of hazardous chemicals in food production and increasing food safety standards (European Commission, 2021). Health data demonstrate a strong link between eating choices and health consequences. Policies that encourage people to eat healthier, more sustainably produced foods can help reduce the prevalence of long-term diseases such as obesity, diabetes, and heart disease.

Policies and Strategies

The food industry is a major contributor to environmental damage. Deforestation, soil degradation, greenhouse gas emissions, and biodiversity loss are some of the most serious environmental challenges (Ten Brink et al. 2001). Agriculture accounts for around 10% of the EU's overall greenhouse gas emissions.

Unsustainable farming methods lead to habitat loss, pesticide and fertilizer pollution of streams, and soil erosion. 45% of EU soils contain insufficient organic matter, which is required to maintain soil

health and fertility. According to the European Environment Agency (EEA), intensive farming methods reduce the variety of species in agricultural landscapes, which contributes to biodiversity loss.

Diabetes, obesity, heart disease, and certain types of cancer are becoming more widespread as diet-related health issues. Being overweight or obese affects more than half of all adults in the EU and is a major risk factor for a variety of noncommunicable diseases (Gallus et al. 2015). According to the European Heart Network, poor dietary choices account for 49% of all cardiovascular disease deaths in Europe. Diet-related disorders have a substantial financial impact; obesity alone costs the EU over €70 billion per year in lost productivity and medical expenses.

In the EU food sector, SMEs account for 99% of enterprises and provide a considerable number of jobs in rural areas. These enterprises' stability and profitability are affected by market and agricultural commodity price fluctuations. For example, significant price fluctuations have had an impact on the revenue stability of dairy producers in the EU (European Commission, 2020). Adoption of innovation is critical for competitiveness. Many SMEs struggle to find the financial and technological resources needed to implement cutting-edge technologies and environmentally responsible practices. It is critical to ensure a steady supply of nutritious, safe meals.

Geopolitical conflicts, volatile economies, and climate change can all disrupt the food supply chain. Extreme weather events such as droughts and floods are becoming more often because of climate change, putting food production at risk. According to the European Commission, if current climate trends continue, agricultural productivity might decline by up to 20% by 2050 (European Commission, 2020). Food waste is a severe issue in the EU, with 88 million tonnes lost each year, accounting for nearly 20% of total food production. This is not only a missed opportunity to promote food security, but it also wastes resources. Contamination and foodborne illnesses remain key challenges in food safety. In just one year, the European Food Safety Authority (EFSA) issued over 5,000 food safety alerts across the EU, highlighting the ongoing challenges in enforcing food safety regulations. A wide range of complex concerns impacting the European food industry necessitate comprehensive and well-coordinated responses. Food security and safety difficulties, public health concerns, SMEs' economic restraints, and environmental degradation must all be addressed. Incorporating data insights into policy formation can help to build more effective approaches to addressing these concerns, ensuring a resilient, sustainable, and just food system in Europe. The European Commission aims to create a framework that prioritizes sustainable practices, supports SMEs, ensures food security and safety, and promotes healthy eating habits.

Potential Barriers and Opportunities

Economic Factors

Financial hurdles, such as high costs and market dynamics, provide substantial challenges to sustainable practices (European Commission, 2021). The expense of shifting to sustainable methods might be prohibitively expensive for many farmers, particularly small-scale growers with low margins.

Critical social hurdles include consumer awareness, cultural preferences, and information gaps. Although there is growing consumer interest in sustainable food, major behavioral change is required to fuel market demand. Cultural preferences for specific diets and foods can make it difficult to embrace more sustainable habits.

Social Factors

Consumer awareness and behavior, cultural preferences, and knowledge gaps are critical social barriers. Although there is increasing consumer interest in sustainable food, widespread behavioral change is needed to drive significant market demand. Cultural preferences for certain diets and foods can also pose challenges to adopting more sustainable practices.

Environmental Factors

Climate change, biodiversity loss, and resource depletion are substantial environmental challenges. Sustainable agriculture practices that enhance soil health, conserve water, and promote biodiversity are essential to mitigating these challenges.

Comparison with Existing Literature and Theoretical Frameworks

This study's findings are consistent with current literature, emphasizing the need for comprehensive approaches that integrate economic incentives, social reform, and environmental conservation (Maziliauskas et al. 2018). Previous research emphasizes the significance of comprehensive policy frameworks that address the interconnectedness of these constraints. Theoretical frameworks such as the sustainable livelihoods framework and the theory of change propose that multi-stakeholder engagement is required to overcome these barriers. The sustainable livelihoods framework highlights the necessity of promoting varied, long-term livelihoods that can resist economic, social, and environmental shocks (European Commission, 2020). This framework promotes policies that improve access to resources, market access, and social capital in farming communities. The literature also underlines the importance of multi-stakeholder collaboration in developing sustainable food

systems. This requires collaboration among governments, private sector entities, non-governmental groups, and local communities.

Integrated Policy Recommendations

Based on the findings and their compatibility with existing literature and theoretical frameworks, numerous integrated policy recommendations emerge:

1. Use agricultural subsidies to promote sustainable practices. Provide financial incentives to farmers who use sustainable practices, such as grants, tax rebates, and low-interest loans.
2. Invest in comprehensive educational programs at all levels, from basic school to adult learning. These programs should emphasize the concepts of sustainable agriculture, the environmental consequences of food choices, and the advantages of biodiversity and climate-smart techniques.
3. Implement policies that benefit small-scale farmers by promoting fair trade, improving market access, and providing financial help. Strengthening smallholders' economic resilience can encourage the adoption of sustainable practices and improve food system equality.
4. Encourage agroecological techniques that increase biodiversity, improve soil health, and mitigate environmental damage. This involves crop diversification, organic farming, and integrated pest management.
5. Make climate-smart agriculture a priority by investing in technologies and practices that increase climate resilience. This approach relies heavily on water conservation, agroforestry, and the deployment of climate-resilient crop types.
6. Create and implement regulatory structures to encourage sustainability. Establish explicit criteria for sustainable farming techniques, monitor compliance, and levy fines for noncompliance.
7. Encourage multi-stakeholder collaboration to maximize varied expertise and resources. Partnerships among governments, business sector entities, non-governmental organizations, and local communities can improve the efficacy of sustainability efforts.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

1. Summary of Key Findings

The report outlines major economic, social, and environmental hurdles to sustainable food systems in the European Union. Addressing these impediments necessitates extensive and integrated policy initiatives that consider the diverse nature of the difficulties.

Economic barriers are especially prominent in agriculture, as small-scale farmers face stiff competition from larger agribusinesses. This discrepancy is worsened by market volatility, which can result in inconsistent revenue for farmers and discourage long-term investments in sustainable methods. Furthermore, current financial incentives frequently favor high-yield, intensive farming methods over more sustainable alternatives. This imbalance impedes the adoption of sustainable practices, which are critical to long-term food security and environmental health.

Social obstacles are also important, with consumer behavior playing a critical role in influencing food systems. There is a pervasive lack of understanding regarding the environmental and social consequences of food choices. Furthermore, socioeconomic disparities cause unequal access to healthful food, with low-income households frequently having the most difficult obstacles.

Educational initiatives and policies that encourage fair access to nutritious food are critical for overcoming these obstacles.

Unsustainable farming practices, which cause soil degradation, water scarcity, and biodiversity loss, are primarily responsible for environmental barriers. Climate change exacerbates these difficulties, resulting in a feedback cycle that reduces food system resilience. Addressing these environmental issues necessitates a shift toward agroecological techniques that increase biodiversity, improve soil health, and lower greenhouse gas emissions.

The potential impact of the proposed framework on the EU and global food markets.

Implementing the suggested framework could result in a more resilient and sustainable food system in the EU, perhaps influencing global food markets by creating an example for other countries to follow. The concept focuses on integrated policy solutions that address economic, social, and environmental impediments holistically.

2. Potential Impact of the Proposed Framework on the EU and Global Food Markets

Implementing the proposed framework could lead to a more resilient and sustainable food system in the EU, with potential ripple effects on global food markets by setting a precedent for other regions

to follow. The framework emphasizes integrated policy interventions that address economic, social, and environmental barriers holistically.

3. Recommendations for Policy Implementation

To achieve the potential benefits indicated above, the following policy proposals are put forward:

1. Policymakers should assess and realign agricultural subsidies and financial incentives to encourage sustainable practices.
2. Governments and non-governmental groups should work together on comprehensive educational efforts to create awareness about the benefits of sustainable food systems.
3. Policies should be developed to help small-scale farmers by promoting fair trade, providing market access, and offering financial aid.
4. The use of agroecological methods should be encouraged through research, extension services, and farmer training.
5. Policymakers should emphasize climate-smart agriculture by investing in technologies and practices that increase resilience to climate change.
6. Policies should be implemented to provide equal access to healthful meals for all socioeconomic categories.
7. The EU should take the lead in worldwide efforts to promote sustainable food systems, engaging with other nations and international organizations.

Policymakers, stakeholders, and future research should consider the following recommendations.

4. Policymakers

1. Policymakers should restructure agricultural subsidies to favor sustainability.
2. Current subsidies frequently favor intensive, high-yield farming practices that are harmful to the environment.
3. In addition to reforming subsidies, governments should give financial incentives for sustainable practices.
4. Comprehensive education and training initiatives are critical to the widespread adoption of sustainable practices.
5. Policymakers must design and implement strong regulatory frameworks that support sustainability.

5. Stakeholders

1. Stakeholders, including farmers, food processors, merchants, and consumers, should work together to share information and resources. Cross-sector collaboration can ease the exchange of best practices and promote innovation.

2.Stakeholders should fight for policies that promote sustainability. 3.Stakeholders should take proactive measures to incorporate sustainable practices into their operations. 4.Stakeholders should involve consumers in the transition to sustainable food systems. 5.Stakeholders should support community-based programs that encourage local food production and consumption.

6. Future Research

1. Future studies should investigate the long-term effects of sustainable practices. 2.Researchers should focus on creating new answers to growing difficulties in sustainable food systems. 3.Future study should broaden the area of analysis to encompass a wider range of geographical regions, farming systems, and socioeconomic circumstances. 4.Researchers should concentrate on gathering and analyzing information on the adoption rates, costs, and advantages of sustainable practices. 5.Future study should assess the efficacy of current and newly adopted policies.

7. The limitations of the study

The study's shortcomings include potential biases in the literature evaluated, the changing nature of EU policy, and the need for additional empirical evidence to support the recommended recommendations. The changing character of EU policies also poses a hurdle. As policies evolve in response to new knowledge and changing circumstances, the study's results and recommendations may need to be reviewed and updated on a regular basis. Furthermore, the study emphasizes the necessity for further empirical evidence to confirm the given recommendations. Many of the recommendations are based on theoretical frameworks and case studies, which, while useful, need more empirical validation.

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