ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

THE LINK BETWEEN THE TURKISH WHEAT SECTOR AND THE SUSTAINABLE DEVELOPMENT GOALS; ALONG WITH RECOMMENDATIONS FOR TURKEY'S SDG 2050 TARGETS

M.Sc. THESIS

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ISTANBUL TEKNİK ÜNİVERSİTESİ ★ LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ

TÜRKİYE BUĞDAY SEKTÖRÜ VE SÜRDÜRÜLEBİLİR KALKINMA HEDEFLERİ ARASINDAKİ BAĞLANTI; TÜRKİYE'NİN SKH 2050 HEDEFLERİ İÇİN ÖNERİLERLE BİRLİKTE

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To my mother and father,

FOREWORD

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ABBREVIATIONS

CDP : Carbon Disclosure Project
CE : Circular Economy
CGF : Consumer Goods Forum
CSR : Corporate Social Responsibility
ESG : Environmental, Social and Governance
FAO : Food and Agriculture Organization
FLW : Food Loss and Waste
FSA : Food Safety Association
GRI : Global Reporting Initiative
GHG : Green House Gas
ICE : Istanbul Commodity Exchange
IFAC : International Federation of Accountants
NGO : Non-governmental Organizations
OSP : Official Statistics Program
RERA : Renewable Energy Resource Areas
SDG : Sustainable Development Goals
SPO : Soil Product Office
TSDG : Turkey Sustainable Development Goals
UN : United Nations
UNIDO : The United Nations Industrial Development Organization
UNFCCC : United Nations Framework Convention on Climate Change
VNR : Voluntary National Review
WHO : World Health Organization

SYMBOLS

° C	**:** Degrees Celsius
CH_4	**:** Methane
CO_2	**:** Carbon Dioxide
Gwh	**:** Gigawatt Hours
Km^3	**:** Kilometres Cubed
mm	**:** Millimeter
N2O	**:** Nitrous Oxide
TL	**:** Turkish Lira

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THE LINK BETWEEN THE TURKISH WHEAT SECTOR AND THE SUSTAINABLE DEVELOPMENT GOALS; ALONG WITH RECOMMENDATIONS FOR TURKEY'S SDG 2050 TARGETS

SUMMARY

This study emerged with the aim of elucidating the connections between the wheat sector and sustainability in Turkey. Here, the selection of wheat, as in many countries, is due to its fundamental role as a staple food source in Turkey and its significant proportion within agriculture in the country. The main objective of the study is to demonstrate the relationship between the Sustainable Development Goals (SDGs) proposed by the European Union and ESG (Environmental, Social, and Governance) principles with the wheat sector. To achieve this, four main goals that could be pursued in alignment with the wheat sector were selected, and the statuses of these goals in Turkey were examined using both reports and analytical data. The desired evidence here is to demonstrate the interrelations among the four selected SDGs, their connections with the wheat sector, and their linkage with ESG principles. Since the four SDG titles selected here are general descriptions, they have been linked to the wheat sector with subheadings to make the study more efficient. For example, under SDG 13 Climate Action, subheadings such as temperature and precipitation levels that could affect the wheat sector were selected as filtering criteria. The data in this study was collected to cover the last 5 years, considering both the scarcity of numerical data in Turkey and the recommendations for the 2050 targets.

In the literature review, the main topics influencing food waste were initially divided into four categories: economy, production and consumption, climate, and finally, energy. The primary factor in selecting these topics is their role in bridging the gap between the chosen SDGs and the wheat sector. Additionally, the connections between ESG and SDGs have been linked to the Global Reporting Initiative (GRI), which has become a reporting standard used by many companies today.

In this study, it was measured whether the report published by the Republic of Turkey and the numerical data obtained from various sources supported each other. For the visualization of numerical data and to demonstrate the connection between the subheadings of the wheat sector and the SDGs, the Correlation HeatMap application was preferred. The Correlation HeatMap was selected for its ease of readability and the possibility of obtaining accurate results with a small amount of data. To demonstrate its limitations, two alternative maps were used in this study.

When looking at the results of this study, two main limitations stand out. The first one is that the selected SDG goals are main topics and contain quite broad definitions. Since it is quite challenging to conduct numerical analysis without reducing these broad topics into subheadings, representing each SDG with subheadings was considered as a solution in this study. However, this choice also has a limitation. Since the correlation between the selected subheading and the wheat sector will be proven, the connection between some subheadings and these two topics has not been sufficiently proven. For example, while the topic of SDG 2 Zero Hunger could show a higher correlation with wheat as a main topic, the selected "minimum wage based on the poverty line" showed a lower correlation. This fact should not be forgotten when examining this study. The second limitation is the lack of numerical data regarding the

2030 SDG goals in Turkey, and therefore, the extent to which the 2030 goals are achieved cannot be fully understood. Consequently, the 2050 goals formulated based on the obtained results remain limited.

Finally, the results of the study were examined point by point, and recommendations were made regarding what could be improved concerning Turkey's 2050 sustainable development goals.

TÜRKİYE BUĞDAY SEKTÖRÜ VE SÜRDÜRÜLEBİLİR KALKINMA HEDEFLERİ ARASINDAKİ BAĞLANTI; TÜRKIYE'NİN SKH 2050 HEDEFLERİ İÇİN ÖNERİLERLE BİRLİKTE

ÖZET

Bu çalışma, Türkiye'deki buğday sektörü ile sürdürülebilirlik arasındaki bağlantıları açıklamak amacıyla ortaya çıkmıştır. İlk olarak, buğdayın seçilmesi, pek çok ülkede olduğu gibi, Türkiye'de temel besin kaynağı olarak önemli rol oynaması ve Türkiye tarım sektörü içinde önemli bir paya sahip olması nedeniyledir. Çalışmanın ana hedefi, Avrupa Birliği tarafından sunulan Sürdürülebilir Kalkınma Hedefleri (SKH) ile buğday sektörü arasındaki ilişkiyi incelerken bu iki başlığın aynı zamanda Çevresel, Sosyal ve Yönetişim (ÇSY) prensipleri arasındaki bağlantısını ispatlamaktır. Bu amaçla, buğday sektörüyle uyumlu olarak izlenebilecek dört ana hedef seçilmiş ve bu hedeflerin Türkiye'deki durumları raporlar ve analitik veriler kullanılarak incelenmiştir. Buradaki temel kanı, seçilen dört SKH'nin birbirleriyle olan ilişkileri, buğday sektörü ile olan bağlantıları ve ÇSY prensipleri ile olan ilişkileri, hepsi temelde birbirinden etkilenen ve birbinirini besleyen unsurlardır ispatını yapmaktır. Burada seçilen dört SKH başlığı genel tanımlamalar olduğundan, çalışmayı daha etkili hale getirmek için buğday sektörü ile abğlantılı olabilecek alt başlıklarla ilişkilendirilmiştir. Örneğin, SKH 13 İklim Eylemi başlığı altında, buğday sektörünü etkileyebilecek sıcaklık ve yağış seviyeleri gibi alt başlıklar, filtreleme kriteri olarak seçilmiştir. Bu çalışmada kullanılan veriler, Türkiye'de sayısal verinin yetersizliği ve 2050 hedefleri için öneriler sunulacağı göz önünde bulundurularak son 5 yılı kapsayacak şekilde toplanmıştır.

Literatür araştırmasında, gıda israfını etkileyen ana başlıklar başlangıçta dört kategoriye ayrılmıştır: ekonomi, üretim ve tüketim, iklim ve son olarak enerji. Bu başlıkların seçilmesindeki ana faktör, seçilen SKH'ler ile buğday sektörü arasındaki köprüyü kurma rolüdür. Bununla birlikte, ÇSY ve SKH arasındaki bağlantılar, yan bir kolda, günümüzde birçok şirket tarafından kullanılan bir raporlama standardı haline gelen Küresel Raporlama İnisiyatifi (GRI) ile ilişkilendirilmiştir. Sonrasında konunun Türkiye2deki durumu ele alınmak istenmiştir. Burada öncelikle Trükiye'de gıda israfına değinilmiş ve sonrasında çalışmanın ana konusu olan buğdayın durumu incelenmiştir. Bu kısımda Türkiye'de yapılmış olan ekmekle ilgili çalışmaların örneklerine yer verilmiş ve Türkiye buğday üretiminin son 5 yıllık tahmini ve gerçek üretim arasındaki sonuçlar grafik ve tablolarla desteklenmiştir.

Bu çalışmada, Türkiye Cumhuriyeti tarafından yayınlanan "Sürdürülebilir Kalkinma Amaçlari Türkiye 2. Ulusal Gözden Geçirme Raporu" olarak yayınlanan raporun incelenmesi ve çeşitli kaynaklardan elde edilen sayısal verilerin analizi ispat amaçlı kullanılan iki yöntemdir. Bu raporun incelenmesindeki temel sebep, sınırlı kaynak dahilinde bulunabilecek en kapsamlı ve en güncel kaynak olmasıdır. Bu raporun okuması şu şekilde yapılmıştır: 17 hedefin hepsine dair açıklamalar ve projeler sunulan bu raporda seçilen dört kaynak, özellikle bağlı oldukları bakanlıklar, uygulanan ana politikalar, yapılan projeler, çıkarılan sonuçlar ve geleceği yönelik yapılabilecek çalışmalar ve öneriler kapsamında incelenmiştir. Rapor sonrasında ikinci ana kaynak olarak, seçilen dört SDG alt başlığının, Türkiye'de son beş yılda sunulan sayısal verileri toplanmıştır. Burada elde edilen sayısal verilerin görselleştirilmesi ve buğday

sektörü alt başlıklarının SKH'lerle olan bağlantısını göstermek için, Correlation HeatMap analizi tercih edilmiştir. Correlation HeatMap, okunabilirliğinin kolay olması ve az miktarda veri ile doğru sonuçlar elde etme olasılığı nedeniyle seçilmiştir. Bu çalışmada bu yöntemin kısıtlılıklarını göstermek için iki alternatif harita kullanılmış. Bu haritada, Türkiye son 5 yıllık buğday üretimi ana veri gibi kullanılarak HeatMap'e yerleştirilmiş ve seçilen 4 SDG alt başlığının verileri özellikle bu veri ile pozitif korele olarak gösterilmek istenmiştir. Correlation HeatMap yönetimi sayesinde, bu kalan dört alt başlığın birbiri içinde (örneğin SDG 2 ile SDG 7'nin birbiri ile pozitif veya negatif korelasyon durumu) etkisi de ispatlanmıştır. Seçilen SDG alt başlıkları, ana başlığın konusundan sapmadan, buğday ile en alakadar olabilecek düzeyde tutulmak istenmiştir. Iki alternatif HeatMap ile gösterilmek istenen de, bu alt başlıkların tercihindeki farklılıkların doğurabileceği sonuçları göstermektir.

Son olarak, çalışmanın sonuçları maddeler halinde incelenmiş ve hem rapor hem de analiz sonuçları eş zamanlı olarak karşılıklı şekilde sunulmuştıur. Burada bu metodun tercih edilme sebebini kısaca açıklamak gerekirse: pek çok yayınlanan raporda, hem ulusal hem küresel düzeyde, SDG maddelerinin birbiri ile içindeki bağlantılarının ispatı daha öncesinde incelenen ve ispatlanan bir durumdur. Ancak sektör bazında bir çalışma konusunda bu alan ksısıtlıdır. Burad ayapılmak istenen bu SDG'lerin her birbirinin birbirini etkilerken, seçilen bir sektörü de etkileyebileceğini ispatlamaktır. Özellikle Türkiye'de bu şekilde sektör bazında bir araştırmanın emsal niyetinde var olmamış olması, bu çalışmanın olabilecek en kapsamlı ve temel seviyede tutulmasıdır sebeplerindendir. Bu kısımda seçilen her bir SDG maddesi aynı zamanda ESG ile bağlanmıştır.

Bu çalışmanın sonuçlarına bakıldığında, iki temel kısıtlama göze çarpmaktadır. İlk olarak, seçilen SKH hedeflerinin ana başlıklar olduğu ve oldukça geniş tanımlamalar içerdiğidir. Bu geniş başlıkların alt başlıklara indirgenmeden sayısal analizinin yapılmasının oldukça zor olduğu düşünüldüğünde, bu çalışmada her bir SKH'yi alt başlıklarla temsil etmek bir çözüm olarak düşünülmüştür. Ancak, bu seçimin de bir kısıtlaması vardır. Seçilen alt başlığın buğday sektörü ile ne kadar ilişkili olduğu kanıtlanacağından, bazı alt başlıklarda bu iki konu arasındaki bağlantı yeterince kanıtlanamamıştır. Örneğin, SKH 2 Açlığın Sonlandırılması konusu ana başlık olarak buğday ile daha yüksek bir ilişki gösterebilirken, seçilen "açlık sınırına bağlı olarak belirlenen asgari ücret" daha düşük bir ilişki göstermiştir. Bu durumun çalışma incelenirken göz ardı edilmemesi gerekir. İkinci kısıtlama, Türkiye'de 2030 SKH hedeflerine ilişkin sayısal verinin bulunmaması ve bu nedenle 2030 hedeflerinin ne kadar gerçekleşip gerçekleşmediğinin tam olarak anlaşılamamasıdır. Sonuç olarak, elde edilen sonuçlara dayanarak oluşturulan 2050 hedefleri de sınırlı kalmaktadır.

Bahsi geçen bu kısıtlamaların ışığında, bu çalışma buğday sektörünün ne kadar sürdürülebilirlik hedeflerine bağlı olabileceğini ispatlarken, hem SDG'lerin kendi içerisinde tutarlı bir bağlantısı olduğunu, hem de ESG ile özel sektörün de bu sürdürülebilirlik hedeflerine ne kadar bağlı olduğunu göstermiştir. Kullanılan Correlation HeatMap üzerinde tüm bu değerler 0 ila 1 arasında gösterilmiş ve sayısal veri analizi sonucunda pozitif korelasyonu ve bağını gösteren bu sonuçlar tezin öneri sürdğü şekilde pozitif korele çıkmıştır. Bunlara ek olarak çıkan sonuçlar ışığında Türkiye'nin 2050 sürdürülebilir kalkınma hedeflerine ilişkin iyileştirmelerin neler olabileceği konusunda önerilerde bulunulmuştur. Ancak belirtilen ksıtlamalar ve

sınırlar sebebiyle bu önermelerin belli bir düzeyde kaldığı ancak bu çalışmanın ileride yapılacak diğer çalışmalara yeni sorular ve alanlar doğurabileceği söylenebilir.

Bu çalışmanın ışığında Türkiye'de 2050 sürüdürülebilirlik hedeflerinin uygulanabilmesi için ilk ve en önemli önerme raporlama olarak sunulmuş. Bulunan konumun doğru analizi ve geliştirilebilmesi için, sayısal verilerden yararlanmak ve şeffaf bir şekilde bu verilerin kullanımı sağlamak önemli bir adımdır. GRI gibi standartların küresel ve ulusal çapta uygulanabilirliği ile bu durumun artabileceği ön görülmüştür. Bununla birlikte bir diğer önerme, kamusal alanda yapılabilecek yeni yönetmelikler ve yasalarla hem bireylerin bilinçlenmesinde hem de kamusal düzeyde atık yönetiminin sağlanmasında yararlı olacağıdır. Özellikle çalışma içinde örnek teşkil eden projelerin devamlılığının sağlanması, yeni projeler ve destekler ile hem bireysel hem de bu sayede toplumsal bilincin oluşmasına katkı sağlayacağı önerilmiştir.

1. INTRODUCTION

In today's world, sustainability has become an increasingly significant concept in both the public and private sectors. Sustainability, which appears in many areas such as economic, agricultural, commercial, nature and climate, has become an increasingly popular topic to understand its impacts on Turkey. With this aim in mind, the wheat sector, one of the fundamental products in the agricultural sector for Turkey, has been scrutinized.

Wheat is an essential ingredient in the production of basic food items, particularly bread. Therefore, the selection of a fundamental product like wheat aims to conduct the most comprehensive and precise examination of Turkey's agricultural sector in terms of sustainability. A framework has been attempted to be established to measure sustainability and position Turkey, and parameters have been sought to enable comparison of the wheat sector over the years. The Sustainable Development Goals (SDGs), published by the European Union and started to be implemented/regulated in many countries, have been found suitable as the main parameter here.

This study began with a question about food waste in Turkey and how it is managed, then continued with the first research examining bread waste. Afterwards, it expanded to the examination of the raw material of bread, wheat, and the state of waste and sustainability in the wheat sector.

The purpose of this study is to examine the position of the wheat sector in terms of sustainability in Turkey and to demonstrate that four goals selected from the Sustainable Development Goals are interconnected within themselves and with the wheat sector. While trying to provide this evidence, emphasis is also placed on the points of connection between SDGs and ESG, and areas correlated with the GRI Standards, which are considered important for sustainability reporting at the global level today, are also presented.

Since the wheat sector was taken as the central focus in the study, other factors were considered almost like a circle around it. Therefore, to clarify the main objective more

precisely, only four SDG goals were pursued. In addition, by examining these four SDG subtopics, which are thought to be most affected by the journey of wheat from soil to plate, the research scope has been narrowed.

ESG stands for Environmental, Social, and Governance criteria. These criteria are used to evaluate a company's operations and how it manages risks related to environmental sustainability, social responsibility, and corporate governance. The GRI (Global Reporting Initiative) Standards are a set of guidelines and principles for sustainability reporting. They provide a framework for organizations to measure and report their environmental, social, and economic impacts in a transparent and consistent manner.

In the light of these explanations, both the interconnection of the selected SDGs and the links between SDGs and ESGs were analyzed by examining the reports published within the framework of the wheat industry and the numerical data of the last five years. As a result, the current state of sustainability in the wheat sector in Turkey has been tried to be revealed. In addition, Turkey's proximity to achieving the 2050 Sustainable Development Goals and what it can do to achieve these goals are also included.

2. LITERATURE REVIEW

The importance of the limited resources of the world we live in has become an issue that has attracted attention for almost the last 100 years, along with the increasing population and industrialization. Identifying the environmental impacts of possible negative consequences of increasing industrialization over the years and increasing natural resource scarcities have led scientists from many different disciplines to think about what can be done in terms of sustainability.

When one examines the history and meanings of words, "sustain" denotes the act of maintaining, supporting, or continuing something over time. It encompasses the continuation or preservation of a process, condition, or activity. “Sustainable” describes a process, action or system that can be sustained or continued over the long term without causing significant adverse effects on the environment, society or economy (Lemaire and Limbourg, 2019). Finally, “sustainability” refers to the concept of creating and maintaining conditions that enable the long-term well-being of the environment, society and economy. It involves balancing ecological, social and economic considerations for the benefit of current and future generations. For better understanding, “maintain” is a verb that refers to the act of maintaining something, “sustainable” is an adjective that describes something that can be maintained over time without causing harm, and “sustainability” is the noun that represents the broader concept of creating and sustaining. Although these terms generally emerged in the field of environment, today they are found in many branches, especially in economics.

The concept of sustainability has emerged as a defined ideal encompassing social, environmental and economic issues. Humanity, which has made rapid progress in many areas with the industrial revolution, needed this concept in order to prevent the destructive consequences of these advances. Robert Goodland confirmed a history documenting this need in “The Concept of Environmental Sustainability”, offering the definition of “environmental sustainability as the preservation of natural capital” and stating it as a separate but related concept from both social sustainability and economic sustainability (Morelli, 2011).

The 1970s witnessed a growing understanding that environmental protection and economic development should go hand in hand. The term "sustainable development" gained prominence in the 1980s, particularly through the 1987 report of the World

Commission on Environment and Development, known as the Brundtland Report. Although it had become a widely recognized term by the 1990s, its acceptance was not universal (Ekins et al.,2019).

Sustainability concerns often focus on the earth's natural resources and the limits of things like clean air, water and soil that once seemed inexhaustible. Particularly today, companies are embracing the environmental aspects of sustainability as the most concrete areas where companies can set goals, document progress, and achieve results that contribute to both profitability and broader environmental benefit (Sarokin, 2022).

Although sustainability was initially seen as a concept that emerged only with climate and environmental aspects, this concept has begun to be used frequently and the consequences of human impacts in other areas have begun to be examined. First of all, this situation has revealed that the effects of humans on the world due to industrialization and developing technologies are "unsustainable".

In fact, this subject, which is divided into many branches, has ceased to be only about nature and climate over the years, and has also pioneered the beginning of recycling formations such as economy, production, education and even renewable energy.

2.1. Sustainable Development Goals

The swift decline in global environmental conditions has prompted the formulation of policies aimed at mitigating the adverse effects of production and consumption on the environment. Several nations have implemented legislation and regulations to institutionalize the recycling principles of a circular economy.

The Sustainable Development Goals (SDGs) were adopted by world leaders at a United Nations summit in September 2015. The 193 member states of the United Nations agreed to a set of 17 goals as part of the 2030 Agenda for Sustainable Development (Lemaire and Limbourg, 2019). These goals target not only conscious consumption and animal-nature-human balance, but also the work that needs to be done and the regulations that need to be made worldwide on issues such as gender equality and the right to education.

The 2030 Agenda outlines 17 Sustainable Development Goals (SDGs) and 169 targets that are interconnected and inseparable, addressing economic, social, and environmental aspects:

• Goal 1. End poverty in all its forms everywhere.

• Goal 2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

• Goal 3. Ensure healthy lives and promote well-being for all at all ages.

• Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

• Goal 5. Achieve gender equality and empower all women and girls.

• Goal 6. Ensure availability and sustainable management of water and sanitation for all.

• Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all.

• Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

• Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

• Goal 10. Reduce inequality within and among countries.

• Goal 11. Make cities and human settlements inclusive, safe, resilient, and sustainable.

• Goal 12. Ensure sustainable consumption and production patterns.

• Goal 13. Take urgent action to combat climate change and its impacts.

• Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

• Goal 15. Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation, and halt biodiversity loss.

• Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels.

• Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

2.2. Why Wheat and Four SDG?

This study has been developed based on one of today's greatest problems, hunger and inadequate food. In order to understand this issue in the best possible way, it is necessary to look at the paths food waste and waste management solutions have taken up to the present day.

In 1943, a conference called the "United Nations Conference on Food and Agriculture" was held in Hot Springs, Virginia. Delegates from 44 countries attended this conference, which was convened by the United States during World War II to address global food and agriculture issues. Its primary goal was to discuss ways to increase food production in wartime and ensure global food security. It can be said that the second article of the Sustainable Development Goals (SDG2), which was adopted in the new millennium and aims to eliminate hunger by 2030, brings optimism that the first vision of 1943, which envisaged the integration of agriculture and nutrition, has now become a reality (Byerlee and Fanzo, 2019). Accordingly, many references linking nutrition and agriculture were included in the conference manifesto, and expressions such as 'food policy and agricultural policy should be evaluated together' were mentioned. The comprehensive process of crafting the Sustainable Development Goals (SDGs) at a high level has not only reinforced the ownership of the SDG agenda and timelines by individual countries but has also promoted mutual accountability, consistent with the original vision set forth in 1943. The involvement of affluent nations in the SDG agenda has underscored the reality that malnutrition is a global concern, transcending the boundaries of developing countries and affecting the international community as a whole.

Despite significant progress in many countries, the world is largely off track to achieve the second sustainable development goal (SDG2) by 2030 (UNICEF et al., 2019).

Food waste refers to the discard or loss of edible food, often at various stages of the food supply chain, including production, processing, distribution, and consumption. It can occur for various reasons, such as spoilage, overproduction, inefficient harvesting, transportation issues, cosmetic standards, and consumer behavior (Salihoğlu et al.,2017). Globally, approximately one-third (1.3 Gt) of all food produced for human consumption is wasted in the supply chain each year (FAO, 2019). In their article published in 2016, Stancu et al. state that 25% of the food supplied in high-income

countries is wasted, and 50% of this occurs as waste at the household level. According to Porter et al (2016), domestic uses represented more than 40% of total food waste and loss in Europe in 2006. In the forthcoming years, the impact of food loss and waste (FLW) is anticipated to be significantly influenced by developing countries. This is attributed to the growth in their populations and economies, accompanied by a shift in dietary patterns from cereal-based to those centered around fat, sugar, and animal products. The projection indicates a 40% increase in per capita meat consumption in developing countries by the year 2050 (Lemaire and Limbourg, 2019). According to the report published by the UN Food and Agriculture Organization (FAO) in 2014, 0.9 million hectares of land and 306 km^3 of water are required every year for globally wasted food. This reveals the magnitude of the environmental impact of the waste generated. It should not be misconstrued that this problem is only related to developing countries, as Porter et al.'s 2016 publication revealed that the food loss and waste rate in the United States is twice as high as China.

Increased food waste in developing countries may be attributed to insufficient technology or infrastructure, while developed countries might experience higher levels of food waste due to a lower proportion of income dedicated to food expenses. In the European Union, for instance, the average household typically allocates between 10% to 20% of its disposable income towards food expenditures (Lemaire and Limbourg, 2019). In developing countries, 40% of food waste arises prior to harvest, during harvest and processing, whereas in developed countries, it predominantly occurs within the retail sales chains and during consumption (Sputnik, 2019; İSRAF, 2019).

Trying to minimize food loss and waste covers both the before and after of this problem. Considering that the components will directly and indirectly affect the entire problem, it will be possible to address this problem in a cyclical manner. Minimizing food waste is critical due to its economic, social, ecological and health implications, and the impact of the solution will be significant. In the course of this research, the focus will be on examining the issue through an economic lens, exploring aspects such as production and consumption, the climate crisis, and renewable energy.

Statistics about food waste are typically sourced directly from waste treatment facilities, creating a disconnect from the waste producers. This reporting method aligns with the conventional linear economy, addressing waste as an issue after its occurrence. However, advancing circular economy strategies, such as waste

prevention, design for reuse, and extended product lifespans, requires involvement from companies across the entire supply chain. Governments must establish a cohesive set of incentives and enhance coordination among all pertinent stakeholders to facilitate these sustainable practices (Sileryte et al, 2022). In order to prevent waste generation at the national level, it is of great importance at the sectoral level to identify the stakeholders who have a share in this process and to take measures to minimize this situation. While preventing waste from occurring in the first place, it is necessary to look at what can be done to recycle existing waste before it is disposed of appropriately (Paritosh et al., 2017).

Although many of the sustainable development goals can be integrated into key points of a food chain, in order to understand this journey from soil to plate in the best possible way, it is necessary to delve into four of the sustainable development goals. These four objectives have been selected as in Table 2.1 below and the sub-headings are shown in the table;

Table 2.1 : Sustainable Development Goals that the study focuses on and tries to find connections with

SDGs	TARGETS				
SDG 2	2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	2.a: increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries		
SDG 7	7.2 : By 2030, increase substantially the share of renewable energy in the global energy mix	7.a: By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology	7.b: By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support		

Table 2.1 (continued) : Sustainable Development Goals that the study focuses on and tries to find connections with

SDGs	TARGETS				
SDG 12	12.1:Implement the 10-Year Framework of Programmes on Sustainable Consumption and Production Patterns, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries	12.2: By 2030, achieve the sustainable management and efficient use of natural resources	12.3: By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	12.5: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	12.6: Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle
SDG 13	13.2: Integrate climate change measures into national policies, strategies and planning	13.3: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning			

2.3. Turkey's Situation

According to the Türkiye Waste Report, 26 million tons of food are wasted every year in our country. 30% of global food waste consists of grains (half of the world's annual grain production), 40-50% of root crops, fruits and vegetables, 20% of oilseeds, meat and dairy products and fish varieties. This amount corresponds to 15% of the national income and its financial equivalent reaches 555 billion TL (Tekiner et al, 2021).

Furthermore, the escalating volume of solid waste in our country is significantly influenced by the excessive waste generated from bread consumption. In Turkey, a staggering 4.9 million loaves of bread are discarded on a daily basis, accumulating to 1.7 billion annually (Şahin et al., 2018). Breakdown of this figure reveals that 62% of the wastage occurs in bakeries (3 million), 28% in households (1.4 million), and 10% (0.5 million) in staff and student cafeterias, restaurants, and hotels. An investigation into the destiny of stale bread indicates that 71% is repurposed as food or dessert, 49% is allocated to stray animals and pet owners, and 14% is preserved in deep freezers. Astonishingly, merely 11% of the participants in the study admitted to discarding bread directly into the trash (Turkey Waste Report, 2018).

Studies on food waste in Turkey show that the most loss and waste occurs in the processes from the early post-production stage to the middle levels. It reveals that a maximum of 5% of food is consumed and wasted by households (end consumers) (Tatlıdil et al., 2013).

Typically, fresh fruits and vegetables experience losses ranging from 4-12% during harvest, 2-8% during transportation to markets, 5-15% during market preparation, 3-10% during storage, and 1-5% during consumption. This cumulative analysis underscores an overall loss rate ranging from 15-50%. The primary factors contributing to these losses include improper production practices leading to decay, losses during transportation, insufficient pre-cooling, inadequate storage and packaging facilities, and errors in workmanship (Ünlü, 2015).

Some of the regulations and standards that Turkey applies according to T.C. Strategy and Budget Directorate:

National Strategy for Circular Economy (2019): Turkey released its National Strategy for Circular Economy in 2019, outlining its vision and goals for transitioning to a more circular economy.

Zero Waste Project: Turkey has initiated the Zero Waste Project, aiming to reduce waste generation and increase recycling rates. This project focuses on various sectors, including industry, commerce, and households.

ISO 14001 Certification: Many Turkish companies have adopted the ISO 14001 Environmental Management System certification, indicating their commitment to environmentally sustainable practices.

Green Industry Certification Program: Turkey has been working on promoting sustainable and environmentally friendly practices in the industrial sector through the Green Industry Certification Program.

Renewable Energy Investments: Turkey has been investing in renewable energy projects, such as wind and solar power, to reduce its reliance on fossil fuels and promote a more sustainable energy mix.

EU Harmonization: As part of its accession process to the European Union, Turkey has been aligning its environmental policies and standards with EU regulations, which often include sustainability and circular economy considerations.

Turkey, in addition to providing support to various agricultural products, implements diverse policies through the Soil Products Office (SPO) to regulate the grain and wheat markets, which hold a pivotal position among cereals. SPO not only ensures on-site purchases of products in licensed warehouses but also has the flexibility to make purchases through stock exchanges with suitable infrastructure. The noteworthy increase in wheat production in Turkey, attributed to heightened productivity, marks a significant development (Polat, 2020).

2.4. Turkey in Wheat Production and Consumption

Wheat is the most produced crop plant in the world and is an indispensable crop plant in the nutrition, trade and crop rotation systems of many countries. The cultivation areas and production of wheat, which is a plant with no alternative in human nutrition, are increasing in parallel with the population growth. World wheat production, which

increased in parallel with population growth, was approximately 222 million tons in the 1960s, reaching 586 million tons in the 2000s and 650 million tons in 2010. It is estimated that per capita wheat consumption in the world was approximately 70 kg in the 1960s, and by 2011 it was around 100 kg/person (UHK, 2011). Turkey has a share of around 3% in world wheat production (TMMOB, 2018)

Wheat is a versatile crop that can be grown in various conditions, but its production is influenced by several key factors. Considering the conditions required for the production conditions of this product: Wheat is known to be a cool-season crop and grows best in temperatures between 50°F and 70°F (10°C to 24°C). However, some varieties can adapt to different temperatures. Wheat, which requires a certain day length for optimum development and is classified as a long-day plant, can grow in various soil types, but its production is ideal in soils with good water retention properties, good drainage and soil pH between 6.0 and 7.5.

Adequate and timely water supply is very important for wheat cultivation. In areas with insufficient rainfall, supplementary irrigation may be necessary, especially during critical growth stages. Wheat can be grown at different altitudes, but location is of great importance as it is a plant sensitive to day length and sunlight is effective on its growth. In this part, Turkey's soil and geographical suitability make a significant contribution to wheat production in the country. The Central Anatolia region constitutes the country's grain production area.

The time of planting is very important for a quality wheat harvest. Wheat is generally planted in autumn (winter wheat) or spring (spring wheat), depending on the variety and local climate.

Harvesting should be done when the wheat grains are fully developed and reach the desired moisture content. Even though the harvest and planting times of local producers may vary depending on the climate, altitude and other conditions of the region, wheat production generally proceeds in this way.

Turkey is a significant producer of wheat in the world. While Russia, the USA, the EU and Canada, which are the important producing countries in world wheat exports, are at the top, Ukraine and Australia are also among the important wheat exporting countries. According to the TEPGE report in 2020, Turkey ranks 9th in world wheat exports with an export share of approximately 3.5%. Wheat is one of the major cereal

crops grown in the country, and it plays a crucial role in meeting domestic consumption needs. Turkey has favorable agro-climatic conditions for wheat cultivation, and the crop is cultivated in various regions across the country. While there is a slight increase worldwide, it is noteworthy that wheat cultivation areas in Turkey have decreased significantly (UHK,2011). Every year, forecasts are made for possible wheat production in Turkey and annual studies are carried out. Figure 2.1 shows the estimated and actual wheat production in the last 5 years. Figure 2.2 shows a graphical representation of these numerical data.

The exact production figures can vary from year to year due to factors such as weather conditions, agricultural practices, and market dynamics. Turkey's wheat production is influenced by both rainfed and irrigated agriculture.

When we evaluate the developments in wheat in our country from past to present, wheat production, which was approximately 2.5 million tons in the 1930s, increased to 10 million tons in 1967 and 20.6 million tons in 2009. The wheat production increase rate in this period was 724%.

During the initial phase of increased production, expansion of cultivated areas played a significant role. However, in subsequent periods, advancements in breeding studies and the adoption of appropriate cultivation techniques made substantial contributions to the overall increase in production. To illustrate, wheat cultivation areas, which stood at 2.8 million hectares in 1930, surged to 8 million hectares by 1967, a level comparable to that in 2010.

In 1930, the yield obtained per unit area was 92 kg/da, and by 1967, it experienced a notable increase of 35.9%, reaching 125 kg/da. Despite only a 1.0% increase in cultivation areas from 1967 to 2010, productivity witnessed a remarkable surge of 104.8%. Over the span from 1927 to 2010, Turkey's population grew from approximately 13.6 million to 73.7 million. Consequently, the population increase rate from 1930 to 2010 recorded a substantial 442%, while the growth rate in wheat production far exceeded this, reaching 724% (UHK,2011). This robust performance has effectively averted any significant bottlenecks in meeting the wheat demand in the country to date.

Year	Estimated	Actual
2019 (first estimate)	19,5 million tons	19 million tons
2019 (second estimate)	19 million tons	
2020	20,5 million tons	20,5 million tons
2021 (first estimate)	19 million tons	17,7 million tons
2021 (second estimate)	17,7 million tons	
2022 (first estimate)	19,5 million tons	19,8 million tons
2022 (second estimate)	19,8 million tons	
2023 (first estimate)	20,5 million tons	22 million tons
2023 (second estimate)	21,8 million tons	

Figure 2.1 : Comparison Graph of Estimated and Actual Wheat Production in Turkey

When we examine the National Grain Council's 2023 Cereal Evaluation and 2024 Expectations Panel Result Declaration, the conclusions are as follows:

1. The lack of precipitation in the autumn and winter seasons was felt clearly throughout Turkey, and although this situation poses a significant risk in grain production and the risk of meteorological drought turning into agricultural drought, it has been observed that high and balanced precipitation in March, April, May and June supports grain production. It was evaluated that in this production season, total grain production broke the all-time record with 41.5 mt, including wheat production of 21.8 mt, barley production of 9 mt and corn production of 8.75 mt.

2. While the Soil Products Office (SPO) took measures to manage scarcity as the expectation of drought grew stronger, it had to manage product abundance. SPO, which has purchased more than 13 million tons of products, mainly wheat, has stated that this amount can reach 14 million tons with ongoing corn purchases. It was shared that this season was a first in our country, which has a foreign trade surplus in grains and grain-based products, and a significant amount of excess stock of durum wheat was exported.

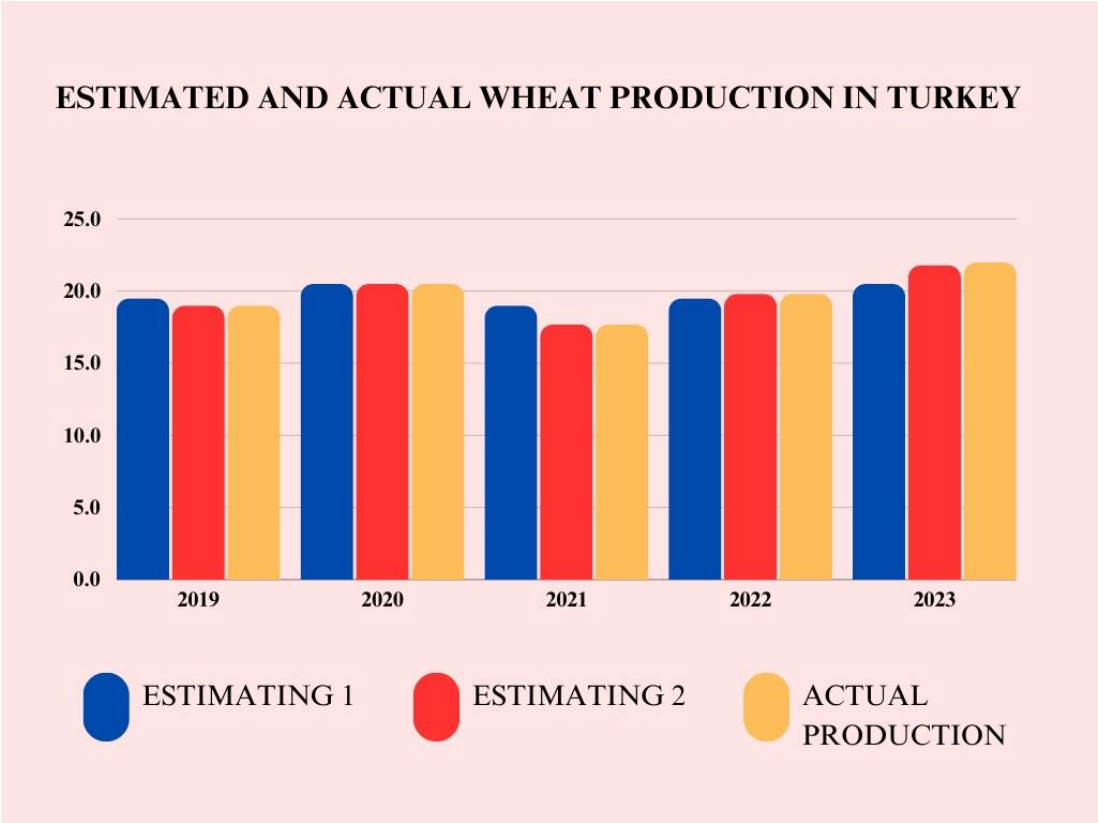

Figure 2.2 : Turkey wheat production forecast and realized amount by year (tons)

The main effects of climate change on Turkey are expected to include drought, desertification, decrease in agricultural productivity, loss of biological diversity and ecosystem services, as well as an increase in forest fires, outbreaks of diseases, and pests (TSDG 2nd National Review Report,2019).

Despite the changing climatic, economic, and sociological conditions over the years, it can be said that wheat production in Turkey has been maintained at a certain level, and the results obtained are close to the annual forecast reports. However, it can also be said that the Covid-19 pandemic, which began in 2020 and its effects, thereafter, has had an impact on many areas of the country, including production-consumption, import-export, and other conditions.

2.5. Linking SDGs to Wheat Sector Through ESG

The topic of food waste is divided into sub-headings in this section and divided into four as shown in Figure 2.3.

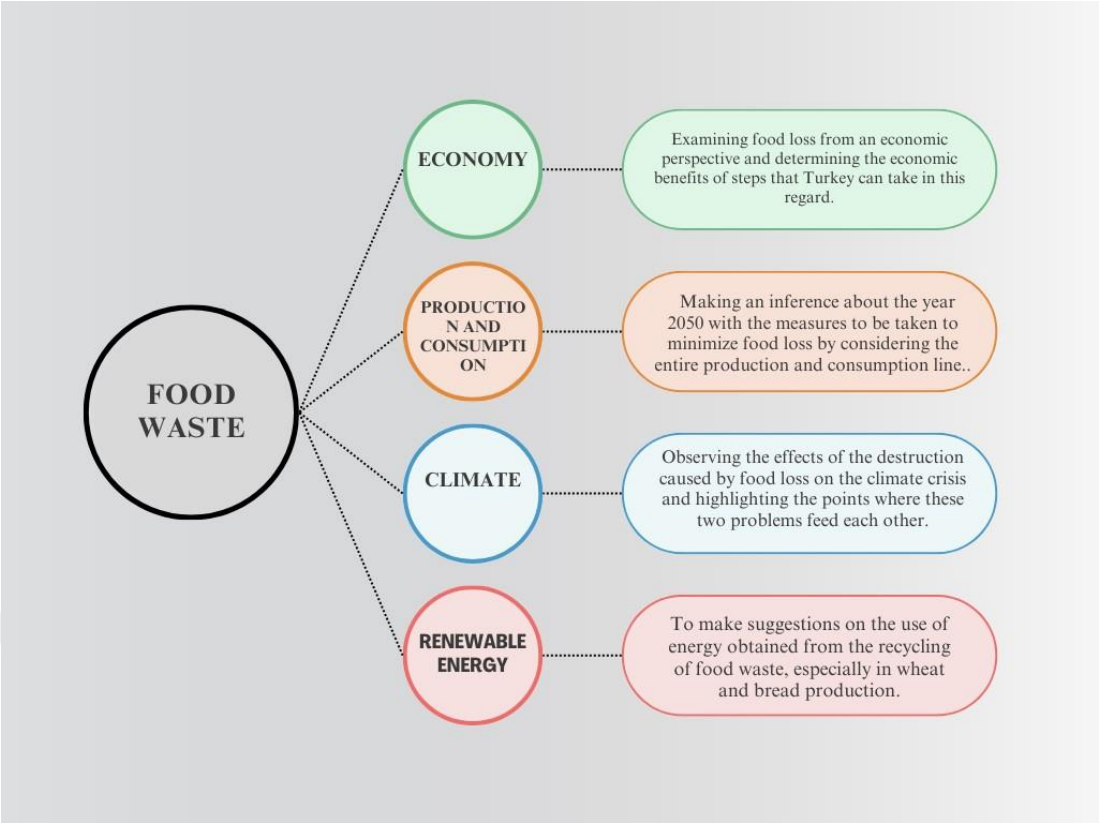

Figure 2.3 : Visualization of the connection between ESG and the wheat sector with SDGs

2.5.1. Economic growth- ESG

Circular economy is the name given to an economic system that aims to minimize waste in every sense and make the best use of available resources. In the linear, classical economic idea, products are produced, used, and then disposed of as waste. In contrast, the circular economy aims to keep products, materials and resources in use for as long as possible by designing the actual disposal of these wastes and through recycling, reuse and renewal. It can be argued that the idea of a circular economy consists of two branches. The first is about the flow of materials in an economy, and the second is about thinking about the economic conditions that might bring about such a flow. These two conceptual currents date back to the early days of the modern environmental movement in the 1960s and 1970s (Heshmati et al., 2023).

To talk about the basic principles of the circular economy: in this idea, which focuses primarily on long-lasting consumption and reusability, reducing the need to extract new raw materials through recycling and minimizing the environmental impact of waste disposal also plays an important role. However, studies on resource efficiency

are an approach that continues to be important, especially in the field of industry and rapid consumption (Kalmykova et al., 2016).

Governments, businesses and organizations around the world are increasingly recognizing the importance of transitioning to a circular economy to address environmental challenges and promote more sustainable production and consumption models. However, it is obvious that this economic understanding and system will not only contribute to the environmental and production aspects, but will also have an impact on the social and social awareness level.

In his award-winning article published in 1982, Stahel identified the extension of the useful life of goods as the logical point for the beginning of a gradual transition towards a sustainable society that is on the path of progress and achieves this progress in a way that is consistent with world conditions (Ekins et al, 2019). According to Stahel, this projected transition involves a "spiral loop system" that minimizes matter, energy flow, and environmental degradation. In particular, this system is designed to achieve these goals without hindering economic growth or social and technical progress. Stahel's outlined framework revolves around four basic processes: reuse, repair, renewal, and recycling (Heshmati et al., 2023), The comprehensive definition and articulation of the circular economy in economic terms did not occur until 1990.

The circular economy was formally defined in the environmental and resource economics textbook written by Pearce and Turner in 1990 (pp. 35-41). Oddly, this concept does not appear in Pearce's popular book "The Blueprint for the Green Economy" (Pearce et al., 1989), published just a year ago. Pearce and Turner (1990) distinguish between (circular) natural systems and (linear) economic systems, regardless of their origin. They also distinguished between capital stocks and flows resulting from them, citing Boulding's article highlighting the importance of the laws of thermodynamics. They emphasized that Boulding's article points out the necessity of thinking of the Earth as a closed economic system, and said that a system in which the economy and the environment are characterized by a cyclical relationship, not linear connections, should be created.

Global environmental degradation has spurred the creation of policies aimed at mitigating the adverse effects of production and consumption on the environment. Several nations have enacted legislation to embrace the recycling principles of a Lorem

ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor circular economy. Germany stands out as a pioneer in this endeavor, having initiated the implementation of a circular economy in 1996.

This was accompanied by the introduction of the 'Closed Substance Cycle and Waste Management Act.' This legislation establishes a framework for the implementation of closed-cycle waste management, ensuring environmentally sound waste disposal and assimilative waste capacity. Another noteworthy endeavor toward implementing a circular economy is observed in Japan. The Government of Japan has formulated a comprehensive legal framework to guide the country's transition to a recycling-based society (METI, 2004; Morioka et al., 2005). The enactment of 'The Basic Law for Establishing a Recycling-Based Society' in 2002 sets quantitative targets for recycling and the long-term dematerialization of Japanese society (Van Berkel et al., 2009).

A successful circular economy model can also be implemented by governments as a development strategy. However, this requires the implementation of a wider range of policies and economic incentives to overcome the challenges likely to be encountered in many areas. The application of CE based on the 3R principles (reduction of material use, reuse and recycling) affects and remains influenced by material and energy flows, as they are related to both production and consumption areas. Zhu and Qiu (2007) viewed the circular economy as a sustainable economic growth model that aims at efficient production and consumption and circulation. In addition, they have adopted the principle of taking into account low demand and consumption in production, low emissions and high materials, water and energy use efficiency, and maximizing the use of renewable resources as basic features.

Environmental, social, and governance (ESG) measures encompass the factors influencing corporate behavior in investment decisions, as outlined by the International Federation of Accountants (IFAC, 2012). The environmental aspect pertains to considerations regarding climate change, population growth, and their adverse effects on the natural world. Within the realm of "Social," lies corporate social responsibility (CSR), which addresses concerns such as climate change, population growth, and the repercussions of corporate operations on local communities (Armstrong, 2020).

In the realm of corporate dynamics, the concept of corporate governance assumes multiple interpretations contingent upon its application context. At its core, it revolves around the stewardship of an organization, chiefly manifesting in the guidance and oversight exercised by its board of directors (Huang, 2021). Governance at an organizational level is concerned with the principal-agent problem arising from the separation of management and capital, and 'deals with the ways in which suppliers of finance assure themselves of getting a return on their investment' (Shleifer and Vishny, 1997, p. 737) with a presumptive orientation towards shareholder primacy.

2.5.2. Production and Consumption

Despite the increasing acknowledgment of the global environmental crisis by governments and business leaders, the situation persists in deteriorating. Human consumption exceeds nature's regenerative capacity by 30%, and the demand on the planet has nearly tripled over the past 50 years.

The United Nations Industrial Development Organization (UNIDO) is a specialized agency of the United Nations that focuses on promoting industrial development for poverty reduction, inclusive globalization, and environmental sustainability. While it may not have a specific program named "Green Industry," UNIDO has been actively involved in initiatives related to sustainable industrialization and environmentally friendly practices. It envisions a global scenario in which industrial sectors actively reduce waste across all forms, employ renewable resources as primary inputs and fuels, and meticulously adopt precautions to prevent any harm to workers, communities, the climate, or the environment. Green industries are poised to be inventive and forward-thinking, continuously devising novel methods to enhance their economic, environmental, and social contributions (Staniskis, 2012).

Average consumption per capita has almost tripled in the last 50 years, and the main reason for this can be said that consumption has become equal to the quality of life. However, the rapid consumption of today's world, easy access to the internet and the support of the increase in consumer mentality have caused many areas of consumption in daily life to almost explode. Due to the absolute limits of our environmental and climate constraints, consumption patterns need to be changed and in some cases reduced (Staniskis, 2012). But radical change in any aspect of society is always easier

said than done, and developing countries are more or less reluctant to do so, believing that it is their turn to reap the benefits of economic growth over the last few decades.

Finding a balance between economic growth and prosperity should be the main goal set here. When creating this sustainable production and consumption chain, the most important factors are having a wide range of sustainable products and services to choose from, as well as education and infrastructure that allow the informed consumer to make the right choices and actions. The way to achieve this is to ultimately create a sustainable production line with regulations.

2.5.3. Climate

The world is facing a major climate crisis characterized by rising global temperatures, extreme weather events, melting glaciers and other environmental changes. The current condition of the climate crisis is significantly hindering or impeding previous attempts to enhance both food security and the overall welfare of rural populations in developing countries. The close connection between climate risk and food security underscores the importance of integrating climate risk management into the overall strategy for attaining the Sustainable Development Goals2 (Hansen et al., 2022).

At the beginning of the steps to be taken to prevent the formation of food waste, it is necessary to look at the production part of this circular situation. In this section, it is obvious that the effect of climate can be seen more clearly when we look at the importance of production under the right conditions and circumstances.

The 2015 Paris Agreement on Climate Change marked a pivotal moment, with 197 countries pledging determined actions to combat climate change, adapt to its impacts, and bolster support for developing nations. Beyond the commitments made by national governments, the Paris Agreement has garnered widespread support globally, extending to endorsements from companies, civil society, and subnational governments. Concurrently, in 2015, United Nations member countries embraced the 2030 Agenda for Sustainable Development. This all-encompassing global roadmap, centered on 'people, planet, and prosperity,' delineates 17 Sustainable Development Goals (SDGs) with 169 targets to be achieved by 2030. Among these goals, SDG13 specifically addresses climate action (Nerini et al, 2019).

There is an ever-expanding body of evidence focusing on how the sustainable development goals, Paris Agreement articles and the 2030 targets are interconnected, both casually and consequently. This evidence shows how the effects of climate change will make it harder to achieve some development goals; for example, the effects of climate change on agricultural production, which could set back efforts to reduce poverty and hunger. This shows how intertwined it is with the circular economy, sustainable production and consumption mentioned in the previous sections. Turkey, which became a party to the United Nations Framework Convention on Climate Change (UNFCCC) in 2004, signed the Paris Agreement in 2016 for its implementation but has not yet become a party to the Agreement (TSDG 2nd National Review Report,2019).

When we examine the SDGs published by the United Nations in terms of climate, it is said that the climate impact may be direct for the following targets;

SDG 2: 2.1, 2.2,2.3,2.4,2.5 and 2.c

SDG 7: 7.1, 7.2, and 7.b

SDG 12: 12.1 and 12.2

However, SDG has Target 13 which is a sustainable development goal that directly addresses climate change and its effects (Nerini et al., 2019).

Effectively addressing climate change necessitates endeavors to strategically plan and manage resources in a unified manner. Recognizing the possible consequences of climate change across all realms of sustainable development is essential for heightening awareness, garnering policy backing for climate action, and devising adaptation programs that mitigate the impacts of climate change while optimizing progress across all Sustainable Development Goals (SDGs).

Nerini and his colleagues have stated that the path to achieving this involves three steps. Firstly, in the "climate development" research phase, they have emphasized the need for mutual methodological integration between natural sciences, engineering, and social sciences/humanities. This integration is essential to understand complex socio-ecological dynamics and develop solutions based on a robust understanding of physical and social systems. As an example, they mentioned an approach led by organizations such as the Swedish Research Council Formas and the United Kingdom Global Challenges Research Fund. This approach enables stakeholders to organize

projects in thematic areas related to Sustainable Development Goals, facilitating the correlation of research outputs across disciplines (Nerini et al., 2019).

Secondly, they have proposed that research on specific subject areas should not be treated separately, and there should be relatively more exploration of the connections between them. They explained this by stating: "At the macro level, despite the inseparable connections between climate change mitigation, climate change adaptation, and sustainable development, they are often classified as separate areas. At the micro level, there are connections in areas such as energy, mobility and transportation, food, land use, biodiversity, etc., but they are not pursued. There is a need for more effort to develop practical frameworks to explore the connections between Sustainable Development Goals and to draw attention to overlooked factors and regions. Additionally, addressing the breadth and depth of information required to make progress in Sustainable Development Goals will be essential. Meta-analyses can be used to gather studies in many disciplines (breadth) to emphasize areas that require more focused research (depth)" (Nerini et al., 2019).

As the third step, Nerini and his colleagues have pointed out that there is a global institutional fragmentation and lack of integration for evidence evaluation and synthesis. They highlighted that there hasn't been enough emphasis on connecting all these outputs and plans among different yet essentially interconnected institutional authorities. They expressed the concern that this situation may not be easily rectified but underscored the necessity for comprehensive data analysis.

2.5.4. Renewable energy

Renewable energy refers to energy derived from sources that are naturally replenished on a human timescale and are considered virtually inexhaustible over the long term. Unlike fossil fuels, which are finite and contribute to environmental issues such as climate change, renewable energy sources are sustainable and have minimal environmental impact. Common types of renewable energy include accordion to Ellabban and his colleagues:

Solar Energy: Generated from the sun's radiation, solar energy can be harnessed using photovoltaic cells to produce electricity or through solar thermal systems to generate heat for various applications.

Wind Energy: Wind turbines convert the kinetic energy of moving air into electricity. Wind energy is a clean and abundant source, especially in regions with consistent wind patterns.

Hydropower: Hydropower, or hydroelectric power, is generated by harnessing the energy of flowing or falling water. Dams and other water infrastructure are used to generate electricity.

Biomass: Biomass energy is derived from organic materials such as wood, agricultural crops, and waste. It can be used for heating, electricity generation, and as a biofuel for transportation.

Geothermal Energy: Geothermal energy is produced by harnessing the heat from the Earth's interior. This can be used for heating buildings, generating electricity, and other industrial processes.

Tidal and Wave Energy: Tidal and wave energy are generated by harnessing the energy from ocean tides and waves. Various technologies are being developed to capture and convert this energy into electricity.

Renewable energy sources are considered sustainable because they have the potential to meet energy needs without depleting finite resources or causing significant environmental harm. They play a crucial role in efforts to reduce greenhouse gas emissions and combat climate change by providing cleaner alternatives to conventional fossil fuels (Riahi et al., 2017). When considering the recycling dimension of the circular economy, it is acknowledged that achieving a fully circular economy may be technically unattainable due to the impossibility of achieving 100% material recycling. Pearce and Turner (1990) contend, however, that the environment possesses the capacity to reabsorb certain wastes harmlessly, potentially transforming them into useful products. This underscores the concept of 'absorptive capacity,' allowing for the integration of most emissions to air and biodegradable waste into a broader circular system that encompasses the natural environment. It is important to note that if this assimilation capacity is surpassed, waste can transition into pollution, posing risks to both natural ecosystems and human health and well-being.

Turkey aims to increase the share of renewable energy in electricity generation to 30 percent by 2023. Even in the exceptionally dry and record-breaking year for gas

consumption in 2017, the share of renewable energy sources rose to 29.7 percent, reaching the set target (TSDG 2nd National Review Report,2019).

2.6. GRI Standards and GRI 13

The acronym "GRI" stands for the Global Reporting Initiative. GRI is an independent international organization that has developed a widely used framework for sustainability reporting. The GRI Standards provide a comprehensive set of guidelines for organizations to report on their economic, environmental, and social performance. These standards are designed to help businesses and other organizations communicate their impact on sustainable development to a wide range of stakeholders, including investors, customers, employees, and the general public (GRI Reporting, 2022a).

The GRI Standards cover a range of sustainability topics, including governance, human rights, labor practices, environmental performance, and more. By using the GRI Standards, organizations can enhance transparency, accountability, and comparability in their sustainability reporting.

The GRI Universal Standards apply to all organizations, and consist of the following:

• GRI 1: Foundation 2021 (GRI 1) outlines the purpose of the GRI Standards, clarifies critical concepts, and explains how to use the Standards. It lists the requirements that an organization must comply with to report in accordance with the GRI Standards. It also specifies the principles – such as accuracy, balance, and verifiability – fundamental to good-quality reporting.

• GRI 2: General Disclosures 2021 (GRI 2) contains disclosures relating to details about an organization's structure and reporting practices; activities and workers; governance; strategy; policies; practices; and stakeholder engagement. These give insight into the organization's profile and scale, and help in providing a context for understanding an organization's impacts.

• GRI 3: Material Topics 2021 (GRI 3) explains the steps by which an organization can determine the topics most relevant to its impacts, its material topics, and describes how the Sector Standards are used in this process. It also contains disclosures for reporting its list of material topics; the process by which the organization has determined its material topics; and how it manages each topic (GRI Reporting, 2022c).

GRI Sector Standards aim to improve the reporting quality, completeness and consistency of organizations. Standards were developed for 40 sectors, starting with those with the highest impact such as oil and gas, agriculture, aquaculture and fisheries, and these standards listed the issues that are likely to be a priority for most organizations in the sector and created a reporting outline (GRI Reporting, 2022b). If a valid Industry Standard exists, an organization is required to use it when reporting against GRI Standards.Every Sector Standard comprises an introductory section that presents an overview of the sector's characteristics, encompassing activities and business relationships that contribute to its effects. The primary segment of the standard enumerates potential priority issues specific to the sector. This section delves into the most significant impacts on the sector, addressing each subject individually. Each subject statement cross-references the pertinent disclosures in the Subject Matter Standards, which the organization will incorporate in its reporting. Additionally, an Industry Standard may outline supplementary disclosures not covered in the Subject Matter Standard, particularly if the existing disclosures fail to offer adequate information about the organization's impacts on the subject matter. The identification of topics and relevant disclosures relies on sector-specific evidence, international documents, and insights from industry experts. Consequently, these standards reflect the collective expectations of diverse stakeholders concerning the management of impacts within the sector (GRI Reporting,2022d)

GRI 13: Agriculture, Aquaculture, and Fishing Sectors 2022 offers guidance to organizations operating within the agriculture, aquaculture, and fishing sectors regarding potential material topics. These topics are deemed material based on the sectors' notable impacts on the economy, environment, and people, encompassing considerations for human rights. Within GRI 13, there is a specified set of disclosures intended for organizations within these sectors to incorporate in their reporting for each identified material topic. This compilation includes disclosures sourced not only from the GRI Topic Standards but also from other relevant references, ensuring a comprehensive reporting approach for organizations in the agriculture, aquaculture, and fishing sectors.

Agriculture, aquaculture, and fishing are fundamental to feeding the world’s population. The sectors have a key role in meeting the growing demand for nutritious, affordable, and safe food for an estimated 10 billion people by 2050 (Agricultural

Outlook, 2021) . At the same time, these sectors' activities are increasingly recognized as having significant impacts on sustainable development. Intensive use of natural resources, the location of operations in rural areas, and large amounts of labor involved into production globally are factors contributing to the scale of the sectors' impacts.

Agriculture, aquaculture, and fishing exert a considerable environmental impact. To illustrate, agriculture is responsible for approximately 70% of global freshwater withdrawals and is a significant contributor to greenhouse gas (GHG) emissions, making up 22% of the total global emissions (1). Likewise, fishing contributes to a minimum of 1.2% of the world's total oil consumption (2). As agriculture, aquaculture, and fishing production hinge on biodiversity, soils, and ecosystems, the adoption of sustainable practices within these sectors becomes imperative for ensuring food security. The global consumption of animal and aquaculture products has consistently risen. However, the agriculture, aquaculture, and fishing sectors face challenges from climate change, impacting yields, disrupting production and supply chains, and posing threats to food security (GRI 13, 2022d). To address these challenges, organizations in agriculture, aquaculture, and fishing play a pivotal role in enhancing global food security and development. This involves building resilience to climate change, minimizing food loss, and providing income and livelihoods to farmers, fishers, and their communities. By implementing these measures, these sectors contribute significantly to ensuring a sustainable and secure global food supply. When the intersections of the 4 SDGs selected in Table 2.2. and GRI 13 are analyzed, it is proven that these two issues are in fact highly relevant.

Table 2.2 : The intersection points of GRI standards topics with selected SDG goals

GRI 13 Topics	SDG 2	SDG 7	SDG 12	SDG 13
Topic 13.1 Emissions		●	●	●
Topic 13.2 Climate adaptation and resilience	●			●
Topic 13.8 Waste			●	

Linkages between the likely material topics for the agriculture, aquaculture, and fishing sectors and the SDGs.

Topic 13.1 Emissions : This topic addresses emissions to air, including greenhouse gasses (GHGs) and ozone depleters, and other significant air emissions. Greenhouse gas emissions are also one of the important effects that cause climate change. The agricultural sector is responsible for a large portion of greenhouse gas (GHG) emissions. From 2007 to 2016, this sector accounted for approximately 13% of carbon dioxide (CO2), 44% of methane (CH4) and 82% of nitrous oxide (N2O)emissions from human activities worldwide; This amounts to 23% of the total net emissions (Special Report on Climate Change and Land, 2019). Achieving the objective of the Paris Agreement, which aims to restrict global warming to well below 2°C, necessitates organizations to establish emissions targets in alignment with cumulative carbon budgets. These budgets define an upper limit for the total allowable carbon dioxide emissions (Paris Agreement, 2015).

Topic 13.2 Climate adaptation and resilience : Organizations play a dual role in the realm of climate change, both contributing to it and grappling with its effects. Climate adaptation and resilience involve how an organization not only adjusts to existing and

anticipated climate change-related risks but also contributes to enhancing societies' and economies' capacity to withstand the impacts of climate change. The significant impacts of climate change encompass a rise in acute weather events and enduring shifts in climate patterns. Consequently, recent decades have witnessed adverse effects on crop yields and biogeographic suitability. In agriculture, increased volatility, intensity, and duration of weather-related events can lead to crop damage and harvest losses.

Topic 13.8 Waste: Waste encompasses items that a possessor discards, intends to discard, or is obligated to dispose of. Poorly handled waste can exert detrimental effects on both the environment and human health, with consequences extending beyond the sites of waste generation and disposal. This subject explores the repercussions of waste and the strategies involved in its management. Waste generated by entities in the agriculture, aquaculture, and fishing sectors encompasses both organic and inorganic materials. Examples of organic waste include crop residues, animal manure while inorganic waste comprises items like plastics. Certain

organic by-products hold the potential to serve as biomass energy sources, feed, or fertilizers, contributing to circular economy practices. However, when these by-products are incinerated without energy recovery or disposed of in landfills, they transform into waste, leading to adverse environmental impacts, including the release of greenhouse gas emissions and water pollution.

In addition, if we need to mention 13.9 Food Security and 13.10 Food Safety in GRI standards within the scope of our research, it can be said that these two items may have a direct connection with SDG 2. In agriculture, aquaculture and fishing, products that were originally intended for human consumption and eventually went to waste are classified as food waste. According to the Food and Agriculture Organization (FAO), approximately 13.8% of food was lost globally from harvest to retail in 2016 (FAO, 2020). Inefficiencies at different stages of the supply chain contribute to food loss. At the farm level, these inefficiencies can arise due to factors such as suboptimal harvest timing, adverse climatic conditions, inadequate processing practices, post-harvest activities and difficulties with product sales. Food loss not only wastes resources such as water, land, energy, labor and capital, but also contributes to greenhouse gas (GHG) emissions. Mitigating measures against food loss include ensuring appropriate storage temperatures and conditions, establishing robust infrastructure, and optimizing transportation efficiency.

Food safety is a standard that includes the proper processing of food and feed products to prevent the risk of contamination and foodborne diseases. According to the World Health Organization (WHO), an estimated 600 million people worldwide become ill each year after consuming contaminated food, resulting in approximately 420,000 deaths per year (WHO, 2020). Environmental contamination is the main cause of food safety concerns. Major sources of pollution from agriculture, aquaculture, and fishing activities include pollution of water, soil, or air used in growing or raising plants or animals. Inadequate management practices in the growing, collection, capture, primary processing, transportation and storage of crops or animals can also contribute to contamination. From here, as in the field of circular economy, the effects of output and input materials (production and consumption) on each other in terms of health, quantity and recycling in the food sector can be easily visualized.

Global warming-induced land degradation can further intensify the frequency and severity of flooding, drought, pest prevalence, diseases, heat stress, dry spells, wind, sea-level rise, wave action, and permafrost thaw. Failure to adapt to climate change-related impacts can result in operational disruptions for organizations, heightened occupational health and safety risks, loss of livelihood, and food insecurity. These disruptions reverberate across an organization's workforce, suppliers, customers, as well as smallholder farmers, fishers, indigenous peoples, and local communities. Disruptions in food production may translate into increased hunger for an additional 34 to 600 million people by 2080, contingent on the unfolding scenarios of climate change (Parry et al, 2005).

Organizations can respond effectively to climate change impacts by embracing practices and technologies that enhance resilience. For instance, in agriculture, adopting low or no-till farming practices can mitigate soil erosion, leading to improved soil and water quality (GRI 13, 2022). Additionally, measures such as c contribute to a reduced demand for land and natural resources to produce the same output, thereby lowering greenhouse gas emissions.

2.6.1. GRI302: Energy 2016

GRI 302: Energy 2016 contains disclosures for organizations to report information about their energy-related impacts, and how they manage these impacts.Organizations have diverse forms of energy consumption, including fuel, electricity, heating, cooling,

or steam. Energy can be either self-generated or procured from external sources, and it may originate from renewable sources like wind, hydro, or solar, or from non-renewable sources such as coal, petroleum, or natural gas. Prioritizing energy efficiency and choosing renewable sources is crucial in the fight against climate change and in reducing an organization's overall environmental impact.

2.6.2. GRI306: Waste 2020

Within GRI 306: Waste 2020, organizations can find disclosures to communicate information about their impacts related to waste and the strategies implemented to manage these impacts. These disclosures empower organizations to share details on both waste prevention measures and the management of unavoidable waste, encompassing their own activities as well as those upstream and downstream in their value chain. The generation of waste can arise from the organization's internal activities, such as the production of goods and the provision of services. Additionally, entities both upstream and downstream in the organization's value chain contribute to this waste generation. When inadequately managed, waste can pose significant negative impacts on the environment and human health, often extending beyond the locations of its origin and disposal.

The resources and materials embedded in waste that undergo incineration or landfilling are permanently lost, accelerating their depletion and hindering future usability. Recognizing the importance of responsible consumption and production, the UN emphasizes their role in achieving the SDGs. Specifically, targets under Goal 12 call on organizations to adopt environmentally sound waste management practices, emphasizing the prevention and reduction of waste through strategies such as reuse and recycling.

GRI standards offer several benefits to organizations that choose to adopt them for sustainability reporting. Since GRI standards transparently reveal the compliance of organizations with the standards established on many subjects, they enable stakeholders, including investors, customers, employees and the public, to see the performance of the organization transparently.

GRI is widely recognized and used worldwide as a standard for sustainability reporting. This can increase the reliability and comparability of an organization adhering to GRI standards at a global level. At the same time, some countries have

legal and regulatory requirements regarding sustainability reporting. Adhering to GRI standards helps organizations meet these requirements and comply with evolving regulations.

Because GRI encourages organizations to engage a wide range of stakeholders in the reporting process, this fosters better relationships and informed decision-making for both parties. These reports are also helpful in predicting and preventing risks, making strategic decisions and integrating business goals with sustainability. Providing this reporting periodically helps the company in areas of continuous improvement and development.

As the issue of sustainability becomes a frequently talked about topic in the business world today, organizations that implement GRI standards can gain a competitive advantage by being more valued and supported by investors and consumers, and even by getting ahead in access to capital.

We can say that GRI standards, which are said to have an impact on the development of employee conditions and satisfaction in addition to all these, have become widespread in use by many companies today and have become a topic where their benefits are discussed.

3. METHODOLOGY

In order to understand in which Turkey will be able to achieve SDG in 2050, this paper develops suggestions based on some selected indicators for the period 2019-2023. In this study, the data intended to be uncovered has been qualitatively researched, and in line with the predictive method, inferences have been attempted. While implementing this methodology, efforts have been made to compare past data and resources with the world and Turkey, and at the same time, the progress Turkey has made over the years in terms of sustainability has been examined.

Firstly, a comprehensive literature review on concepts such as sustainability and ESG was conducted, followed by an overview of the history of Sustainable Development Goals. The connections and similarities between these two concepts form the main framework for this study. As depicted in Figure 3.4, it is shown that ESG and the four SDGs under consideration support and are interconnected with each other bidirectionally. Additionally, the relevance of the wheat issue, which forms the main question of the study, to these two main topics has been attempted to be proven.

Subsequently, each of the four main goals selected from the SDGs was thoroughly examined, explained, and presented along with their targets for further elaboration. Following this, the discussion transitioned to the 'Food waste' section and was diversified with ESG for the main connection lines. Accordingly, the topic of food waste was elaborated upon with the headings of economy, production and consumption, climate, and renewable energy (Fig, 2.3). In the subsequent stage of the study, the globally recognized and disseminated GRI Standards were introduced, and efforts were made to identify commonalities with the aforementioned measures. Particularly, emphasis was placed on the connections between GRI Standards and SDGs.

In the following section, concerning the part related to Turkey in the study, efforts were made to examine the sustainability-related efforts undertaken in Turkey over the years, and data were sought regarding the feasibility of implementing SDG targets in the country. However, challenges were encountered due to insufficient data and limited research findings. Particularly in this section, government reports and data were scrutinized, and opinions were sought regarding the steps taken in light of the projects implemented. The Turkey Sustainable Development Goals and 2nd National

Review Report were used as the most important source here, and this study, which compares Turkey's current situation and goals for 2030, was taken into consideration. Requirements and conditions for achieving these goals were examined, and the proximity of these goals to the data of the respective year was attempted to be measured. As a result, information is provided to support the connections proposed at the beginning of this report.

Finally, wheat production, consumption, and loss in Turkey were examined. Efforts were made to access current knowledge, the information was taken from The Turkey Sustainable Development Goals and 2nd National Review Report, with a particular focus on bread as a staple food, to draw conclusions. Based on all this data, suggestions were made for Turkey in 2050, attempting to foresee Turkey's potential status regarding sustainability and offering some recommendations.

In this study, the interconnection of the 4 SDGs examined has been attempted to be explained through the wheat market. These four main items have been chosen due to the consideration that wheat is integrated in every aspect from the cultivation process to processing and consumption. When wheat production is considered as a circular chain, the selected SDGs can be evaluated as gears that make up this chain. However, it is also aimed to prove that these SDGs are interconnected in the same way, and the existence of significant linkages that can be proposed between ESG-SDG and wheat has been emphasized.

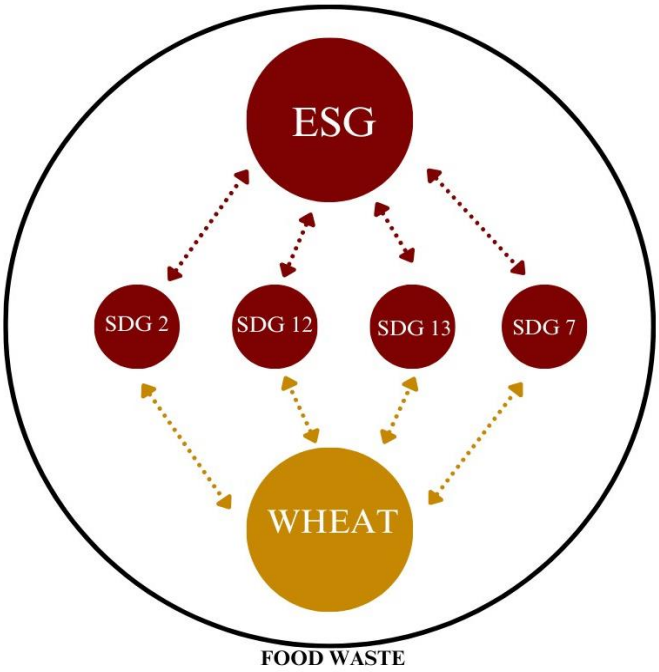

Figure 3.1 : Visualization Of Factors Affecting Waste

3.1. Correlation Matrix with Heatmap

The relationship between features and the target feature is presented through a correlation matrix, as depicted in Figure 4.11 and Figure 4.12., correlation matrix visually represents data to ascertain which features are most correlated with the target feature. Each feature in a dataset is assigned colors, conveying information to researchers about the correlations between features (Buyrukoğlu and Akbaş, 2022). In this research, a heatmap of the correlation matrix was generated, as outlined in four variables and one master data.

The most accurate way to describe the approach taken in this part of the study before moving on to the results of the preferred HeatMap for numerical data validation would be to explain it.

In the presented study, data from the last 5 years has been utilized. It was assumed that the HeatMap would provide the best representation of the correlation between the data obtained from various sources between 2019 and 2023. Accordingly, the results were

correlated between 0 and 1. Initially, a primary component was selected, and an attempt was made to examine whether other matrices were positively correlated both within themselves and with this primary component.

The numerical data of wheat production in Turkey over the past 5 years was used as the primary component. Regarding the demonstration of the study's connection with the Sustainable Development Goals (SDGs), a subheading was chosen to represent each of the 4 SDGs items selected for the study (SDG2-SDG7-SDG12-SDG13). For instance, under SDG 2: Zero Hunger, instead of general hunger data in Turkey, the implementation of minimum wage determined according to the poverty line in Turkey was considered to narrow the scope. In this way, subheadings were determined for the four SDG items mentioned in the study, and it was aimed to prove their correlation both within themselves and with the primary component, which is the annual wheat production in Turkey.

Due to the limited studies on numerical data in Turkey, the most appropriate titles have been selected for these subheadings. It should be noted that these subheadings may not fully represent the entire SDG item to which they are affiliated.

Finally, in interpreting the HeatMap, any value between 0 and 1 (with 1 indicating the highest correlation) indicates a positive correlation between the two compared items. In comparisons made on HeatMaps, sometimes negative correlation results (indicating no correlation) can be observed between items.

Since the connection between these SDG items and ESG cannot be demonstrated numerically, the study's intended linkage between SDG and ESG was shown not through the HeatMap but through the report used in the analysis.

4. ANALYSIS, FINDINGS AND RESULTS

Unfortunately, it is not known at what stage Turkey is in terms of compliance and integration with the existing SDGs due to the lack of current data. Considering the 2030 targets, this report, which must be prepared and presented every year, must include an analysis of the current situation and proximity to the targets. However, unfortunately, Turkey does not have an effective and detailed national reporting source in recent years. For this reason, in this literature, situation assessment and SDG approaches are discussed in the light of the latest published national report.

4.1.Findings from Turkey Sustainable Development Goals and 2nd National Review Report

In this section of the study, the "Turkey Sustainable Development Goals and 2nd National Review Report," published in 2019, has been examined, and Turkey's steps towards sustainability and some of the conclusions drawn for the 2030 targets have been presented. In light of these, SDG connections and propositions for 2050 are discussed.

Turkey has chosen not to pursue a separate action plan or policy document for SDGs but instead, it adopts an integrated approach by incorporating SDGs and indicators into Development Plans and sectoral strategies. The 2030 Agenda, with its broad framework, comprehensive approach, and structure addressing all elements of development, has brought a new perspective to sectoral development policies in Turkey. The Voluntary National Review (VNR) process has also accelerated the evaluation of policies from this perspective. The 2030 Agenda, both globally and in Turkey, necessitates the establishment of multi-stakeholder collaborations, equalization of financial resources, and the development of innovative practices and solutions. To achieve this, it is important to bring together not only public resources but also the contributions of the private sector, local actors, and international financial institutions, along with the efforts of non-governmental organizations (NGOs). Achieving the goals requires not only financial resources but also awareness and ownership by citizens, starting from the public sector to the private sector, from local governments to NGOs, and from the academic community. With this sensitivity, the

Voluntary National Review (VNR) process has focused on the principles of inclusivity and leaving no one behind.

After presenting its first Voluntary National Review (VNR) Report in 2016, Turkey conducted a comprehensive Current Situation Analysis Project over the course of one year. This project, carried out in parallel with the foresight outlined in the report, involved contributions from approximately 350 individuals representing about 150 organizations from the public sector, non-governmental organizations (NGOs), academia, and the private sector. The project aimed to determine which SDGs are relevant to Turkey, assess the current status and gaps for these goals, and undertake roles such as legislation and budget approval, effective implementation of Sustainable Development Goals (SDGs), and ensuring accountability by national parliaments.

The private sector in Turkey, aware of the importance of sustainable development, initially conducted its efforts in this field within the framework of corporate social responsibility projects. With the emergence of the 2030 Agenda, they started to prioritize sustainability by focusing on Sustainable Development Goals (SDGs). Business associations with numerous regional and sectoral members from the business community, such as TÜSİAD, TÜRKONFED, MÜSİAD, and TOBB, have embraced SDGs and taken steps to involve the private sector in various initiatives.

In addition to these efforts, the Business and Sustainable Development Association (SKD Turkey) was established in 2004 with the goal of making sustainability a fundamental strategy for companies. In 2014, the BIST Sustainability Index was created on Borsa Istanbul to enhance understanding, knowledge, and practices related to sustainability among companies listed on the stock exchange. This initiative aimed not only to increase companies' awareness of sustainability but also to provide investors with information about companies' policies on environmental, social, and corporate governance issues.

When the presence of 215 indicators covered in the Official Statistics Program (OSP) is examined proportionally: SDG 2 Zero Hunger 15% produced 85% not produced, SDG 7 Accessible and Clean Energy 60% produced 20% substituted 20% not produced, SDG 12 Responsible Production and Consumption 10% substituted 90% not produced and SDG 13 Climate Action is 100% non-produced.

Distribution of corporate responsibilities on the basis of SDGs according to T.C. Strategy and Budget Directorate:

SDG 2: Ministry of Agriculture and Forestry / Presidency of Strategy and Budget, Ministry of Family, Labor and Social Services, Ministry of Environment and Urbanization, Ministry of Treasury and Finance, Ministry of Internal Affairs, Ministry of Health, Ministry of Industry and Technology, Ministry of Trade, Central Bank, TÜBİTAK, TIKA, Universities.

SDG 7: Ministry of Energy and Natural Resources / Presidency of Strategy and Budget, Ministry of Environment and Urbanization, Ministry of Foreign Affairs, Ministry of Energy and Natural Resources, Ministry of Treasury and Finance, Ministry of National Education, Ministry of Industry and Technology, Ministry of Agriculture and Forestry, Ministry of Commerce, Ministry of Transport and Infrastructure, General Directorate of DSI, Energy Market Regulatory Authority, TUBITAK, TIKA.

SDG 12: Ministry of Environment and Urbanization / Strategy and Budget Directorate, All Ministries, Public Procurement Authority, Energy Market Regulatory Authority, BIST, Union of Municipalities of Turkey.

SDG 13: Ministry of Environment and Urbanization / Strategy and Budget Presidency, Ministry of Energy and Natural Resources, Ministry of Treasury and Finance, Ministry of National Education, Ministry of Agriculture and Forestry, Ministry of Commerce, TIKA, AFAD, Natural Disaster Insurance Institution.

In the assessment of the feasibility of implementing these SDGs, there are considerable gaps and noticeable data deficiencies. The need for enhancing data-based analytical capacity and widespread adoption of appropriate technologies for decision support mechanisms continues in our country. Although pre- and post-project evaluations are frequently conducted in Turkey regarding the assessment of progress, a systematic evaluation process specifically for Sustainable Development Goals (SDGs) has not been defined.

4.1.1. Developments of SDG 2 in Turkey

Some of the main policies created based on Sustainable Development Goal 2 are as follows:

Creating an agricultural sector that uses natural resources sustainably, increasing productivity in agricultural production, supporting agricultural research and technology development activities, and reviewing agricultural supports on the basis of sustainable production,

Reducing poverty, improving income distribution and social inclusion, and supporting access to food through social policies.

Increasing participation in economic activities, facilitating producer organizations' access to the market, and ensuring sustainable supply of domestic raw materials in the food industry at competitive prices and quality.

Collecting data on food, health, and nutrition at regular intervals, considering their interrelationships, and improving data quality.

Improving living conditions in rural areas and preserving genetic resources and establishing gene banks.Conducting effective inspections on the reliability of agricultural and food products, eliminating scale and efficiency problems of agricultural enterprises, developing agricultural insurance within the scope of risk management, and activating product stock management to ensure food safety.

Looking at the legal regulations in this regard, the aim is to increase agricultural productivity and make agriculture resilient to challenging conditions (resilient agriculture) with the goal of increasing income levels in rural areas. Support for small and medium-sized enterprises, improvement of animal and plant health practices, prevention of rural migration, and promotion of good agricultural practices and organic farming are also among the regulations applied by laws. The regulation and development of marketing, especially the Agricultural Law, are included in Turkey's legislation. Additionally, there are legal regulations on supporting investments based on agriculture and ensuring that farmers affected by natural disasters can continue their agricultural activities, preserving ecological balance, improving soil and water quality, increasing agricultural productivity, and strengthening the agricultural business structure. Furthermore, issues such as the collection, storage, production, characterization, evaluation, documentation, and exchange of genetic resources of plants, animals, and aquatic creatures, which are very important for agriculture, are also determined and implemented by these legal regulations.

Looking at the prominent developments and areas in need of development in this regard, the first striking practice is expected to be food banking, which is anticipated to positively contribute to improving food security through campaigns aimed at preventing food waste and losses. Policies are focused on increasing agricultural productivity and sustainable farming practices, emphasizing the development and efficiency of agricultural employment, the scale and efficiency of agricultural enterprises, and the effectiveness of research and development activities. In Turkey, approximately 5 million hectares of the total 23.4 million hectares of agricultural land are used for irrigated farming, while the rest rely on rainfall to sustain production. Therefore, a potential shortage of rainfall can have significant effects on production quantities. However, 70-75% of annual water consumption is spent in irrigated farming areas. Consequently, it is evident that measures need to be taken to mitigate the threat that climate change could pose to the agricultural sector, and there is a clear link between SDG 2 (Zero Hunger) and SDG 13 (Climate Action).

The project named "Zero Food Loss from Field to Table," initiated in collaboration with Kerevitaş Gıda in 2013, aims to prevent approximately 50% of food loss that occurs from the field to the consumer. Among the outcomes of this project are measures to minimize waste in the production of food in the first chain with region-appropriate certified seeds, utilizing new machines during harvest to streamline the process, and eliminating delays and losses in the handling and storage of products due to weather conditions. Additionally, incorporating the latest technology into the process with agricultural engineers to enhance soil fertility is also among the project's achievements. Kerevitaş, along with its brands, is still continuing the 'Zero Food Loss from Field to Plate' project: aiming to prevent losses from farmer education to the final consumer, while also striving to support local farmers and consequently the economy through resource production within a circular system (3).

When examining the impacts of this project, the first and foremost contribution is to educate farmers on suitable seeds and planting methods, disseminating knowledge from generation to generation. The project also puts an end to losses due to maturity or immaturity by harvesting crops at the right time. One noteworthy effect is the reduction of air and time-related losses for crops harvested within one to two hours using modern harvesting machines and transported to factories within 2-3 hours, bringing the losses down to 1.5%. Additionally, plant residues generated after

production in factories, especially potato residues, can be utilized as animal feed or as renewable energy in biogas facilities. This effect highlights the connection between SDG 2 (Zero Hunger) and SDG 7 (Affordable and Clean Energy).

In order to achieve SDG 2 (Sustainable Development Goal 2) successfully in Turkey in the upcoming period, it is proposed to implement some policies.

Firstly, starting from the ground up to achieve self-sufficiency through production and efficiency improvements, activating agricultural R&D services and support, improving the agricultural statistical infrastructure, transitioning to agricultural production methods that adapt to new technologies and changing climate conditions, and considering the cost-income balance while supporting agricultural production are among these objectives. Subsequently, involving the human factor, scaling up farm operations, supporting the on-site employment of rural residents for the continuity of agricultural production, ensuring the sustainability of producers in the sector, increasing their productivity through agricultural education and extension activities, and supporting youth and women to ensure the sustainability of the agricultural workforce are aimed. Lastly, from a socio-economic perspective, regulating especially small agricultural enterprises for more efficient production and market access, reducing food waste and losses to increase food aid to the target population, developing legislation for the conservation of genetic resources and biodiversity, meeting the basic food needs of low-income groups, and enhancing coordination and collaboration in food-health-nutrition policies are also included in the objectives.

4.1.2. Developments of SDG 7 in Turkey

Some of the main policies created based on Sustainable Development Goal 7 are as follows:

Maximizing the utilization of local and renewable energy sources to the highest possible extent and integrating them into the economy in a reliable, economical, and high-quality manner, alleviating the economic burden of energy costs, and promoting the widespread use of highly efficient motors in industry.

Minimizing the waste and environmental impacts of energy, supporting the use of domestic equipment in renewable energy production, and reducing energy intensity in the industrial sector.

Initiating efforts to increase energy production from sources such as solar, wind, geothermal, and biomass, in addition to hydropower, and diversifying and increasing the share of renewable energy in electricity generation resulting from the obtained production. Supporting energy efficiency in buildings and increasing the use of electric vehicles in transportation.

When looking at the legal regulations made for the implementation of this goal, electricity market legislation stands out as one of the top priorities, aiming to ensure that produced electricity is made available to consumers in an adequate, high-quality, continuous, cost-effective, and environmentally-friendly manner. This legislation seeks to establish a financially robust, stable, and transparent electricity market with independent regulation and oversight, while also providing an incentivizing framework for electricity production from renewable energy sources. Various regulations promoting increased energy efficiency in industry, buildings, and transportation have also been aimed at in the field of energy efficiency. The European Energy Charter Treaty, regulations imposed by the UN Framework Convention on Climate Change (UNFCCC), and the Kyoto Protocol contain provisions for international collaboration to enhance energy security by improving efficiency throughout the process from production to distribution and encouraging investment in clean energy technologies.

In the context of increasing the share of renewable energy in the total energy supply, Turkey aims to prioritize diversifying energy sources, reducing dependence on imports, developing local manufacturing industries, and reducing greenhouse gas emissions through energy production from renewable sources. With the impact of improved legislation and incentive mechanisms, there has been a desire to achieve a significant increase in the share of non-hydroelectric renewable sources such as wind and solar in the renewable energy sector. In light of this, the 2009 Electricity Market and Supply Strategy aimed to raise the share of renewable energy in electricity production to at least 30% by the year 2023. In 2016, the Renewable Energy Resource Areas incentive mechanism was implemented to increase the use of renewable energy resources.

The "Renewable Energy Resource Areas" project initiated by the Ministry of Energy and Natural Resources in 2017 aims to increase the share of renewable energy in production through the establishment of R&D facilities and the increase of solar and

wind power plants. It aims to contribute to the reduction of greenhouse gas emissions, the decrease in electricity prices, and the increase in green employment. The RERA project, being a large-scale project across Turkey, continues to sustain its existence through competitions and new field plans throughout the year.

In order to achieve SDG 7 (Sustainable Development Goal 7) successfully in Turkey in the upcoming period, it is proposed to implement some policies.

Initially, the goal is to enhance the efficiency and technology of the necessary grid infrastructure for uninterrupted energy supply on a national scale, increase applications for the development of smart grids, and develop long-term grid infrastructure plans. Additionally, determining the roadmap for a long-term national energy and climate strategy, establishing legal infrastructure for energy storage systems, providing incentives for fuel-efficient vehicles, and promoting the widespread use of efficient vehicles in transportation and agriculture sectors while evaluating alternative financing mechanisms for promoting domestic equipment are also among the objectives. On a broader scale, increasing public awareness of energy efficiency and creating market infrastructure for demand-side participation, promoting the widespread use of Energy Performance Contracts for energy efficiency applications in public buildings, increasing the share of high-efficiency regional heating and cooling systems within total heating and cooling systems, and defining energy efficiency targets for public buildings have also been included as goals.

4.1.3. Developments of SDG 12 in Turkey

Some of the main policies created based on Sustainable Development Goal 12 are as follows:

To promote the sustainable use of natural resources and establish an effective environmental management system, to systematize measurement, monitoring, and evaluation related to the environment, to encourage clean production/eco-efficiency practices, to increase research and development efforts and innovation capacity,

To implement regulations to ensure the compatibility of practices during investment and operational phases with Environmental Impact Assessment Reports, to identify clean production potential in pilot sectors and conduct clean production and life cycle analyses, and to raise awareness among businesses and enhance human resources and capacity in clean production/eco-efficiency,

To raise environmental awareness and consciousness in society and educate the public on waste reduction and segregation to minimize waste production in households, to prefer environmentally friendly products in public procurement to support sustainable production and consumption, and to develop sustainable tourism practices within the framework of environmental sensitivity and responsibility.

Ensuring stability in product markets to ensure food security and reducing losses in the production, marketing, and consumption chain through effective stock management, establishing preprocessing facilities for domestic solid waste disposal and ensuring the disposal of non-recoverable waste through controlled landfill methods, and promoting the economic recovery of materials with reuse value from solid waste,

Improving practices for the safe collection, transportation, disposal, and monitoring of hazardous waste, and closing/rehabilitating old landfill sites,

Increasing coordination and collaboration between central and local governments and the private sector in the collection, transportation, and disposal of special waste, and establishing an effective monitoring system by registering waste production.

Looking at the legal regulations in this regard, Turkey has introduced regulations aimed at achieving this goal through international agreements on environmental protection to which it is a party, in addition to national regulations in line with the 10-Year Framework Programme on Sustainable Consumption and Production Patterns. Regulations ensuring the sustainable management of natural resources, such as prevention of soil and water pollution, control of industrial pollution, and management of waste and chemicals, have been incorporated into the legislation.

With the Productivity Strategy and Action Plan (2015-2018), Turkey aimed to transform towards an industrial structure based on high value-added, high-tech production, emphasizing sustainable production, particularly by ensuring resource (raw material) efficiency in production processes and implementing clean production (eco-efficiency) approaches. Under the main objective of "structural transformation of industry based on productivity," the goal of "widespread implementation of applications and technologies in the transformation process towards sustainable production infrastructure in industry" was included under the title of "Sustainable Production," leading to the emergence of the Turkey Industrial Strategy Document,

which contains significant policies to promote domestic, innovative, and green production. In this context, regulations highlighting the importance of directing resources and energy efficiently and implementing environmental policies during the transition to a sustainable industrial structure have led to the initiation of various projects concerning sustainable water, energy, chemical use, reuse, and pollution prevention in production processes.

The project named "Heat-Pipe Heat Exchanger Design and Heat Recovery System from Tunnel Kilns," initiated by Eczacıbaşı Building Materials in 2017, aimed to recover energy in the ceramic sector, which experiences significant energy consumption due to intensive drying and baking processes. A decrease in carbon emissions was observed following the reduction in natural gas usage, and it was noticed that pollution during production could also be reduced through suitable product design for the facility. In light of this data, the connection between responsible production and consumption (SDG 12) and sustainable energy sources (SDG 7) can also be emphasized.

When the food supply chain is considered as a whole in Turkey, the highest loss rate is observed in agricultural production, which is the first link of the chain. Between 25-40% of the annual production of 49 million tons of fruits and vegetables is wasted during production, distribution, and sales due to various reasons. In order to reduce losses in the food supply chain, it is important to strengthen the registration system, promote licensed warehousing, and improve the logistics infrastructure in the fresh fruit and vegetable supply chain. In this context, it is essential to prioritize the establishment of packaging, transportation, storage, and retail sales standards, as well as the efficient operation and modernization of wholesale markets in Turkey.

In order to achieve SDG 12 (Sustainable Development Goal 12) successfully in Turkey in the upcoming period, it is proposed to implement some policies.

The objectives such as transferring environmental taxes to environmental support mechanisms nationwide, developing financing mechanisms for sustainable investments, and promoting initiatives like "Zero Waste" at an industrial scale and the establishment of sustainability platforms have been identified. While the number of waste collection centers is being increased in local administrations, supporting the availability of raw materials in regions where production is insufficient has been

highlighted. In the production sector, incentives are provided for the production and use of environmentally less harmful alternative products like bioplastics, and activities to increase awareness of sustainable consumption and production, especially among consumers, are recommended. For future steps, promoting product promotion through ecological labeling to reduce environmental impacts throughout the product life cycle, disseminating scientific, fact-based information to consumers, certifying product sustainability, supporting branding, and promoting exports through this means have been proposed. Additionally, goals such as increasing green procurement capacity and developing certification tools, reducing unconscious consumption in tourism, and building capacity in sustainability reporting and integrated reporting have also been discussed.

4.1.4. Developments of SDG 13 in Turkey

Some of the main policies created based on Sustainable Development Goal 13 are as follows:

Contribution based on the principles of common but differentiated responsibilities and respective capabilities in the context of combating climate change, increasing the share of indigenous and renewable energy sources in the context of adaptation to and mitigation of global climate change, considering supply security,

Enhancement of energy efficiency and reduction of losses in electricity transmission, and prioritizing transportation systems that promote clean fuel and environmentally friendly vehicle usage along with energy efficiency,

Promotion of railway and maritime transportation and development of combined transport opportunities,

Establishment of standards for safe, energy-efficient, and environmentally friendly structures and widespread adoption of energy efficiency practices in buildings, alongside promotion of public transportation in urban areas and strengthening integration of transportation infrastructure with other infrastructures,

Evaluation of green growth opportunities in sectors such as energy, industry, agriculture, transportation, construction, services, and urbanization, supporting new job areas that promote environmentally sensitive economic growth, and fostering research, development, and innovation,

Promotion of recycling and reuse through the implementation of integrated waste management principles,

Implementation of necessary measures, including water conservation, combating drought, and preventing pollution, by assessing the impacts of climate change and activities in water basins on water quantity and quality,

Preservation, sustainable utilization, and effective management of water resources, efforts against desertification and erosion, monitoring of environmental and social impacts of agricultural activities on soil resources, increasing preventive measures, and strengthening implementation mechanisms and management capacity for reducing disaster risks.

Legislation in Turkey, primarily the Constitution and the Environmental Law, contains provisions related to the prevention of environmental pollution and the improvement of the environment. It encompasses the objective of controlling emissions by regulating issues such as waste reduction and management, efficient use of energy and natural resources, and the use of environmentally friendly technologies in industry. Additionally, the legislation includes principles related to monitoring, reporting, and verification of greenhouse gas emissions originating from energy and industrial facilities, as well as the use of economic instruments and incentives. The legislation also establishes preventive and regulatory measures concerning aspects such as exhaust gas emissions and emissions from heating in relevant areas such as soil and land conservation, drought prevention, agriculture, agricultural insurance and support, groundwater use, disaster risk management, and natural disaster insurance. Turkey has supported regulations and projects aimed at adapting to and mitigating the effects of climate change.

Agriculture, being a nature-dependent activity, is one of the sectors most vulnerable to the adverse effects of climate change. The project titled "Turkey's First Green Loan Agreement," conducted by Garanti Bank between 2014 and post-2018 periods, aimed to pioneer and innovate in sustainable banking practices, set an example for the entire sector, and ensure that green loans are used as a performance indicator for non-financial environmental, social, and governance criteria. Looking at the outputs of this project, in 2014, Garanti Bank adopted a Sustainability Policy. Collaborating with Zorlu Energy, a $10 million loan was secured through the Green Loan, where the loan

interest was indexed to the company's sustainability performance, marking a first in Turkey in this field. As part of the Green Loan process, Zorlu Energy's environmental, social, and corporate governance performance was regularly assessed by the international independent rating agency Vigeo-Eiris. Consequently, the expected impact is to positively contribute to the environmental, social, and governance performance of companies receiving the Green Loan, enhance firms' national and international reputation, and establish a loan mechanism leading to reduced financing costs through a decrease in loan interest rates.

In the upcoming period, the implementation of the following policies is aimed at achieving SDG 13:

The enhancement of measures aimed at reducing emissions in sectors causing greenhouse gas emissions across the country has been emphasized, ensuring control of greenhouse gas emissions through the reduction of electricity losses and the implementation of new technologies and energy efficiency practices. It has also been highlighted the necessity to develop the technical and institutional capacity required for conducting risk analysis in priority areas, to increase resilience to climate risks, and to identify and prioritize the impacts and adaptation needs of climate change at both national and local levels, as well as in various sectors. Additionally, it has been mentioned that increasing capacity for climate change mitigation and adaptation, along with enhancing water conservation, drought resilience, pollution prevention practices, and promoting integrated waste management practices are essential. Preservation of qualified agricultural lands and forest assets, especially significant natural protected areas, combating desertification and erosion, improving pasture and meadow areas for more effective and efficient use, developing drought-resistant crop varieties, monitoring the effects on soil resources, and taking preventive measures have been underscored as crucial in the production field.Furthermore, it has been recommended to prioritize transportation systems that promote energy efficiency, encourage the use of clean fuel and environmentally friendly vehicles, and promote energy efficiency practices in buildings. Leveraging smart transportation systems to improve public transportation in urban areas, activate demand management in traffic management, and increase the share of railway and maritime transportation in freight transportation are also additional recommendations.

4.2. Findings Obtained From Numerical Data Related To The Subheadings Selected For SDG Targets And Heatmap Visualization

4.2.1. Target 2

The subheading chosen for this goal is the minimum wage. The minimum wage is a universal tool developed to regulate labor-capital relations. In Turkey, according to Article 39 of Law No. 4857, the minimum wage is applicable to all types of employees working under an employment contract. The legal authority to determine the minimum wage lies with the Minimum Wage Determination Commission to be established by the Ministry of Labor and Social Security (Güler,2023). In Turkey, it is a legal requirement for TURKSTAT to present the minimum subsistence level proposal to the Minimum Wage Determination Commission for the determination of the minimum wage. The correlation between Turkey's minimum wage and inflation has sparked debate for years, with questions arising about whether it keeps pace with inflation or falls short. In addition, a relationship is thought to exist for minimum wage with the hunger and poverty thresholds (Sevinç,2022).

Table 4.1.: Turkey's minimum wage over the last 5 years (in TL)

Years	2019	2020	2021	2022	2023
Minimum Wage	2.558,40 TL	2.943,00 TL	3.577,50 TL	5.004,00/ 6.471,00 TL	10.008,00/ 13.414,00 TL

Due to economic challenges and inflation, Turkey has set its minimum wage twice in 2022, following the same pattern in 2023. As of 2024, the minimum wage in Turkey is gross 20,002.00 TL as shown in Table 4.1. The change in the last 5 years is shown as a column graph in Figure 4.1.

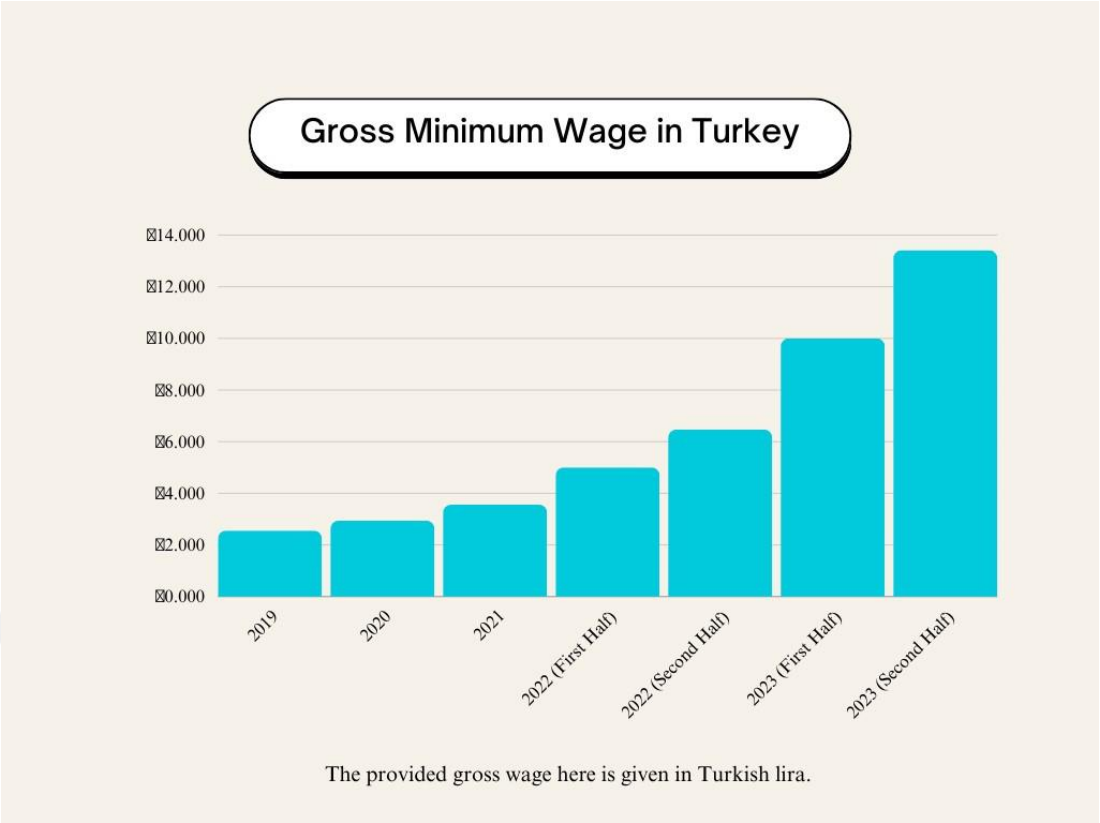

Figure 4.1 : Graph Of Minimum Wage In Turkey For The Last 5 Years

4.2.2.Target 7

The subheading chosen for this goal is Turkey's solar energy production. Solar and wind energy have the potential to lead the transformation of the global electricity sector. It is observed that the installed capacity of hydroelectric power, which is the most electricity-producing renewable energy source today, has been growing at an annual rate of approximately 2.7% since 2010 (PWC, 2021).

Table 4.2: Turkey's solar energy production graph for the last 5 years (in Gwh)

Years	2019	2020	2021	2022	2023
Installed capacity	5,995.0 Gwh	6,667.0 Gwh	7,816.0 Gwh	9,425.4 Gwh	18,599.0 Gwh

When we look at Turkey's use of solar energy, it is determined that there is a noticeable difference, especially among the increased amounts. The data here is as shows in the Table 4.2.

From 2010 to 2020, the annual average growth rate of solar installed capacity, which increased by 33%, reached a level of 710 GW by 2020. Solar energy, with the greatest potential among all energy sources, is projected to quadruple its current installed capacity to reach 3,063 GW by 2030 (IEA,2021). It is expected that solar and wind will have the highest share among renewable energy sources in 2050. The amount of installed capacity of solar energy between 2019-2023 is shown in Figure 4.2 as a bar chart.

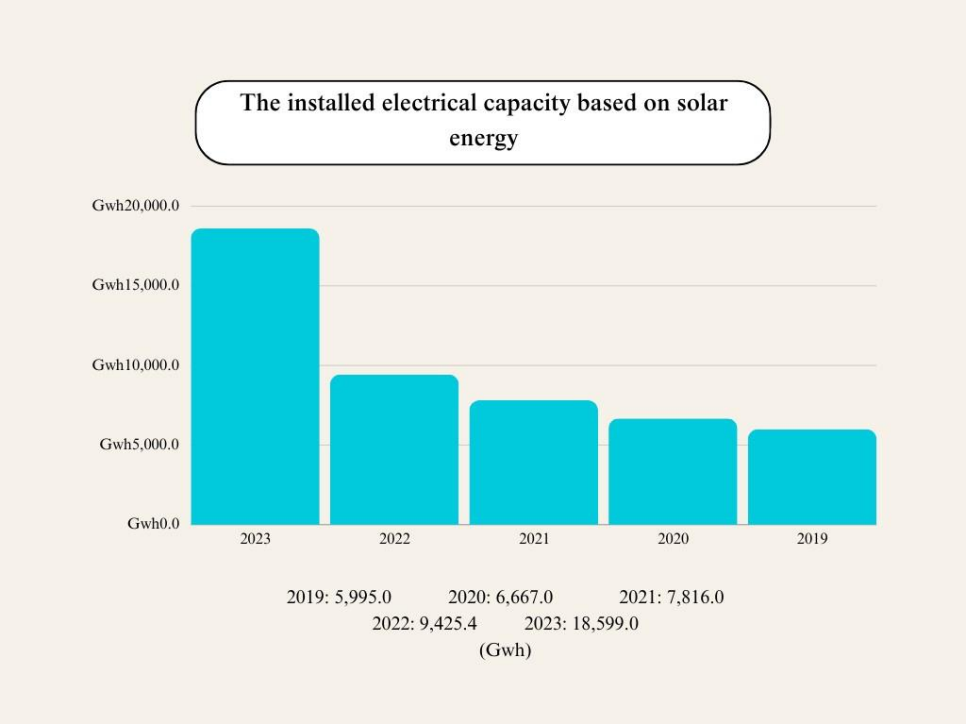

Figure 4.2 : Graph Of Installed Solar Energy In Turkey Over The Last 5 Years

4.2.3. Target 12

The subheading chosen for this goal is wheat efficiency. The report published by the Agricultural Products Markets in July 2023, which extensively detailed sowing areas and productivity, was supplemented with information from the main report published by the General Directorate of Soil Products as a main source. The visual representation of this report is provided in the Figure 4.3. below.

Year	Wheat Production	Planted Area	Efficiency
2019	6,846,327	19,000,000	278
2020	6,922,236	20,500,000	296
2021	6,744,666	17,650,000	262
2022	6,628,739	19,750,000	298
2023	7,300,000 (est.)	22,000,000	301

Figure 4.3 : Turkey's wheat efficiency data for the last 5 years

In reports published by the National Cereal Association, wheat planting areas in Turkey are analyzed by regions and forecasts for the year are shared. In the Wheat Production Yield 2nd Estimate Report for 2022-2023 (October 1, 2022, to May 31, 2023), which we looked at to complete the missing 2023 year in the table published by the General Directorate of Soil Products, it was stated that 7.3 million hectares of wheat cultivation is expected in the 2022-2023 production year (Figure 4.4).

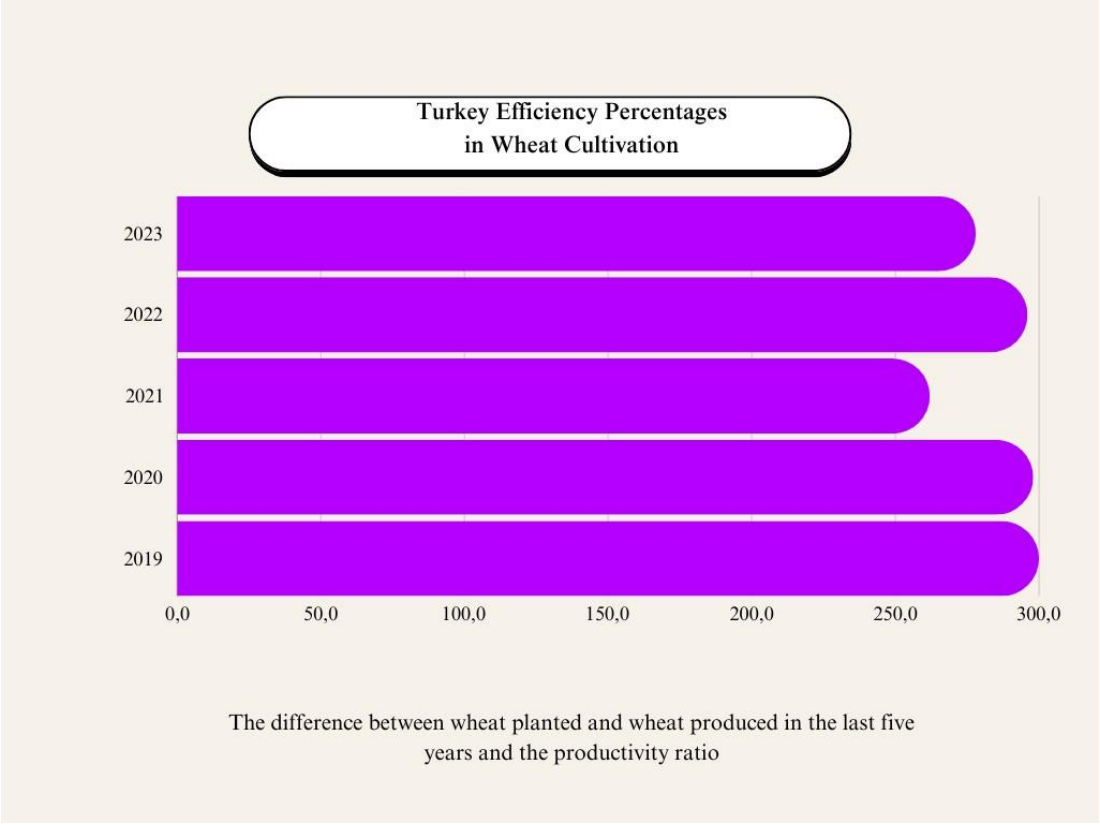

Figure 4.4 : Graph Of Wheat Productivity In Turkey Over The Last 5 Years

4.2.4.Target 13

When addressing SDG target 13, two different variables were examined, and therefore, two different HeatMaps were used in the study. The first selected subheading was deemed appropriate to compare wheat production with the rainfall rates of the last 5 years, on behalf of Turkey, in order to assess the effects of climate change on countries dependent on agriculture. The reports published by the General Directorate of Meteorology, affiliated with the Ministry of Environment, Urbanization, and Climate Change of Turkey, have been used as the primary data source in this field. Accordingly, the rainfall rate in Turkey for the last 5 years is as follows in millimeters, as shown in the Figure 4.5. below.

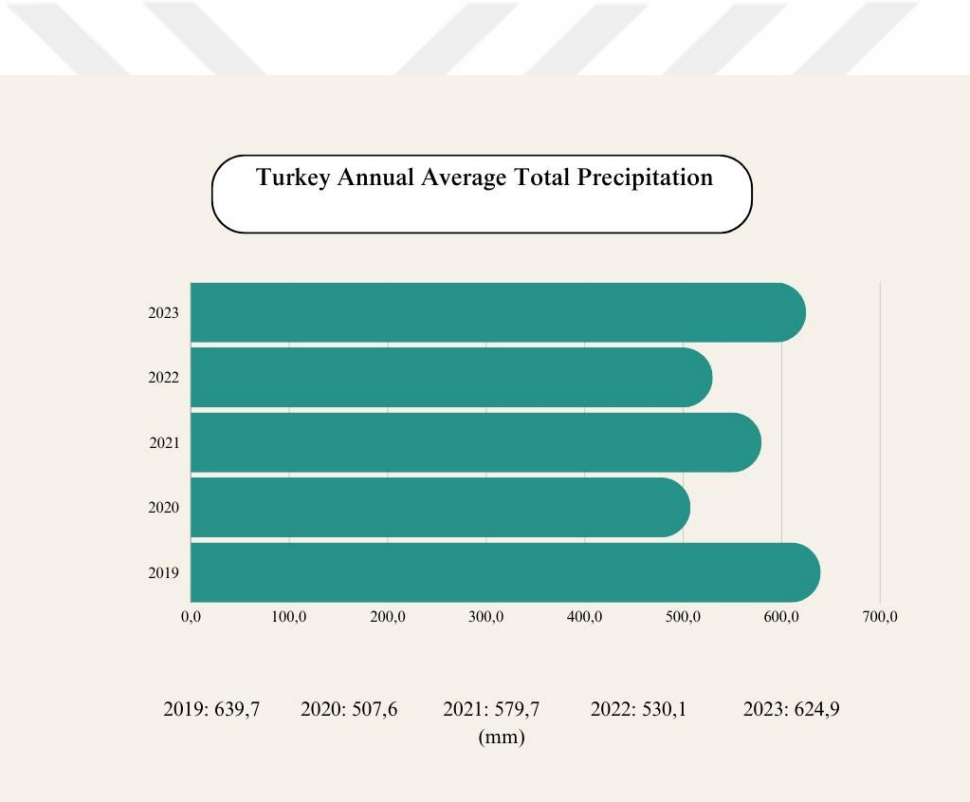

Figure 4.5 : Graph of the average precipitationin Turkey over the last 5 years

In a different report obtained from the same source, the temperature increase in Turkey over the last 5 years was considered and used as a metric for correlation with the main data. The data on temperature increase is shown in the Figure 4.6. below

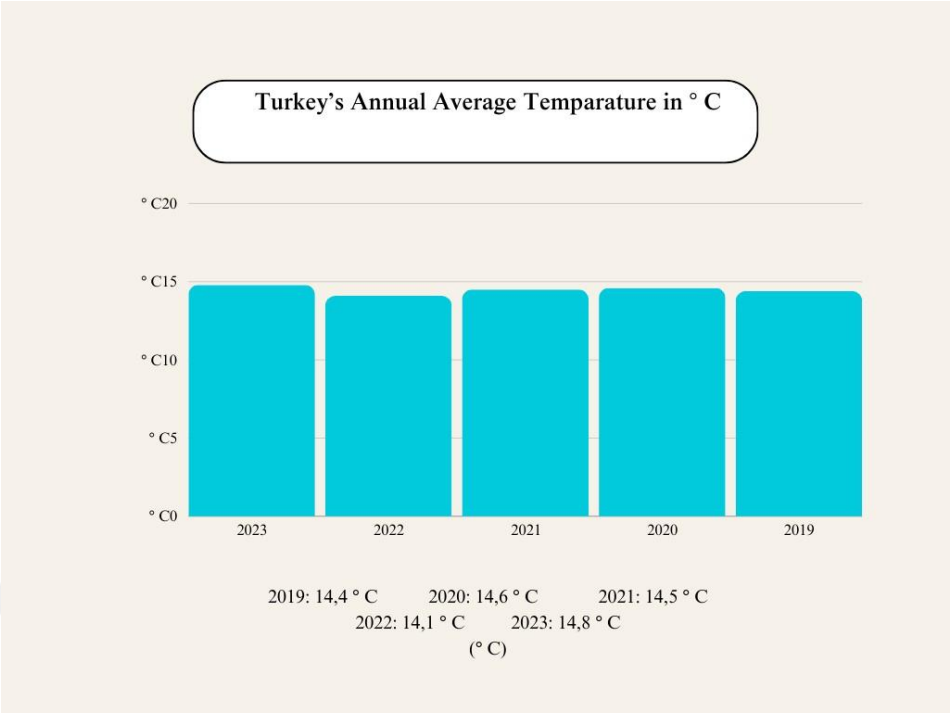

Figure 4.6. : Graph of the Turkey's average temperature over the last 5 years

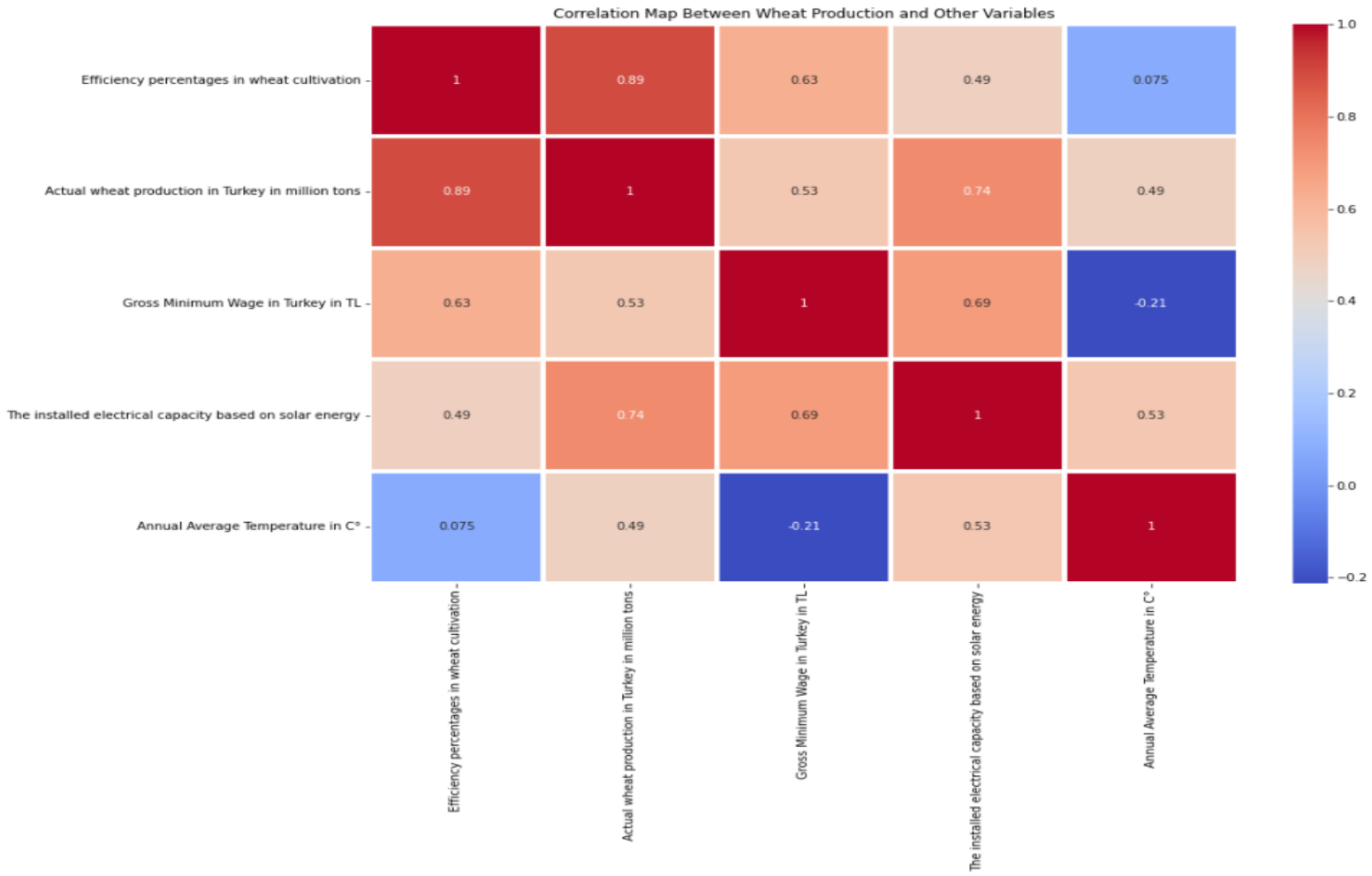

Figure 4.7 : The first HeatMap visualization where the data is evaluated

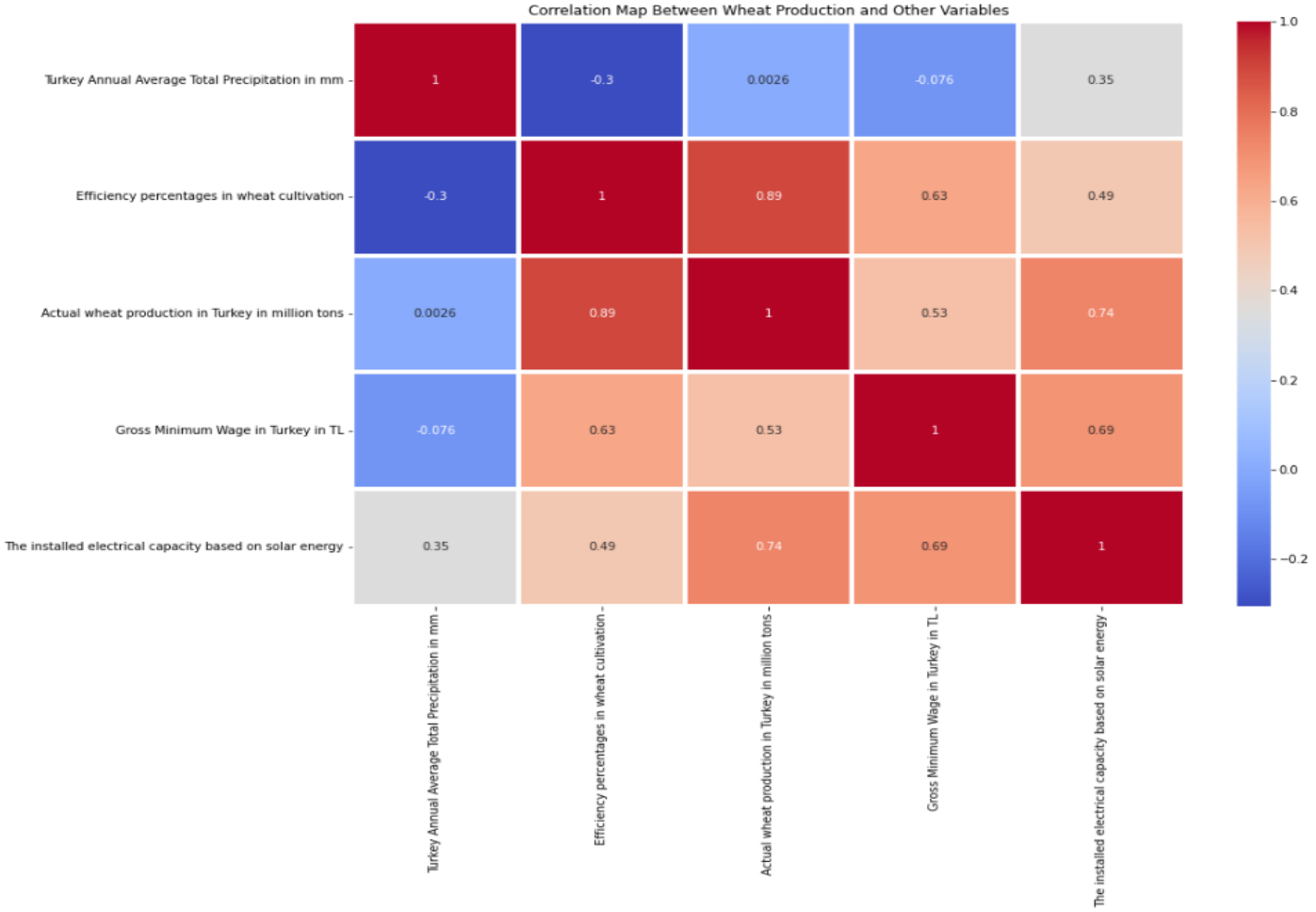

Figure 4.8 : Alternative Heatmap study

5.SUMMARY OF RESULTS

In this part of the study, a comparison will be made between two different primary data sources used in the methodology and analysis, and the results obtained from the numerical data created by correlating the theses resulting from the Turkey Sustainable Development Goals and 2nd National Review Report with the Correlation HeatMap. The reason for comparing two different data sources in this section is that the Turkey Sustainable Development Goals and 2nd National Review Report provide a more comprehensive result where the linkage of SDG targets progresses in coordination with ESG. Connections with ESG have been referenced solely through this report.

The most important inference from the correlation based on numerical data, represented by the HeatMap, is the complete correlation coefficient of 1 between the annually wheat production in Turkey, selected as the main data, and the other four selected subheadings, proving that they are positively correlated at the highest level possible. This demonstrates the main aim of the study, establishing the connection between the wheat sector and sustainable development goals, by yielding positive correlated results on both HeatMaps. However, the study goes beyond this by also showing the correlation among the selected subheadings within this sector.

The findings and connections arising from the Turkey Sustainable Development Goals and 2nd National Review Report, which were thoroughly examined in previous sections, are presented below. The connections emphasized throughout the study are supported by the projects discussed and exemplified, and contrary claims are also included.

I. The first connection can be inferred in the light of the Zero Food Loss from Field to Table project. This project proposes the idea of utilizing general waste generated in production facilities, especially plant residues, as animal feed or as renewable energy in biogas plants. With this proposition, it is observed that in the planning of sustainable production, there could be a connection between waste management and SDG 2 (Zero Hunger) and SDG 7 (Affordable and Clean Energy).

   When looking at the connection between Target 2 and Target 7 through the Correlation Map, we observe a positive correlation of 0.69. In this case, it can

be said that there is a connection between these two targets with numerical results, as stated in the report.

In addition to the report, other sources also shed light on the connections intended to be highlighted, especially the projects initiated in Turkey. Particularly, to summarize the connection between SDG 2 and ESG, reference was made to the Food Waste Prevention Efforts report prepared by Migros, a well-known retail chain in Turkey, in 2021. The mentioned report outlines the following: Within the scope of the studies conducted in collaboration with the Food Safety Association (FSA), a "Food Waste and Label Reading Survey" was carried out to identify consumer perceptions and behaviors leading to food loss. Parallel to this, as a member of the Food Waste coalition within the Consumer Goods Forum (CGF), Migros has committed to reducing its food waste rate by 50% by the year 2030. Within the scope of Migros' "Respect for Food" project, offering fresh products with approaching expiration dates and ripe fruits and vegetables at a discounted rate of 25-50% to prevent waste is also one of the clearest examples of company-level efforts in ESG. Similarly, the Istanbul Commodity Exchange (ICE) has established a commission to carry out efforts to prevent food waste and aims to facilitate new ideas and solutions through award-winning projects, thus showcasing the connection between corporate ESG awareness and SDG goals.

II. In a study published by Pradhan et al. in 2017, a trade-off connection between Target 2 and Target 12 was identified. Additionally, in a paper by Pakkan et al. in 2023, a positive correlation of 0.72 was found between Target 2 and Target 12 using the Correlation HeatMap (Pradhan et al., 2017; Pakkan et al., 2023). In addition, when looking at the United Nations' SDG report, there is a notable item under Target 2: "2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality". It can be said that the resilient agricultural developments mentioned within this item overlap with the points targeted by Target 12.

Finally, in the Correlation map we worked on by narrowing down to minimum wage and wheat productivity, a positive correlation of 0.63 is observed between these two factors. The reason for obtaining a numerical result different from the correlation map made by Pakkan and colleagues is that in this study, the goals were narrowed down to subheadings to reach numerical data.

III. The findings on 4.1. Developments of SDG 2 in Turkey shows the threat that climate change poses to the agricultural sector in Turkey and globally, emphasizing the need for measures to prevent it. This indicates that there is a clear connection between Sustainable Development Goals 2 (Zero Hunger) and 13 (Climate Action), with a linear dependency between them. Both the examined report and the report published by Pakkan et al. in 2023, which investigated the connections between the SDGs, showed a positive correlation between SDG 2 and SDG 13. However, as explained in the methodology section, since the SDG targets in this study were evaluated with only one aspect, it does not encompass the entire scope of the target. Therefore, in both HeatMaps in this study, SDG 2 and SDG 13 have shown a negative correlation.

IV. It is necessary to mention the project named "Heat-Pipe Heat Exchanger Design and Heat Recovery System from Tunnel Kilns" for the third proposition. This project has resulted in two very important conclusions. The first is the observed reduction in carbon emissions following the decrease in natural gas usage, clearly demonstrating the linear dependency between SDG 12 (Responsible Production and Consumption) and SDG 7 (Sustainable Energy Sources). When looking at the connection between Target 7 and Target 12 through the Correlation Map, we observe a positive correlation of 0.49. In this case, it is evident that there is a numerical connection between these two targets, which are subdivided into efficiency and solar energy, as well.

V. Similarly, the proposition suggests that with the second outcome of this project, namely "the reduction of pollution during production through appropriate product design for the facility," it can be said that such a responsible production system could environmental harm in the long term at the production facility. In

this case, it actually highlights the involvement of ESG in both SDG 7 and 12, not only connecting the two goals but also revealing how ESG plays a role in both factors as both an actor and an affected party.

VI. It is observed in the report that one of the main policies mentioned for SDG 13, "Enhancement of energy efficiency and reduction of losses in electricity transmission, and prioritizing transportation systems that promote clean fuel and environmentally friendly vehicle usage along with energy efficiency," is directly related to Target 7. Similarly, it also proves this theory that one of the goals that Target 13 aims to implement in practice is "The enhancement of measures aimed at reducing emissions in sectors causing greenhouse gas emissions across the country has been emphasized, ensuring control of greenhouse gas emissions through the reduction of electricity losses and the implementation of new technologies and energy efficiency practices." Similar to the previous point, when examining the correlation between Target 7 and Target 13 based on Pakkan's study, a positive correlation of 0.74 was found between these two factors in that study.

Similarly, between solar energy used for Target 7 and the subheading of rainfall rate used for Target 13, a positive correlation of 0.35 was obtained using the HeatMap in this study. The reason for the lower correlation rate again in this section compared to the other study is due to this study's continuation by subdividing targets into subheadings due to the limited data source.

VII. Based on the same project that mentioned in Suggestion 1, the proposition of using the waste and plant residues as animal feed supports the alleged connection between SDG 12 (Responsible Production and Consumption) and ESG-circular economy.

VIII. Finally, when we individually examined the two separate subheadings selected for Target 13 for SDG 12 and SDG 13 in this study, one showed a negative correlation while the other showed a positive correlation. In the main report that led the study, SDG 12 and 13 showed a positive correlation, and similarly, in Pakkan's 2023 publication, a positive correlation between these two targets

was demonstrated. The different results for these items in the two HeatMaps are also due to the limitations mentioned in the methodology, namely the restriction imposed by dividing the main target into subheadings.

IX. To examine the connection between SDG 13 and ESG, it is best to recall the mentioned GRI standards at the beginning of the study. In today's corporate world, GRI standards, which are highly useful for measuring companies' connection with and applicability of ESG, are divided into main topics internally. When we look at its connection with SDG 13, which is the climate crisis, the report "Linking GRI and CDP: How are the GRI Sustainability Reporting Standards and CDP's 2017 climate change questions aligned?" published by GRI emphasizes the connections between the climate crisis and GRI standards.

5.1. Recommendations for Turkey's SDG 2050 Targets

Based on the conclusions drawn from the examination of this report and its findings, it appears unlikely that Turkey will achieve the targets set in the 2030 agenda, considering its sustainability goals. In this context, it would be more effective to address the areas needing improvement by separating them into public, private sector, and individual contributions.

In fulfilling public targets, the first steps can be said to be "prioritization" and "data analysis." Turkey needs to make more progress in analyzing public reports and accurately interpreting the data obtained. To identify ongoing problems and provide targeted solutions, leveraging data analysis and expert opinions is crucial in the public sector. Necessary projects in these areas should be managed and monitored both in city municipalities and districts, and committees should be established for this purpose. Additionally, these projects must be subjected to regular reporting and audits regarding their progress.

The focus on wheat in this study is linked to its agricultural importance due to its frequent use in staple food sources. Although Turkey's agricultural reforms and legislative changes have varied over the years, it has been observed that this situation depends not only on the economy but also on many external factors (such as climate,

energy, and consumption). Addressing this issue at a public and national level requires a holistic approach. The outcomes of this study indicate that if the Republic of Turkey aims to take steps towards a more sustainable future, it should recognize that these sustainability goals serve as a "whole" and interact with each other, and therefore choose to advance with appropriate laws and reforms.

Regarding recommendations for the private sector in Turkey, the 2023 Turkey Sustainability Governance Scorecard Report by Oskay and Türker, published in 2024, has been reviewed as a guide. Upon examining the findings of this report, it has been observed that while the number of companies publishing sustainability reports is increasing every year, the quality of these reports is also improving. Additionally, as reporting standards become more common and holistic, these reports are becoming more useful for the decision-making processes of various stakeholders. The report emphasizes that to truly contribute to a sustainable future, companies need to broaden their perspective on sustainability. Looking at the SGS Turkey General Evaluation, many companies' scorecard ratings have shown a positive trend over the years (Oskay ann Türker ,2024). For instance, according to the SGS 2023 research results, the top two companies in Group 1 are Arçelik and Coca-Cola İçecek. They are followed in Group 2 by Anadolu Efes, Enerjisa Enerji, Ford Otosan, Migros Ticaret, Tüpraş, and Ülker. Reviewing research from previous years, it is observed that many companies have moved up to a higher group over time due to accurate reporting and appropriate steps.

Publishing such reports and scorecards at both the public and private sector levels is crucial for analyzing the current situation and identifying the needs and gaps to improve existing outcomes. It is evident that the most important targets for the 2050 agenda are good data analysis, a holistic approach, and transparent sharing.

Finally, although not central in this report, the importance of individual contributions and individuals' adherence to existing laws and regulations is evident. Whether it's waste separation or home composting, the significance of individual awareness and contributions in sustainability, where a holistic approach is crucial, is clear. Many examples demonstrate how small steps can lead to significant changes. Therefore, projects, regulations, and education in relevant areas, supported by government contributions, will be essential to raise public awareness. For the goal of a more sustainable society by 2050, educating and holding the community accountable are

crucial. As Turkey progresses towards its 2050 sustainability goals, it's important to emphasize the role of societal awareness and contribution in achieving these goals.

6.CONCLUSION

In this study, the wheat sector in Turkey has been considered a fundamental component, and an attempt has been made to establish its connection with four main Sustainable Development Goals (SDGs) selected from those published by the European Union. In assessing the existence of this connection, both a report published by the Turkish government and numerical data have been utilized. Initially, a historical investigation concerning sustainability and sustainable development goals was presented in the literature review. Following this investigation, where Turkey stands in terms of sustainability was identified, and the position of Turkey in wheat production was discussed. Additionally, the reasons for selecting wheat as the main subject and why progress was made with four of the SDGs were explained. Following this examination, the four main targets were introduced, and the objectives within their subheadings were presented. At this point, the decision was made to incorporate ESG into the broader picture. Through this inclusivity, the analysis aimed to demonstrate the interconnected and supportive aspects between SDG goals and ESG.

After the inclusion of ESG into the picture, mention was made of the GRI standards, which facilitate the use and reporting of these SDGs in sectors like wheat, ensuring accuracy, transparency, and adherence to specific standards. Especially the GRI standards, which could be relevant to the four selected SDGs, have been introduced, and intersections with these SDGs have been identified. In the next step, two methods used have been introduced, and a comparison has been made between qualitative and quantitative data obtained from two main sources in different ways. Firstly, the report used has been thoroughly examined for the four SDG targets, notes have been taken regarding sample reports, and planned regulations. Additionally, a conclusion has been drawn from the report for each SDG. Subsequently, for the quantitative data section, the wheat production over the last 5 years has been considered as the main component to create a Correlation HeatMap. To create a clear and concise map, a subtitle has been selected for each SDG item. For example, for SDG 7 (Ensure Access To Affordable, Relıable, Sustaınable And Modern Energy For All), instead of a general definition and numerical data, "Turkey's solar energy production" has been chosen. All remaining subtitles have also been selected as subtitles that could affect or be affected by the wheat sector in Turkey.

Here, the limitations encountered and data deficiencies have been explained, and the reasons for proceeding with these subtitles have been clarified for each. Then, in the summary of results section, the findings from both sources have been evaluated in bullet points, supporting and comparing each other. Additionally, these comparisons have been enriched with research from different sources, highlighting the intended points.

Given the subject matter, the main aim is to demonstrate that the sustainable development goals set forth by the European Union for a sustainable future have significant impacts on the wheat sector. Consequently, it is evident that the wheat-SDG-ESG trio are mutually influential and supportive in various aspects, as intended to be proven in the analysis. Ultimately, despite the limitations imposed by the constrained research scope, the study concludes that there is a positive correlation between the selected four SDG goals and the wheat sector in Turkey.

7.DISCUSSION AND LIMITATIONS

In the final section, it is important to discuss the areas and situations where the study remained limited in order to ensure its correct interpretation and analysis. Firstly, it is crucial to emphasize the limitations of the main data sources used in this study, particularly concerning their specificity to Turkey and the constraints in accessing numerical data for a selected subheading. Additionally, the lack of updates in the available reports over the years and the difficulty in accessing retrospective numerical analyses even for a limited timeframe like the chosen 5 years, despite the presence of more recent findings, has been quite challenging in terms of accurate analysis and substantiation.

Another factor is the nature of the methodology, particularly the division of each selected SDG target into smaller and more specific subheadings, which necessitates analysis and HeatMap results that may not be comprehensive or applicable to all SDGs. The reason for examining the general headings of the four main SDGs with subheadings rather than their general titles in this section is primarily due to the aforementioned data limitations. It is believed that the published general reports and government data would not suffice to examine both wheat production and their interconnections within themselves and with ESG for the selected four SDG targets; therefore, these subheadings were chosen, and a narrower scope of evidence was pursued.

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