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Review Article

A REVIEW ON ISSUES AFFECTING SUSTAINABLE AGRI-FOOD SUPPLY CHAIN

Mustafa Kan [*1], Humera Amin [2]

[1]*Kırşehir Ahi Evran University, Agriculture Faculty, Department of Agricultural Economics, Kırşehir, Turkiye*
[2]*University of Sargodha, Department of Agricultural Extension and Rural Studies-Pakistan*
**Corresponding author: mustafa.kan@ahievran.edu.tr*

Abstract

The objective of this article is to provide a critical assessment of prior literature on agri-food supply chain issues. Today, our world faces many problems, such as population growth, rapid and unbalanced urbanization, environmental pollution, and especially climate change, which make the concept of sustainability topical. The increase in agricultural production in line with the principle of sustainability and the guarantee of equitable distribution are among the strategic goals of many countries. The agricultural sector is both necessary and ancient, as it meets people's necessities for food, clothing, and shelter. Each country is mainly responsible for achieving its citizens' healthy, reliable, and accessible food needs and is supported to varying degrees, including food security and food safety. The equilibrium between population growth and increase in production mentioned in Malthus' "Population Theory" at the end of the 18th century has not yet been experienced in total production. But there is certainly a problem of distribution and sharing. Although technology is an important factor in the theory that has not yet been realized, it would not be wrong to say that the increase in nutrients has not reached the desired speed, despite the rapid growth of the world's population today. The problems that will arise when natural resources are exhausted in the future will be the world's acid test. With this study, an evaluation has been made on the changes and effects that have occurred in recent years on the agri-food supply chain. Especially the breaks in the agri-food supply chain, and the results of these breaks have been revealed with statistical data. In this regard, an evaluation has been made on the Grain Corridor, which Turkiye has played especially in the Ukraine-Russia war in recent years, and it has been revealed how a deterioration in the agriculture-food supply chain affects food security in the World. The document analysis method was used to investigate the research question of significant events influencing SFS (Sustainable Food System) today.

Keywords: Sustainability, Food Security, Agri-Food Supply Chain, Grain Corridor
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1. INTRODUCTION

The agricultural sector is crucial for meeting human food, clothing, and shelter needs. Countries are responsible for meeting healthy, reliable, and accessible food needs, with food safety policies supporting food security and safety. Despite a shift from industry to services, no country has underdeveloped agriculture. Agricultural policies are essential for countries, and while liberalization in world goods trade has been limited, developed countries often intervene with market-distorting support policies to ensure food security due to the agricultural sector's strategic location.

The world faces challenges like population growth, urbanization, pollution, and climate change, emphasizing the importance of sustainability and agriculture in meeting basic needs (Maslow, 1943), is undeniable. It is theoretically inconceivable to have other needs without meeting the basic needs of the world's population, which is expected to approach 9 billion by 2035 and 10 billion by 2050 (UN, 2019; Woldometers, 2019). Malthus' "Theory of Population" suggests that distribution and sharing issues persist despite population growth and production

increase. Technology plays a role in this, but the speed of nutrient increase is not reaching the desired level. The future of natural resources will be crucial. Many countries aim to increase agricultural production while respecting sustainability and ensuring equitable distribution. Hunger and malnutrition are major global issues, causing thousands of deaths annually. Sustainable food supply is crucial for meeting growing population needs and ensuring a livable world for future generations (Jurgilevich et al., 2016; Holden et al., 2018; EPA, 2019; Searchinger et al., 2019; Vågsholm et al., 2020; Cassani and Gomez-Zavaglia, 2022). For this reason, the actors and their roles in the agricultural food supply chain are important for the sustainability of production.

Food systems encompass the production, collection, processing, distribution, consumption, and disposal of food products from agriculture, forestry, or fisheries and the entire spectrum of actors involved in parts of the wider economic, social, and natural environments in which they exist, and their interconnected value-adding activities (FAO, 2018). A sustainable food system (SFS) is a food system that ensures food security and nutrition for all without compromising the economic, social, and environmental foundations that will ensure food security and nutrition for future generations (FAO, 2018). In this context, SFS;

- Profitable across the entire system (economic sustainability),
- Having numerous advantages for society as a whole (social sustainability),
- Has a beneficial or neutral effect on the environment as a whole (environmental sustainability).

Alternative production and consumption ways are required to develop a more durable and sustainable food system (Macfadyen et al., 2015).

Fresco (2009) defines a sustainable food system as resource and energy-efficient, productive, and sensitive to changes. Food inflation fluctuations, caused by the debate over disruptions in the agri-food supply chain, pressure inflation (OECD, 2020; Advanced Mobile Group, 2022; Aminetzah et al., 2022; Chari et al., 2022). The global food system prioritizes cheap fossil fuels over modern technology, with high commercial competition and global partnerships for competitive advantage. (Roberts, 2008; Ackerman et al., 2014). Some scientists state that the global food system is in crisis due to increasing environmental externalities and its consequences on agricultural production (Vermeulen et al., 2012; Tilman and Clark, 2014). Concerns about environmental impacts such as land, soil, and water degradation, deforestation, and loss of biodiversity are among the factors that negatively affect the food system (UNEP, 2010; Wiskerke, 2009). The agricultural sector requires a multidimensional strategic planning approach due to its close relationship with economic employment, foreign trade, food, health, environment, and tourism policies. Underdeveloped and developing countries prioritize agriculture-based industries, focusing on food safety, veterinary, and phytosanitary conditions. Target-9, "Industry, Innovation and Infrastructure," is crucial for creating innovative structures, while Goal-12, "Responsible Production and Consumption," focuses on preventing wasteful consumption. Recent developments, such as the Ukraine-Russia food crisis, climate change, COVID-19, and food waste, contribute to the sustainable agriculture-food chain.

2. Materials and Methods

The article examines the function of documents as a data source in qualitative research and discusses the document analysis procedure in the context of actual research experiences. The main methodology of the study consists of the evaluations made by compiling the studies on this subject through document analysis, which is one of the qualitative research methods. It describes the nature and forms

of documents, outlines the advantages and limitations of document analysis, and offers specific examples of document use in the research process (Glen and Bowen 2009).
Qualitative research in the social sciences can be defined as “research that uses qualitative data collection techniques, such as observation, interviews, and document analysis, and follows a qualitative process to reveal perceptions and events realistically and holistically in a natural environment" (Yıldırım and Şimşek, 2008). In this context, national and international articles, reports, opinions, and statistical data were used as material.
There are many obstacles to SFS. In this study, the document analysis method was used to examine the research question of important events affecting SFS today. Document analysis is a scientific research method defined as the collection, review, questioning, and analysis of various documents as the primary source of research data. This study is based on the major issues affecting SFS today: climate change, global pandemics (COVID-19), the Ukraine-Russia war, and losses and waste in the food supply chain.

3. RESULTS AND DISCUSSION

3.1. Agri-Food Supply Chain

The agriculture food supply chain (AFSC) produces and delivers agricultural products from production to consumption through a series of stages. Each stage of AFSC adds a distinct worth to the end product. The raw produce is manufactured at the production stage and then processed at the processing stage. After processing, it is stored at distribution facilities before being delivered to different retailers. Consumers get their produce from retailers. Farmers, consumers, agricultural suppliers, food processors, and distributors, non-governmental organizations (NGOs), national and international agriculture organizations, government, related associated institutions, and others are among the AFSC stakeholders (Viswanadham and Kameshwaran, 2013). The management of food supply chains is a constantly evolving field that encompasses all facilities, operations, and activities involved in the movement and change of products and services, from raw materials to consumers and the associated information flows. Agri-food supply chain management, on the other hand, is a rapidly evolving field, with climate change, product preservation, changes in consumer preferences, a diverse set of stakeholders, and concerns about the environment all posing significant challenges to chain growth and efficiency measurement as seen in Fig. 1.

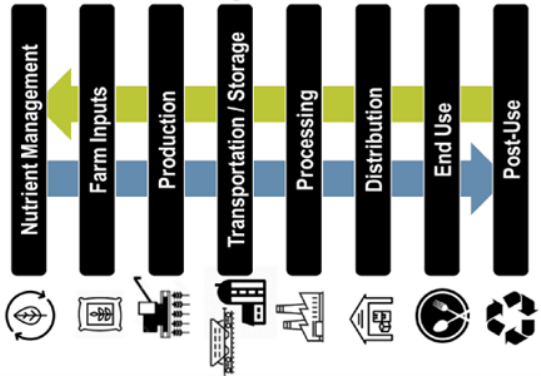

Fig. 1. Agri-Food Supply Chain (adapted from Humphrey, J. and Memedovic O. (2006)

3.2. Agri-Food System

The agri-food system, as a multifaceted and interconnected system, is influenced by environmental and socioeconomic variables and includes a variety of processes such as production, processing, distribution, preparation, and consumption. However, the current state of the ecosystem, as well as problems with the environment, have a direct impact on productivity in agriculture. To make the agri-food supply chain more sustainable, all stakeholders must work together to improve existing working methods (Tümenbatur, 2022).
An environmentally friendly food system combines both sustainable food security and sustainable food security ideas. It is generally recognized that a comprehensive security of food idea must incorporate the following four fundamental elements:
• Availability of food: Ensuring there's always sufficient food for everybody.

• Accessibility of food: A sufficient supply of healthy food on a national or international scale, as well as financial and physical access to food that is frequently available
• Stability of food: Sustainable food production and management,
• Utilizing food (utilization): Everyone gets sufficient energy and nutrients; the body makes the most beneficial use of different nutrients, and there is sufficient for everyone (FAO, 2008).

3.3. World Food Supply Issues

The world's food supply has contracted for various reasons in recent years. There are several reasons for this reduction, including;
• Climate change-induced contractions in the production supply
• Production constraints because of limited labor supply, primarily due to mobility limitations caused by war and pandemics,
• Utilization of agricultural inputs is difficult, particularly because of war and climate change, resulting in crop losses and degradation in the supply chain.
• The interruptions in the production of food because of obstacles to obtaining energy resources.
• Problems caused by waste and losses in the supply chain

Most of these are supply-side distortions, while demand-side shocks cause significant supply contractions. Covid-19 restrictions, quarantines, global unemployment, and loss of income due to price inflation in recent years can all be attributed to demand-side contractions. The most recent improvements in these variables, effective in forming a sustainable agriculture-food system, are discussed under the headings and presented below.

3.4. Climate Change

Climate change causes a threat to the operation of food systems. Increased temperatures, harsh and unpredictable weather conditions, and disturbance of water cycles are already reducing staple crop yields in certain regions of the world, posing serious risks to agricultural ecosystems, food security, and a lot of food-dependent livelihoods. As a result, the relationship between the changing climate and food systems requires two distinct analyses. When analyzing the relationship between climate change and the food system, it is clear that it is examined in two parts (HLPE, 2017). The first is the food supply chain; the second is the food environment (Fig. 2).

Fig. 2. Two Sides of Food Systems (HLPE, 2017)

Fig. 2 shows all stakeholders that contribute to the food system in any particular setting worldwide. The main issue here is to streamline the extent to which every stakeholder is impacted by climate change. However, in general, the effect of climate change on the food system can be classified into the following categories.

- AGRICULTURE
  - Temperature, Water, and CO2
  - Ground-Level Ozone
  - Pests
  - Pollinators
  - Agricultural Labor
  - Nutrient Losses
- FISHERIES
  - Sea Temperature Rise
  - Ocean Acidification
  - Nutrient Quality
- ANIMAL HUSBANDRY
- EFFECTS ON FOOD SECURITY AND NUTRITION
  - Conflicts
  - Increases in Prices of Staple Foods

- GDP Growth
- Food Utilization and Disease
- Volatility

The indicators and goals developed within the framework of the United Nations' Sustainable Development Goals, which were published in 2015, are primarily concerned with both indirect and direct use of land, the production and distribution of food, health, and food security. The United Nations Food and Agriculture Commission defines a sustainable food system as one that ensures adequate nutrition and food security for subsequent generations while offering access to safe nutritious food on social, environmental, and economic grounds. (UN, 2020). Climate change is one of the most significant barriers to long-term sustainability. Climate change currently hurts agri-food security. As a result, to ensure the food system's sustainability, it is critical to assess the agricultural sector's ecological efficiency and create more efficient resource-use processes. Climate change affects all interconnected food system actors and processes, including production, processing, distribution, consumption, and disposal. Most significantly, global food value chains contribute up to 34% of climate-changing greenhouse gas (GHG) emissions. Agriculture, land utilization, and land use change activities are the first to contribute to changing the climate, resulting in approximately 71% of these emissions (Crippa et al., 2021).

Yet there are various methods to the effect of global warming on the food system, and the points discussed are largely similar. In the study carried out by Owino et al., (2022), the effect of climate change on the supply chain for the agricultural food and food system was set to be revealed, as shown in Fig. 3. When Fig. 3 is examined, it becomes clear that climate change is a more complicated framework, affecting not only the agricultural food supply chain but also the nutritional value of food and its effect on human health. As a result, it is becoming clearer that the food system should be approached from multiple perspectives.

3.5. Pandemics-Covid-19

Furthermore, to the economic crises we've seen, global climate change and the Covid-19 pandemic process, which has been ongoing since 2019, have threatened countries' security of supply and agricultural production approaches. The adverse effect of the Covid-19 pandemic has resulted in increased use of sustainability and health and safety terminology, not only in food supply security but also throughout the food supply chain. Along with these variations and changes, problems that involve sufficient

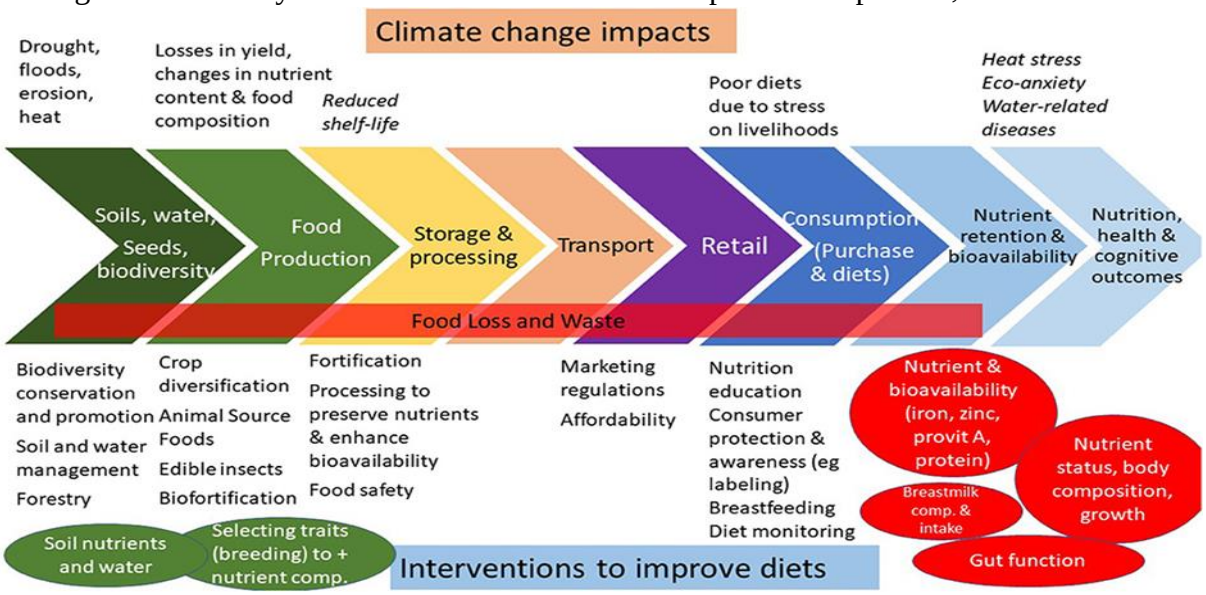

Fig. 3. The impacts of climate change on food system (Owino et al., 2022)

agricultural production, environmental sustainability development, life in rural areas, policies that preserve the natural environment, policies that ensure the uninterrupted regularity of the agri-food supply chain, individual safety and welfare, seasonal employees in agriculture, and logistics are becoming more important in food security. The COVID-19 pandemic has highlighted the importance of ensuring a sustainable and nutritious food supply. Because virtually all expenses were cancelled during the quarantine period, consumer interest in the sector increased due to the necessity of food.

The COVID-19 epidemic, which influences the lives of billions of people, has caused periodic food insecurity, with adverse effects such as economic downturn, interruptions in food systems, and threats to human health. The epidemic has challenged the national and international health systems and demonstrated the fragility of food supply chains and how effortlessly they can deteriorate (Béné, 2020). Circumstances that threaten food security during the COVID-19 epidemic include reduced crop production, restrictions on trade, as well as supply chain difficulties (Laborde et al., 2020).

Through the changing global economy, the supply chain has become a more dynamic structure in which decisions are made more quickly. Along with this, with each future project, manufacturers and suppliers are expected to work together. As consumer demands become more environmentally conscious, organizations are starting to change their supply chain structures into more sustainable ones. The fact that supply chain developments are predominantly exhibited in digital technologies has resulted in establishing sustainable resource planning, customer relations, and environmentally friendly logistics services in industries. Many activities, such as supply keeping, transportation, managing inventories, and demand forecasting, are optimized due to process digitalization. With the surge in e-commerce demand during the COVID-19 process, technological advancements have become increasingly important in the supply chain.

The COVID-19 global epidemic has shown how fragile food supply chain processes, such as agricultural production and processing of food, are when interrupted by illness among food supply chain workers.

Foods like vegetables and fruits, which expire quickly and are unable to preserve their freshness for long periods regardless of dependable storage conditions, remain on the farm and in their original state in the face of both supply and demand-side events and are not delivered to consumers, resulting in significant waste as well as price increases. This situation, which reduces consumers' financially access to food, has resulted in a shortage of food for certain areas of society.

The food supply chain is critical in addressing the issue of food access during the COVID-19 epidemic for two distinct reasons. First, a lack of food can result in a deficiency in critical nutrients and calories required to combat disease symptoms in the early stages. Second, the trend towards low-nutrient and low-quality food because of reduced revenue will likely cause medical issues such as diabetes, overweight, and hypertension, which may harm the body's immune system (O'Haraa and Toussaint, 2021).

3.6. Wars in the World - Two Sides of Medal: Production and Consumption

The Covid-19 epidemic, logistics slowdowns, severe health regulations in sea and land transportation, and many countries' restrictions on exports of agricultural products have all contributed to an increase in global food prices. As the impact of pandemic-related issues on food availability and cost continued to fall, Russia and Ukraine went to war on February 24, 2022. The war disrupted logistics, hampered the food supply chain, and forced the closure of ports and major commercial enterprises.

Furthermore, the fact that Russia and Ukraine are the world's suppliers of several essential foods has influenced the consequences of the war on food security (they account for 27-30% of global barley exports, 30-34% of wheat exports, and 17-20% of maize exports). Maize and wheat production dropped by millions of tons due to the maintenance of crops and harvesting issues during the cultivation season of the war in Ukraine. Furthermore, Russia's natural gas export contribute to 20% of global trade (soaring energy prices raise the price of manufacturing energy-intensive inputs like fertilizers and pesticides). Russia exports approximately 15% of the world's potassium and nitrogen fertilizers. Belarus, a wartime participant, accounts for approximately 15% of global potassium-based fertilizer exports, and restrictions on trade have raised worldwide prices for fertilizer (UHK, 2022). Countries have been known to stockpile, cut off, or prohibit exports, while individuals have been known to stockpile basic commodities in response to food insecurity and panic. All of this, combined with major challenges in obtaining food, has resulted in substantial rises in worldwide food costs and inflationary trends, even in countries that have never experienced price inflation.

Although the worldwide production of wheat is estimated to be 778 million tons, consumption is expected to be 788 million tons, with stocks expected to fall. But the main issue is the drop in production in Ukraine this season, which is expected to be much more dramatic next season, and the inability to deliver to the world's markets goods which were in storage last season as well as those manufactured this season due to the war. Furthermore, as a result of the issues caused by the war and the restrictions Russia is having difficulty supplying its goods to markets, albeit not to the same extent. These circumstances have caused cereal product prices (Fig. 4) to reach levels that communities are unable to afford because of to the challenges of providing the market with variables such as energy, fertilizers, and pesticides, that are having a direct impact on expenses, as well as price increases.

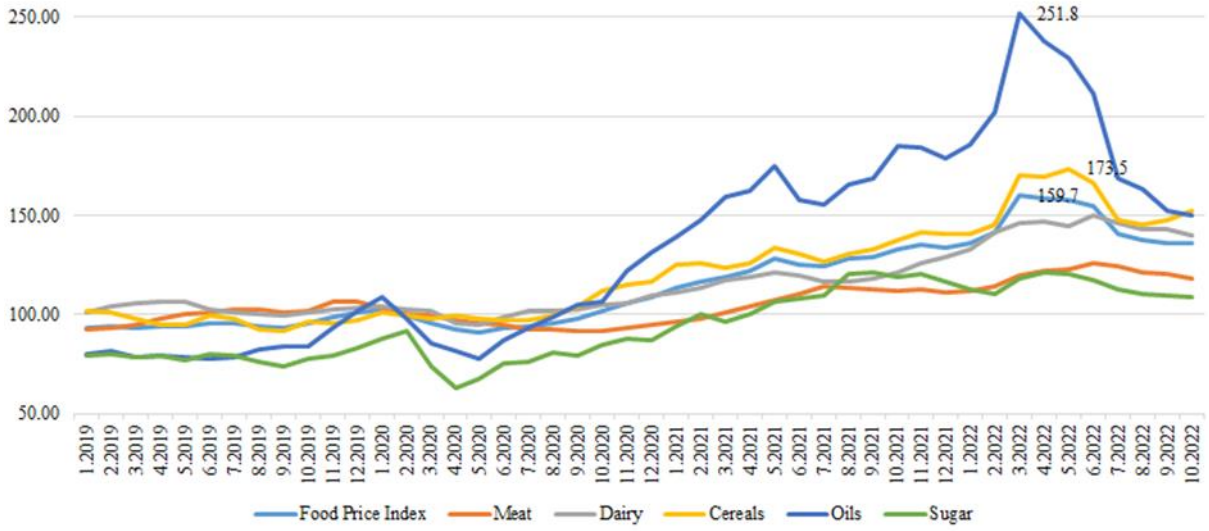

Fig. 4. The impacts of the Ukraine-Russia War on food system (FAO, 2022)

The Food and Agriculture Organization of the United Nations (FAO) has created a "early warning tool" known as the Food Price and Monitoring Analysis (FPMA). Following the 2008 and 2011 food crises, the FAO developed a "early warning indicator to identify unusual increases in prices in markets for consumers in the developing world" (Baquedano, F. G. (2014). The FPMA uses a wide range of sources of information to feed their database. While some parts of the world, particularly many African countries, are already at risk of famine because of

drought, the situation is escalating and becoming a humanitarian disaster as a result of problems with supplying or high prices for cereals, which are basic foodstuffs. Actually, the cost of bread wheat, which was 250 dollars per tons before the epidemic, raised with the epidemic and, with the addition of the war, hit a level of approximately 500 dollars (Fig. 5).

Turkey has resumed its balanced negotiations with both sides, as well as its pro-peace stance, which it has maintained since the outbreak of the war. The "Grain Corridor" agreement was signed on July 22, 2022, by the United Nations Secretary General, Turkiye's President Recep Tayyip Erdoğan, along with relevant ministers from Russia and Ukraine. The agreement guarantees the secure delivery of grains and other comparable goods to world markets via three Ukrainian ports. According to the memorandum, the "Coordination Center" to be established in the city of Istanbul will be in charge of the plan's execution and control. Turkiye's tireless efforts resulted in the establishment of the Coordination Center on July 26, 2022, and its activities began in Istanbul shortly thereafter. The process of loading tons of grain products onto ships at Ukrainian ports has begun, and it was recently announced that the goods will be on their way to global markets in a very short period of time under the Coordination Center's monitoring and preparation. The anticipated consequences of the Grain Corridor agreement are as follows: (Dellal, 2022).

• To reduce the risk of malnutrition and hunger of the population in developing and underdeveloped countries,

• Preventing social problems, especially a new wave of migration,

• Supply of chemical fertilizers that will be needed in the coming production periods.

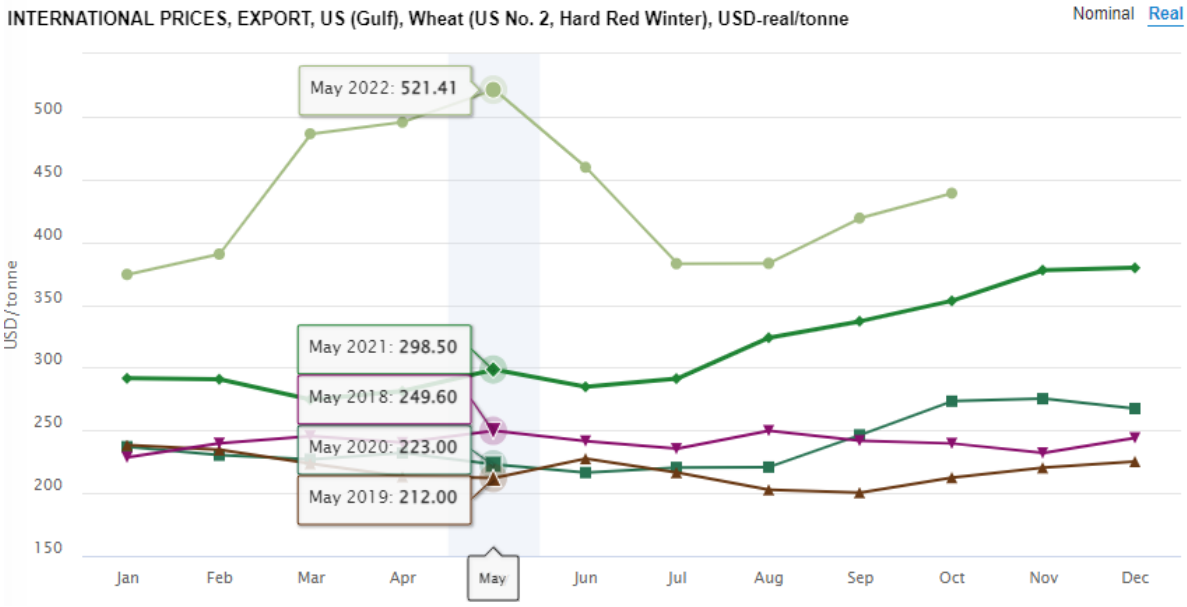

Fig. 5. The impacts of the Ukraine-Russia War on international prices (FPMA, 2022)

With these reasons, rapid decreases in grain price tags have been observed, which have begun a pattern of decline with the reduction of the pandemic effect and the impact of harvest quantity (Fig. 6). Bread wheat prices, which had risen to 450 dollars per ton, have now fallen to 358 dollars. Durum wheat prices fell again to $455 and barley prices to $318. 431 ships have traveled across the "Grain Corridor" established as a result of Turkiye's initiatives to mitigate the danger of a "food crisis" due to the Russia-Ukraine war, and the total quantity of grain transported is

now approaching 12 million tons (MoAF, 2022; UN, 2022).

Ships delivered ten different types of cargo, including the seeds of sunflowers, sunflower meal, oil from sunflowers, barley, maize, wheat, soybeans, beet sugar, pea, and canola seed. While countries with a small need for more than 60% of the goods to be transported by sh ips, the countries who require it most, nevertheless, remained at six percent (Fig. 7.) (MoAF, 2022; UN, 2022).

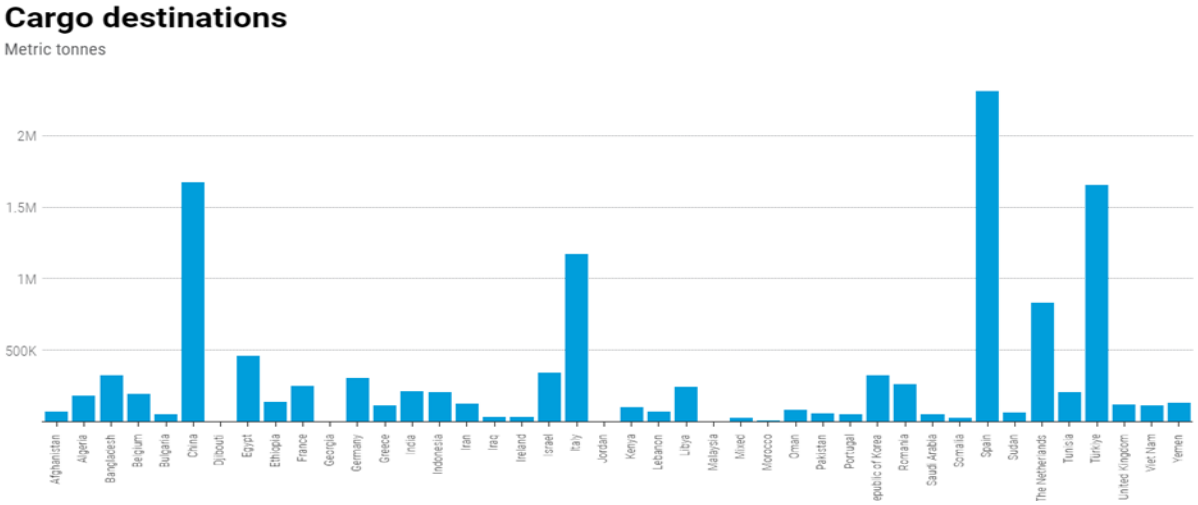

Fig. 7. The cargo destination of the ships (UN, 2022)

3.7. Food Loss and Waste

Food waste and loss can be defined as quantity decreases and/or losses in quality in the chain of supply of edible food intended for human consumption.

Fig. 8. Food loss and waste in the food supply chain (Onethird, 2022)

The main distinction between waste and loss of food is that they occur at different points along the supply chain. Food loss is defined as the food lost before reaching the final customer in the supply chain of food suitable for utilization. In contrast, food waste is the loss of food that reaches the final consumer but cannot be consumed for multiple reasons (Yıldırım et al., 2016). In another way, food loss is a reduction in the quantity or quality of food caused by decisions and actions taken by food suppliers along the supply chains, excluding sellers, providers of food services, and customers. Food waste is a reduction in the quantity or quality of food caused by the decisions and actions of retailers, providers of food services, and consumers (FAO, 2019). Fig. 8. shows the stages of food loss and waste.

Food losses and waste are typically addressed in five stages throughout the agriculture and food supply chain: crop production, after-harvest storage and processing, packaging, and processing, distribution, and consumption. The stages in which the loss of food is more prevalent according to the socioeconomic level of the countries show significant variations (Fig. 9.). Food loss is more common in developing countries during the initial stages of the supply chain. This is due to technological, financial, and management constraints in harvesting techniques and storage and cooling infrastructure. Food waste occurs higher in the supply and demand chain in countries with high and middle incomes. In contrast, waste and losses are primarily the result of consumer

behavior. Even though the causes and stages of the identification of losses vary among developed and developing countries, the amounts are relatively similar. On a global scale 14 percent of food valued at approximately USD400 billion is lost from harvest up to, but excluding retail (FAO, 2019). 17 percent more gets wasted at both the consumer and retail levels (UNEP 2021). In 2019, households, retailers, restaurants, and other types of food services discarded an estimated 931 million tons of food, or 17% of the total food available for consumers (UNEP, 2022). Globally, vegetables and fruit, as well as root and tuber crops are the most frequently lost and wasted food group (FAO, 2013).

The agricultural field, which is linked to various sectors ranging from industry to food and livestock to the chemical-based sector, has grown in importance and strategic importance as the worldwide population has increased. Globally, the

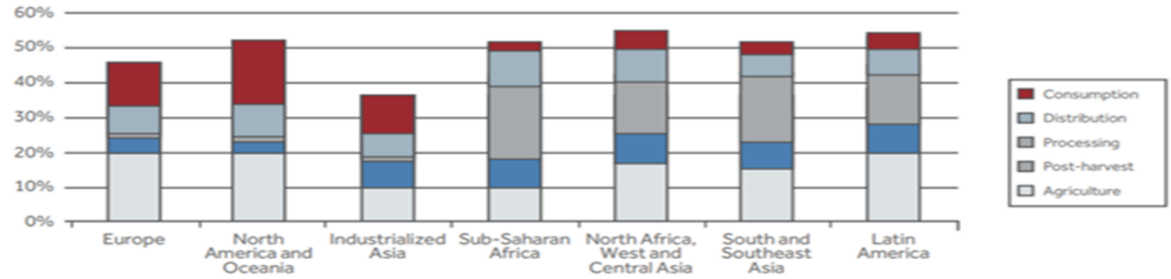

Fig. 9. Food loss and wastage rates by region (Rezaei and Liu, 2017)

availability of food and dietary problems have reached an unprecedented level in every part of the world, owing to the current division of water use into more denominators and the problem with natural resources. As the worldwide population grows, so does the amount of waste produced, and food waste has an important effect on the worldwide climate change crisis. We use additional land to grow more food, utilize pure water, contaminate the environment with chemical fertilizers, reduce ecosystems, and increase global warming and environmental damage through increased greenhouse gas emissions. According to the World Food Organization, roughly one-third of the food we produce is wasted, resulting in the consumption and pollution of our natural resources. This situation leads to increased absorption of carbon, inappropriate use of agricultural land, wastewater, and chemicals that harm the blue planet.

SDG target 12.3 of the globally recognized Sustainable Development Goals (SDGs) focuses on reducing food loss and waste. The FAO maintains some of the most essential records on food losses. In this regard, the record set developed through processing 29.00 pieces of data gathered from over 700 sources provides helpful data about the geographic distribution of food losses. When the Fig. 10. is examined, Food losses have decreased significantly, particularly between 2019 and 2021. In this case, the Covid-19 pandemic is a significant factor. As administrators of this target, FAO and the United Nations Environment Program (UNEP) assess and track progress toward reducing the waste and loss of food using the Global Waste and Loss of Food Index.

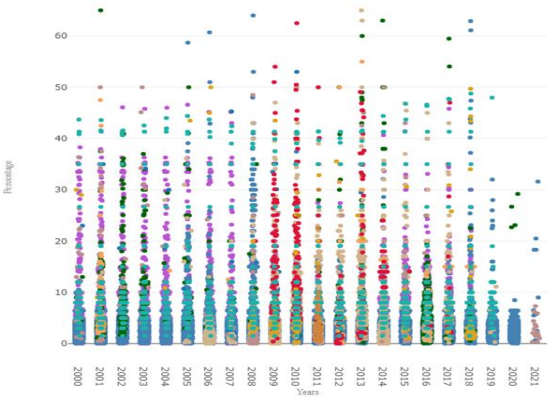

Fig. 10. Food loss as a percentage of domestic Production (FAO, 2021)

4. Conclusion

The agricultural system focuses on providing adequate agricultural production, delivering food to all segments of society, and ensuring sustainability. It includes logistics, infrastructure, storage, and supply security measures. Limiting agriculture to production planning doesn't fully address the system's holistic planning. Countries implement measures like support, direct interventions, prohibition, rulemaking, market inclusion, supervision, and awareness raising. However, market interventions may not always yield the desired results, necessitating structural reforms to make the agri-food supply chain sustainable.

To ensure global food security, studies are being conducted on the agri-food supply chain, focusing on reducing resource pollution, increasing efficiency, developing biochemical, substituting animal protein with plant-based alternatives, reshaping consumer habits, shortening the supply chain, preventing food loss and waste, and using multidisciplinary approaches like genetic studies for efficient seeds.

Population growth and climate change are causing vegetation loss, necessitating productive lands for food security. The global food system can contribute to climate change mitigation and adaptation by adopting low-GHG emissions, reducing food waste, and adopting lower-impact diets. Careful consideration of energy crops and bioenergy is necessary to avoid food security risks. The World Bank aims to achieve these goals by 2030.

The text emphasizes the importance of sustainable income-increasing activities for rural poor, increasing agricultural productivity, developing livestock, aquaculture, and fisheries, establishing market connections, providing job opportunities, ensuring economic structural transformations, ensuring food availability, combating animal diseases, and managing natural resources efficiently.

Sustainable food security is crucial, particularly in the international arena, with public stock programs for food safety being a priority for developing countries. The 12th Ministerial Conference in Geneva, Switzerland, made two significant decisions for sustainable food systems due to Covid-19. The first was the agreement on fisheries subsidies to control harmful subsidies causing overfishing and eliminate illegal fishing practices. The second decision was to continue not imposing customs duties on electronic transactions, enabling consumers to access digital platforms and small businesses to market globally. The WTO also agreed to exclude food purchases from the World Food Program to address food export issues during crises. Working together in the international arena is essential for food system sustainability.

5. Recommendation

• To promote global food security, research studies are carried out on the agri-food supply chain, focusing on decreasing resource pollution and improving productivity.

• The global food system can help mitigate and adapt to climate change by minimizing greenhouse gas emissions, minimizing food waste, and adopting low-impact diets.

• Countries execute various policies, including subsidies, direct interventions, restrictions, legislation, market participation, supervision, and public awareness.

6. Conflict of Interest

The author declares no conflict of interest.

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