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Nazlı Ceylan
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MAGYAR AGRÁR- ÉS ÉLETTUDOMÁNYI EGYETEM

HUNGARIAN UNIVERSITY OF AGRICULTURE AND LIFE SCIENCES

WHEAT VALUE CHAIN ANALYSIS OF TURKEY: CONSTRAINTS AND DEVELOPMENT POSSIBILITIES

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Nazlı Ceylan

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Hungarian University of Agriculture and Life Sciences

The PhD School

Name: Doctoral School of Economic and Regional Sciences

Discipline: Regional Sciences

Head: **Prof. Dr. H.c. LAKNER, Zoltán**

Corresponding member of the Hungarian Academy of Sciences
Hungarian University of Agriculture and Life Sciences
Institute of Economic Sciences

Supervisors: **Dr. JUHÁSZ, Anikó**

Deputy State Secretary of Ministry of Agriculture
Ministry of Agriculture, Budapest, Hungary

Dr. KHADEMI-VIDRA, Anikó

Associate Professor
Hungarian University of Agriculture and Life Sciences
Institute of Economic Sciences

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Approval of the Head of Doctoral School

Approval of the Supervisor(s)

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ABBREVIATIONS

AKS	*Anatolian Hard Red Wheat*
ANOVA	*Analysis of Variance*
AS	*Ammonium Sulphate*
CAP	*Common Agricultural Policy*
CIF	*Cost, Insurance, and Freight*
CIRAD	*Centre de cooperation internationale en recherche agronomique pour le developpment*
CRP	*Climate Risk Profile*
DAP	*Diammonium Phospate*
DRC	*Domestic Resource Cost*
EPC	*Effective Protection Coefficient*
FAO	*Food and Agricultural Organization of the United Nations*
FOB	*Free on Board*
GDP	*Gross Domestic Product*
GNP	*Gross National Product*
GVC	*Global Value Chain*
HS	*Harmonised Commodity Description and Coding System*
INRA	*Institut national de la recherche agronomique*
IPR	*Inward Processing Regime*
KMO	*Kaiser-Meyer-Olkin*
K-S	*Kolmogorov-Smirnov Goodness of fit test*
LSD	*Least Significant Difference*
MT	*Metric Ton*
MMT	*Million Metric Tons*
NPC	*Nominal Protection Coefficient*
NPCI	*Nominal Protection Coefficient on Tradable Intputs*
NPCO	*Nominal Protection Coefficient on Tradable Outputs*
OECD	*Organization for Economic Co-operation and Development*
PAM	*Policy Analysis Matrix*
PCR	*Private Cost Ratio*
RCA	*Revealed Comparative Advantage*

SCP	*Structure-Conduct Performance*
SD	*System Dynamics*
TAGEM	*General Directorate of Agricultural Research and Policies – Republic of Turkey Ministry of Agriculture and Forestry*
TCMB	*Central Bank of the Republic of Turkey*
TEPGE	*Agricultural Economic and Policy Development Institute*
TIGEM	*General Directorate of Agricultural Enterprises*
TMEX	*Turkish Mercantile Exchange*
TMO	*Turkish Grain Board*
TOBB	*Union of Chambers and Commodity Exchanges of Turkey*
TSMS	*Turkish State Meteorological Service*
TUIK	*Turkish Statistical Institute*
UNIDO	*United Nations Industrial Development Organization*
USDA	*United States Department of Agriculture*
VCA	*Value Chain Analysis*
VSM	*Value Stream Management*

1. INTRODUCTION

1.1. Background of the Study

Productivity, competitiveness and sustainability are three important concepts of the modern economic world. These three concepts affect every aspect of our life, from social to environmental issues but most importantly they shape numerous economic activities. Today, success of an economic entity is measured by its productivity and competitive power, as well as sustainability of its activities. In this context, the value-chain approach becomes prominent due to its strong link with these concepts. In simple terms, a value chain can be defined as a series of activities and actors that bring a product from the production stage to its final use, while value is added in each step of this process. From a socioeconomic perspective, value chains can provide great opportunities for social, environmental and economic development if they function effectively. They can also be used as a tool in regional development policies, through the integration of regional clusters with each other or with global markets. Agriculture-based regions especially can generate economic, social and environmental benefits such as an income and employment increase or better use of resources by upgrading the chain and creating added value.

Based on the above-mentioned considerations, my study aims to provide a comprehensive analysis about the wheat value chain in Turkey by addressing the subject from different perspectives. The main reason for examining the wheat sector is the strategic importance of this product at both regional and national levels. In addition to this, staple foods like wheat are the focus of state development policies and food security regulations. Therefore, findings and suggestions based on a holistic value chain analysis in wheat sector are expected to provide a contribution to the sector itself and also to future development policies. The study investigates and compares the comparative advantage of the wheat sector in Turkey and other major wheat producing/exporting countries that produce and trade considerable amounts of wheat whilst having different market structure and state policies. For example, the European Union (EU-28) member countries are subject to the Common Agricultural Policy (CAP), while in the Russian Federation, the state uses different intervention instruments such as export quotas and tariffs. On the other hand, in Turkey, different policies are applied through import tariffs, export subsidies and farmer support mechanisms to ensure food security and sustainability in the agricultural sector.

Consequently, it is important to reveal how the existing market is structured, how regulations and policies affect the wheat value chain, and at which points in the wheat value chain the challenges occur. A value chain approach plays a substantial role, because the overarching character of the value chain analysis provides a comprehensive breakdown to address these issues. In other words, the analysis does not only take into account efficiency of the production segment of the chain, but also those elements which determine the engagement of specific groups in ultimate markets (KAPLINSKY & MORRIS, 2000). In order to get answers to these questions, a gradual analysis is the main goal of this study. The analyses contain; description of the value chain concept and its importance, drawing an outline of the wheat value chain in Turkey, conducting an overall quantitative analysis, revealing bottlenecks and evaluating policy effects by comparing existing conditions with designed alternative policy scenarios. Therefore, the study provides detailed knowledge about the wheat value chain processes and constraints in Turkey through using various quantitative analysis methods as well as a case study. It also focuses on examining the relationship between existing agricultural policies and market conditions and tries to identify where development opportunities lie. The study substantially relies on descriptive data, historical and statistical analysis, thus it should be seen as a complement to the existing literature and also a useful guide in the policy-making process.

1.2. Statement of the Problem

Agriculture is a sector of great importance both nationally and internationally in terms of food security and providing raw materials to the industrial sector. With the development of industry and service sectors in developing countries, the agricultural sector, whose share in the economy has decreased gradually, has been facing various problems. While increasing environmental concerns cause agricultural policies to be questioned, value chains are striving to be economically effective and increase their competitiveness to maintain sustainability.

Turkey, as a country with rich agricultural lands also has been affected by these challenges in the agricultural sector. Wheat-planting areas have shown a decreasing trend and wheat yield has remained below the world average in the last decade, despite an increasing population in the country. Furthermore, a significant increase in wheat imports in the last five years also made it clear that the policies towards the wheat industry play a critical role for the sector’s future. Therefore, in order to increase efficiency in the wheat sector, the current situation should be

analyzed in detail. In this context, the value chain approach offers a comprehensive and inclusive perspective by considering the wheat sector rather than just the production stage.

Policies developed for the entire value chain also contribute positively to regional development through effective integration of regions whose economies are based on agriculture into the value chain. Thus, the outcomes of a holistic research study on the wheat value chain will help the institutions and policy makers to design their plans strategically. This research will contribute knowledge and ideas to the existing literature on constraints that are experienced by wheat value chain stakeholders. The study will discuss the comparative advantages of the wheat sector, its profitability and competitiveness under existing policies, as well as major constraints experienced by the sector from the sector stakeholders' point of view. Therefore, the study aims to contribute to the current literature by revealing the current situation from the perspective of other stakeholders in the sector, besides the production stage of the wheat value chain. The outcomes of this work can be a guidance document for future researchers, institutions and policymakers and it can also serve as a reference for them to carry forward studies on wheat value chain dysfunctions that affect stakeholders.

1.3. Importance of the Topic

Wheat (Triticum) comes from the Poaceae family. It can be said that wheat is the most common source of nutrients among all agricultural raw materials, as the world population obtains more than 60% of its daily energy requirements from grains, mainly from wheat (AKBAS et al., 2005). Besides being a crucial component of human nutrition, wheat has been one of the most strategic commodities in the world economy since ancient times. Therefore, forming a well-functioning value chain or upgrading an existing one can be a good opportunity for agriculture-based regions to gain competitive power, extend their share of the economy and ensure sustainable production. Modern agricultural value chains are broad, and they have become more sophisticated as countries industrialize and strengthen their share in global markets. The number and size of modern value chains, and thus jobs, will increase in developing regions in parallel with economic growth. However, there are several constraints for developing regions in this context. Countries aiming to increase their competitiveness in the global markets may face some challenges such as market-access restrictions, limited resources, and insufficient infrastructure. A value-chain approach in agricultural development helps to identify weak points in the chain and to target these points to add more value. Finding ways to improve value chains also can be very important for raising smallholders' incomes. Small-scale producers can hardly survive unless

they are integrated into the market. Integrating into better markets can help small-scale producers out of poverty. However, achieving this improvement requires more knowledge and many other value chain stakeholders can contribute to providing this component (NORTON, 2014). An important issue for producers in developing countries is entering value chains and finding ways to improve their competitiveness (TRIENEKENS, 2011). It is necessary to improve smallholder farmers' engagement with value chains that designed to deliver higher value in order to lower their risks and enhance their resilience as well (Agriculture for Impact, 2014).

From a regional point of view, it can be said that regional inequalities became more notable following industrial development in Turkey, which created challenges for the regions where the economy was mostly based on agriculture. The working population in rural areas disengaged from agricultural activities and started to migrate to industrial cities. This situation brought many social and economic problems. Therefore, as an important component of rural development, efficient food systems contribute to the improvement of the lagging regions and alleviating regional inequalities. As agriculture in Turkey is characterised by small-medium establishments, it is crucial to create an efficient wheat supply chain to involve them and achieve stronger competition power in international markets. Upgrading value chains can be seen as an important tool for regional economic development, as rural producers are the starting point of most agricultural value chains. Lagging regions, which have an agriculture-based economy, may receive income benefits and also chance to narrow down the regional inequality gap by improving the value chain processes.

In this context, the study contains the following components and tasks: (i) identifying general characteristics of the wheat sector in Turkey, (ii) providing an outline of the wheat industry: starting with the production stage and moving through all value-added points, identifying all major players along the chain, (iii) measuring comparative advantages of the Turkish wheat industry against major wheat producer/exporter countries, (iv) conducting wheat value chain analysis for examining the profitability of producing wheat, alongside measuring the policy impact (v) determining and explaining bottlenecks along the chain with a case study on regional level, (vi) highlighting possible areas to be worked on for sustainable value chain development.

2. OBJECTIVES TO ACHIEVE

2.1. Research Objectives

The most prominent purposes that social research serves are known, namely: exploration, explanation and description. A social research study can have one or more of these. Exploratory studies usually take place when the examined subject is relatively new or a researcher investigates a new interest, while the descriptive approach mainly focuses on describing situations and events. Explanation – the other most common purpose in social research – aims to answer the question 'why', while descriptive studies answer questions what, when, where and how (BABBIE, 2007).

In the light of above-mentioned definitions, descriptive research style was applied in this study. Alongside the increase in wheat imports in Turkey in the last decade, the decreasing trend in cultivation areas also has increased the importance of policies for the wheat sector, which has a critical role in terms of food safety and foreign trade (Figure 1). The main objective of this study was to investigate the overall conditions and challenges in the wheat sector in Turkey, and to highlight the potential areas for development by revealing the bottlenecks in the sector that were obtained from the analyses.

The objectives of the research can be listed in more detail as follows:

- Investigating the Turkish wheat sector within the framework of the value chain approach.
- Examining the position of the Turkish wheat sector among major wheat producer/exporter countries in the context of comparative advantage.
- Analyzing the policy impact on the Turkish wheat sector.
- Assessing the outcomes of possible different market conditions by generating various scenarios.
- Analyzing the insights of the wheat sector stakeholders on the main areas (financing, infrastructure and technology, marketing and communication) in the sector, within the scope of a case study to identify potential areas of improvement in the value chain.

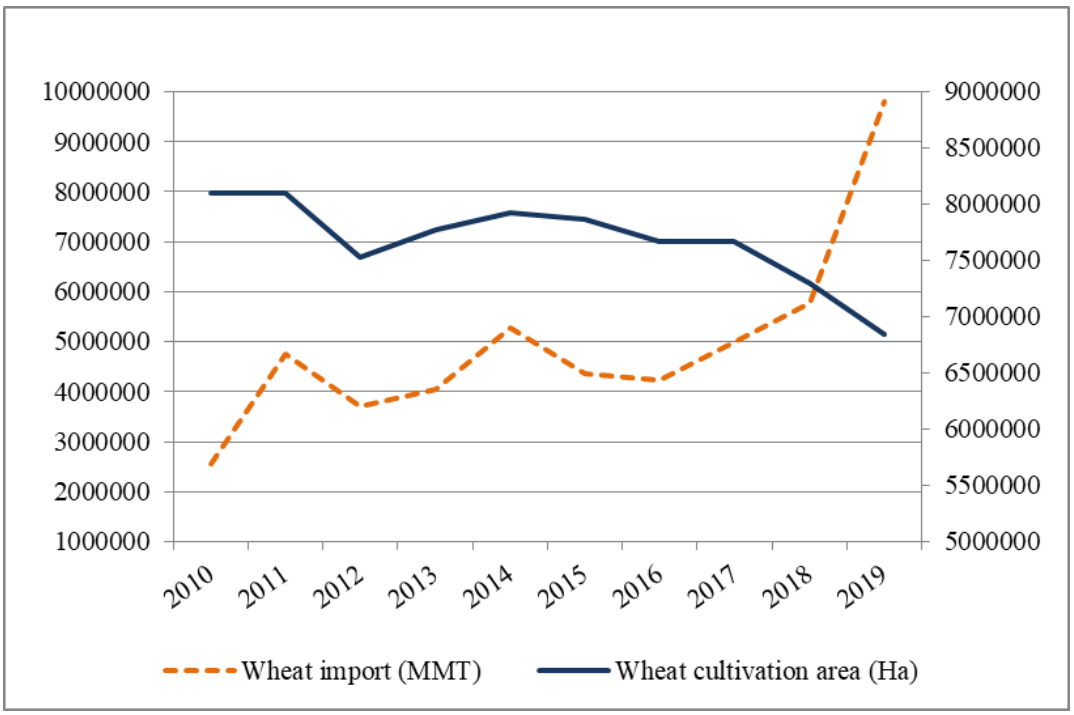


Figure 1: Wheat imports and cultivation area trends in Turkey
Source: (International Trade Centre, 2020), (TUIK, 2020a)

The target region for the case study in this research is the Central Anatolia Region of Turkey. The Central Anatolia Region is the leader in the country regarding wheat production. The share of the region in wheat production is more than one third of the total production (Table 1). In addition to a high volume of wheat production, there are also a significant amount of processed wheat- products production facilities in the region.

Table 1: Wheat production by region in Turkey – 2018 (Tons)

Region	**Common wheat**	**Durum wheat**	**Share (%)**
Central Anatolia Region	5 680 000	1 362 000	35
Southeast Anatolia Region	2 241 000	1 237 000	17
Marmara Region	2 706 000	1 000	14
Aegean Region	1 890 000	321 000	11
East Anatolia Region	1 647 000	92 000	9
Blacksea Region	1 146 000	467 000	8
Mediterranean Region	1 190 000	20 000	6

Source: Adopted from (Turkish Grain Board, 2019), based on TUIK data.

In order to obtain comprehensive data, industry stakeholders actively operating in the region were included in the survey. The stakeholders of the sector were classified as: processed wheat producers (wheat flour, pasta, bulgur), feed producers, seed producers, establishments engaged

in the purchase-sale and transportation of wheat and others (such as commodity exchanges or associations). More details about the structure of the wheat sector and the characteristics about the region are given in the relevant chapters.

2.2. Research Questions and Hypotheses

This study aims to provide a comprehensive analysis of the Turkish wheat industry by combining empirical analysis and selected methodologies within the framework of the value chain approach. The study follows step-by-step value chain analysis, as well as examining existing policies in the Turkish wheat sector.

2.2.1. Research Questions

- How is the wheat industry structured in Turkey?
- Does the Turkish wheat sector have a comparative advantage compared to other major producer/exporter countries?
- How do current policies for the wheat industry affect wheat production?
- What are the issues that need to be addressed primarily in the wheat value chain?
- Which areas should be focused on for the effectiveness and sustainability of the wheat value chain?

2.2.2. Research Hypotheses

Although the processed wheat products industry in Turkey has shown remarkable development in the last decade, the significant increase in import dependency on raw materials in recent years has negatively affected the competitiveness of the sector. Therefore, this research tests the following hypothesis:

Hypothesis 1:

Policies aimed towards the Turkish wheat sector should prioritize the low-value segment in order to increase competitiveness.

In this study, the main areas of constraints in the Turkish wheat value chain were grouped into three sub-categories: (i) Marketing and Communication, (ii) Infrastructure and Technology, and (iii) Financing. These sub-categories were analyzed both within the value chain stakeholder context and the spatial context. The reason for revealing whether the above-mentioned sub-categories of the constraints faced by the value chain stakeholders differ based on their location or activity areas is to determine the priority areas, stakeholder groups, and

provinces for future actions and solutions directed towards the sector. Furthermore, revealing the differences enables policymakers or value chain stakeholders to develop better-tailored solutions considering the specific needs of an activity area or the province in which they are located. The following research hypotheses were tested based on the results of the case study survey investigating the opinions of the Central Anatolian Region wheat sector stakeholders:

Hypothesis 2:

Financial-related problems in the Turkish wheat value chain are more likely to be severe when compared to infrastructure and marketing-related problems.

Hypothesis 3:

Constraints faced by the Turkish wheat value chain stakeholders differ based on their location.

Hypothesis 4:

Constraints faced by the Turkish wheat value chain stakeholders differ based on their activity areas.

2.3. Structure of the Dissertation

This dissertation consists of eight main chapters with some chapters containing several sub-sections. The introductory chapter presents the background of the study, statement of the problem and importance of the study. Chapter 2 explains research questions and research hypotheses. Chapter 3 provides theoretical fundamentals starting with conceptual framework and selected literature on the research area, elaborates the role of agriculture in the Turkish economy and takes a closer look into the wheat value chain by exploring the main stages of the chain. Chapter 4 presents the materials and methods applied in the study and it explains the design of the research and description of methods as well as providing information about each research step. The research methodology in this study consists of a combination of different methods, for each method more detailed information is given in the relevant sub-sections. Three steps analysis with their discussions and results are presented in chapter 5, starting from international level to the country level and finally to the regional level. Following chapter, chapter 6 presents the conclusions of the research based on the obtained results and recommendations. Chapter 7 discusses new scientific findings and finally, chapter 8 presents summary of the study.

3. LITERATURE OVERVIEW

This chapter of the study presents discussions on existing literature on the problems of value chains, as well as discussions on developed and applied methodologies. It reviews the theories and conceptual framework that supported and directed the study. The chapter also presents information about Turkey and its agriculture and explores wheat value chain in Turkey. Analysis of existing literature is of great importance as it guided the research from beginning to end.

3.1. Conceptual Framework

The concept of value chain has been used within different scopes in parallel with changes in the global economy. Hopkins and Wallerstein introduced the concept of "commodity chain" in the late 1970s. They defined it as a network of the production process and labour that results in a finished product in the end (HOPKINS & WALLERSTEIN, 1986). This description further developed due to changing economic and social conditions, shifting from local and regional industry frameworks to international commodity chains. This concept has gained a new perspective as a result of Porter's emphasis on the importance of the concept of "added value" within the frame of the value chain studies. PORTER (1998) considered value chains in the context of "competitive advantage" and defined value activities that create added value as the building blocks of competitive power. Value chains involve various activities like inbound logistics, operations, marketing and sales, outbound logistics and services. In addition to these basic elements, supporting elements such as firm infrastructure, human resource management, technology development and procurement are also within the frame of the value chain (PORTER, 1998). For an effective value chain, the above-mentioned elements should work in harmony.

Another noteworthy example of a value chain concept is the “filière” approach. Filière can be translated as industry or faculty but in this context, it means chain or thread. The filière concept was developed to analyse contract farming and vertical integration in French agriculture in the 1960s. Its roots go back to the efforts to analyse agricultural production systems in countries under the French colonial system. The system was established by researchers at the Institut national de la recherche agronomique (INRA) and the Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) in France. In general, the filière approach was applied for analysing agricultural commodities. Although there are similarities

with the value chain concept at some points, it has a narrower perspective mostly focusing on local-scale production and its connection with large-scale industries. At first, the focus was on production and consumption at a local scale, then later processing and exporting stages. In addition, mapping the system, constructing flow charts and revealing the connections between activities and agents were part of this approach (RAIKES et al., 2000). RAIKES et al. (2000) emphasised that one of the strengths of this approach is that it includes structures and commodity relations as a whole. As mentioned, there the limitations of this approach were its narrow focus on several products over a short time period, and lack of general conclusions.

In the 1990s, the term "global commodity chains" appeared as Gereffi and others went further. With the global commodity chain approach, the "value added chain" was linked to the global industrial system directly. Global commodity chains were described as the new type of control and coordination between nations and firms in international industries by GEREFFI (1996). They combined the trade analysis and the industrial organization as a value-added chain. The global commodity chain approach includes all types of activities from turning raw materials to finished products. The main activities in this process are; (i) production, (ii) marketing, and (iii) delivery of an output to the consumer. While this type of chain may occur locally, when these activities expand between various countries, they become "global" (JARED et al., 2017).

In the agricultural sector, value chain refers to a whole range of activities and various actors connected to each other to bring an agricultural commodity from its production to final consumption, and each stage of this value chain generates added value. Basically, a typical agricultural value chain begins with the provision of inputs, then continues with the production, wholesaler/retailer stages, and then reaches the end consumer. However, in practice, agricultural value chains have a much more complex structure. The starting and ending points of the value chain may differ sometimes. For example, thanks to the increasing awareness of recycling and developing technologies, an agricultural product can be included in the value chain and continue to produce added value even after the consumer phase.

Added value is created by various actors at each stage of the value chain. It can be generated in different ways, such as cost, quality, delivery times/flexibility, and innovation. The price that a customer is willing to pay for a product determines the size of the added value (TRIENEKENS, 2011).

Value chains can be examined in three different groups:

1) Activity-based Value Chains: Activity-based value chains are characterised by a series of value-adding activities through each segment of the chain. A segment refers to each vertical part of a value chain and it generates a specific function, such as production, processing, or marketing (UNIDO, 2011). As this definition puts emphasis on value adding activity at each stage of the chain, it can be seen as close to Porter's perspective on value chains.

2) Actor-based Value Chains: Actor-based value chains mainly focus on stakeholders (actors) in a chain. Another description of the value chain highlights the role of actors (besides activities) in the chain, addressing it as a series of activities, where players connected along a chain produce, transform, and deliver commodities/services to end-users (UNIDO, 2011). The difference between activity-based value chains and actor-based value chains is that actor-based value chains put stakeholders at the centre of the chain, and value-adding activity is seen as secondary.

3) Network-based Value Chains: The aim of network-based value chains is to prioritise consumer's demand. This type of value chain fits to the value chain definition by HOBBS et al. (2000), as they define value chain as "a vertical allience or strategic network between a number of independent business organizations within a supply chain".

Various definitions of value chains can be seen as a result of different conditions and approaches to the way chain concepts evolve from commodity chains to global networks. Although these definitions emphasise different points, they are not very different from one another. However, even minor differences between characteristics of the value chains can change the required policies. For example, for upgrading an activity-based value chain, targeting improvement of production, logistics, or marketing can be a priority, while an actor-based value chain may require improvements that focus on value-chain actors. Consequently, for network-based value chain development, the main focus of improvement can be strengthening links among chain actors.

3.2. Selected Literature on the Problems of Value Chains

Food security, economical efficiency and environmental sustainability are three major issues stand out regarding agricultural value chains. As agricultural value chains are primarily considered in terms of food security, from an economic perspective, the improving producer incomes and the integration of small-scale farmers into global value chains come to the fore. In

addition to these, recently, due to concerns on climate change, value chains are also being considered from an environmental perspective.

GODFRAY et al. (2010) summed up overall threats against food security under three main subjects: (i) increasing population and meeting rapid changes in food demand, (ii) doing it in an environmentally and socially sustainable way, (iii) finding solutions to poverty. They suggested that producing more food from the same size of land while mitigating the environmental effects, so called "sustainable intensification", can help to ensure sustainable food systems as well as food security.

Recent studies underline multiple dimensions of the food systems that play a significant role in maintaining better integrated food security. It has become better understood that food security can not be ensured by focusing only on food production (ERICKSEN et al., 2009). In this regard, MWONGERA et al. (2019) pointed out that existing studies largely focused on the production stage of agricultural value chains and interest in other stages such as harvesting, storage, processing and marketing was relatively low. REARDON (2015) has a critical opinion about the efforts to ensure food security substantially focusing on farm production and trade stages rather than on intermediate segments of the value chain in developing countries. According to Reardon, the processing, logistics, and wholesale segments of the value chain need to be taken into consideration in a food security agenda, as they constitute 30-40 percent of the overall value added and costs.

From an environmental perspective, RASUL & THAPA (2004) drew attention to the fact that there is no significant difference between conventional and ecological agriculture in Bangladesh with regard to economic benefits and added value. However, since the impact of agro-chemical based products on health is not yet a big concern in Bangladesh, with the increase in urbanization in the future, ecological agricultural products may be sold at high prices and their economic returns may increase. In seeking sustainable solutions for Nigerian agriculture, NWAJIUBA (2012) highlighted three issues against green transformation for food security, such as input dependency, smallholder farmers, and an increasing population. His study revealed that low-carbon, resource-efficient, and socially inclusive food systems could be a solution to these problems. Similarly, FLORA (2010) also advocated a systems approach to ensure food security in developing countries, based upon the sustainability of the local ecosystem, socio-cultural

relationships, and economic security to increase productivity. Her study asserted that in developing countries, resource-conserving agriculture has been demonstrated to boost yields.

Besides the above-mentioned challenges, one of the major obstacles against effective functioning value chains is the integration of small-scale agricultural producers into the food systems. International experience has pointed out that, in modern food systems, small-scale agricultural producers experience various disadvantages compared to medium/large-scale producers. These constraints may result in either exclusion from the market or distorted income distribution. There are major challenges, which constitute the greatest barrier for smallholder farmers at the very early stages of the value chain. These challenges include lack of access to sufficient and productive land for expansion, insufficient water as well as lack of modern irrigation systems, technologies and mechanisation. Due to a shortage of long-term storage facilities, small-scale farmers tend to sell their products right after harvest when the prices are lowest because of a supply surge. At the later stages, logistics, market information constraints, weak participation of farmers and difficulties related to access to various agricultural support services are the factors that reduce the competitiveness of smallholders.

It is also worth to note that, there are studies that evaluate the relationship between farm size and yield from different perspective. For instance, a study on relationship between farm size and yield in Turkey (UNAL, 2008) revealed that there is an inverse relationship between these two in all regions of Turkey. The study also looked at the impact of land fragmentation on productivity and labor input, revealing a positive relationship and attributing the inverse yield and farm size relationship to increased labour input per acre (UNAL, 2008). Another example on farm-size and productivity relation in Slovakia also showed that there is an inverse relationship between farm size and productivity and positive impact of credits per hectare on productivity (LADVENICOVA & MIKLOVICOVA, 2015). However, when considered within the framework of the value chain approach, it should be taken into consideration that the disadvantages faced by small-scale producers are not only limited to yield level.

Small-scale producers play a significant role in agricultural development as well as in economically, socially, and ecologically well-functioning food systems. Smallholder agricultural producers may face difficulties being involved in high value-added food chains. However, they can be competitive when they are integrated into local and global agricultural value chains. As a strategic sector, small-scale farming involves all dimensions of sustainable development through its economic, socio-cultural and environmental functions. Besides, smallholder engagement with

food systems is beneficial as it rests upon traditional knowledge, promotes farmers' participation and community building, and it raises the real value of capital input while also providing a significant source of income for farmers and households, so helping poverty-reduction efforts (WOLFENSON, 2013).

Furthermore, small farms may have advantages over large ones as they have the potential to produce more per hectare in conditions of underdevelopment with relatively low-cost labour (WIGGINS, 2009). Yet small-scale producers face many difficulties in accessing resources, finance, technology and ultimately the market itself. BARRETT et al. (2010) put emphasis on these limitations and provided three overarching challenges smallholders face in this respect — geographic or biophysical, technological, and institutional. Geographic constraints can be water scarcity or difficulties accessing limited productive assets such as labour, land, livestock, and tools that hamper their capacity. Likewise, available and suitable production technologies can also be limiting for smallholders. In regard to institutional constraints, the major challenges smallholders face is narrow access to credit and insurance, unsecured land rights, and obscurity arising from new risks (BARRETT et al., 2010).

The challenge of smallholder integration into agri-food value chains is of primary importance to policymakers who want to promote economic growth in rural areas and reduce poverty. Accordingly, it is important to build interconnections between small-scale agriculture and food systems. Multi-stakeholder processes can help improve horizontal (e.g. coordination between smallholders) and vertical coordination (e.g. coordination between smallholders and value chain actors), but can also hinder process and product upgrading (KILELU et al., 2017). In this context, VON LOEPER et al. (2018) drew attention to the problem of sustainable smallholder producers in achieving long-term food security. Smallholder farmers face competition not just from medium/large producers in domestic market, but also on an international scale. With the increasing complexity of global agri-food value chains, smallholders' access to the markets has become more difficult than before. Questions have begun to arise about whether the rise in private food standards adversely affects small farmers and the mitigation of poverty in developing countries (LEE et al., 2012).

Some insights on smallholder integration into value chains are linked to standards that can make market access difficult (FAO, 2014). Agricultural policies towards smallholder integration into these value chains should be more realistic and prioritise supporting smallholder farmers against

new difficulties arising from food safety standards, both private and public (HUMPHREY, 2006). It is also worth noting that differences (regional, institutional, and value chain) affect the impact of standards systems. Therefore, the impact of standards on smallholder market participation is context-dependent (FAO, 2014). Since the problems faced by each food system are different, the required solutions should be unique to the relevant system.

3.3. Selected Literature on the Methodology

In order to ensure sustainable development in the agricultural sector, it is of great importance to analyse strategic food products in detail within the framework of the value chain approach. A considerable number of qualitative and quantitative methods and approaches have been put forward to date, aiming to reveal the current state of food value chains, in order to determine their vulnerability and to provide solutions to eliminate these weaknesses. Value chain analysis can be applied in the frame of a wide range of different disciplines, using a single method or multiple methods, depending on the needs of the analysed sector.

In their study on climate-smart value chains, MWONGERA et al., (2019) applied an assessment method called "Climate Risk Profile" (CRP) that involved expert interviews, focus group discussions and stakeholder workshops. By addressing different segments of the value chain, the CRPs help to assess existing climate risks as well as possible threats, in order to provide local governments and stakeholders with localised evidence of fragilities and favourable responses. TAYLOR (2005) used a different methodological context to achieve value chain development practices for a whole chain, from production to consumption. His value chain analysis was based on three main methodological basics; (i) value stream management (VSM) — by using convenient tools and techniques, (ii) the case study approach — analysis for a particular supply chain in a specific sector, (iii) action research — an approach to obtain necessary data from relevant value chain actors for the research.

GEREFFI & FERNANDEZ-STARK (2011) emphasized the importance of global value chains (GVCs) and underlined that, especially for low-income countries, active participation in these chains is a necessity for their development. They described the four dimensions of GVC analysis; (i) input-output structure, (ii) geographic scope, (iii) governance, and (iv) institutional context. STARITZ (2012) emphasised the importance of structural and asymmetric power relationships, as well as mitigating poverty and the role of institutions to achieve effectiveness in value chains. VAN MELLE et al. (2007) highlighted the importance of measuring the estimated

impact on smallholders in value chain analysis and pointed out the Structure-Conduct-Performance (SCP) approach which comprises; (i) functioning structure — such as products, types of actors, (ii) conduct — relations among chain actors, and (iii) performance, corresponding to criteria such as efficiency, innovation, flexibility, and responsiveness. Additionally, SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis and problem/solution trees to specify the critical spots in the value chain were emphasized in their study. On the other hand, FERNANDEZ-STARK et al. (2012) developed a holistic four-pillared model to improve agricultural producers' (especially small and medium-scale producers) competitiveness. The four pillars of the model consist of:

- Access to market
- Access to training (awareness building, technical training, entrepreneurial training and social skills training)
- Coordination and collaboration (horizontal and vertical) building
- Access to finance

Another characteristic of this model, which was developed to overcome the difficulties faced by agricultural producers, is the prioritisation of sustainability. The model also advocates that a potential intervention in the value chain can be successful if it is economically, socially and environmentally sustainable. Enhancing the competitiveness of agricultural production allows farmers to increase their incomes and contributes to economic and social development of regions dependent on agriculture.

Regarding the main competitiveness factors, PORTER's (1990) diamond model provides a comprehensive framework for value chain analysis. As an analytical framework to assess competitive advantage, the diamond model asserts four interrelated determinants to identify multiple dimensions of competitive strength in a specific industry. Factor conditions (such as capital resources, human resources, physical infrastructure, natural resources, etc.), demand conditions, related and supporting industries (presence of internationally competitive industries), and firm strategy, structure, and rivalry, constitute four major elements of the diamond model. According to Porter, the government is unable to create competitive industries and the role of the government is identified as both a catalyst and a challenger.

On the other hand, SMIT (2010) argues that Porter's diamond framework has some confusing aspects regarding the countries' international competitiveness. According to Smit, Porter's

methodology is based upon assessing of revealed comparative advantage developed by BALASSA (1965) for the calculation to define industries. Therefore, his methodology defines the comparative advantage or economies of scale of those specialised countries' industries. The industries were identified primarily for their comparative advantages when they presented stronger diamonds compared to their trade rivals. However, modern and conventional trade theories fall short of determining a country's specific advantages, which play a significant role in international competitiveness. The diamond approach is found to be a helpful management tool to understand the competitive advantage sources of a country, which is beneficial for a firm to compete internationally rather than a new theory of comparative advantage.

As each value chain has its own characteristics and its competitiveness depending on different factors, WEBBER & LABASTE (2009) emphasized that value chain interventions to increase competitiveness should aim at elements of priority. Having said that, it is critical to determine the major factors of success and propulsive forces of the target markets and to set benchmarks against main rivals accordingly. Additionally, monitoring and evaluation techniques can also be helpful as a management tool to assess and evaluate value chain performance (WEBBER & LABASTE, 2009).

SCHMITZ (2005), contributed to the value chain analysis to make it a useful tool, which can be applied by policy makers and planners at regional and national level. His guide focused on the bottlenecks in various areas, such as; market access, local enterprises' capabilities, local employment practices and working conditions, and interactions among key stakeholders. According to Schmitz, it is important to reveal priority bottlenecks in the chain to address a policy. Some constraints can be resolved by the private sector itself, while some specific challenges may require the implementation of a specific government policy or public-private corporation.

One of the most widely adopted methods for policy evaluation in agriculture is the Policy Analysis Matrix (PAM) developed by MONKE & PEARSON (1989). Besides qualitative analysis, quantitative policy analysis paves the way for a more constructive policymaking process by keeping agricultural sector objectives and policies consistent. By taking into consideration the fact that small-scale domestic markets need to compete with industries in international markets, the economic impact of policies is of major importance for those economies dependent on agriculture. To achieve sustainability in agri-business, either consumer

compensates for the non-competitive sector by paying high prices, or the government subsidises these sectors to increase international competitiveness. Built around a simplified analytical framework, Monke and Pearson's Policy Analysis Matrix provides a quantitative approach to evaluate existing policies in a specific sector. The matrix consists of two accounting identities; profitability (revenues-costs) and the effects of divergences (observed parameters and parameters that would exist if the divergences were removed). The main advantage of the PAM methodology is that it allows for the evaluation of the effectiveness of an agricultural system as well as policy impacts on that system. The limitation of the PAM approach is that analysis results are on a yearly basis. Therefore, the results should be altered as basic parameters such as international prices of outputs and inputs, interest rates, wage rates, and production technologies may change over time. However, the method can easily adapt to the above-mentioned changes (MONKE & PEARSON, 1989). The PAM methodology is criticised by MORRISON & BALCOMBE (2002) for its inability to allow attachment of any level of confidence to the results, apart from that obtained through sensitivity analysis. Thus, in order to measure the uncertainty degree surrounding indicators generated from PAM, Morrison and Balcombe applied a method called bootstrapping and conducted a study on wheat production in Slovakia.

Some prominent PAM and related studies have also analysed sugar production in Indonesia (NELSON & PANGGABEAN, 1991), Thai agricultural diversification policy for soybeans, rice and mung beans (YAO, 1997), effects of policy changes on the competitiveness of maize production under agroforestry-based technologies in Cameroon (ADESINA & COULIBALY, 1998), comparative advantage and protection of main agricultural products —rice, wheat, corn, sorghum etc.— in China (FANG & BEGHIN, 2000), the efficiency of cotton production in India (MOHANTY et al., 2002), profitability in rice cultivation in Eastern Spain (MARTINEZ et al., 2008). The FAO (BELLU, 2012) presented a holistic assessment tool, named VCA[1] Software, which includes the Policy Analysis Matrix as a part of an overall agricultural value chain analysis. This quantitative methodology can be applied to agricultural value chain research to reveal the policy impacts on a food system. The most important feature of this tool is that it allows the analysis of the current market situation as well as making it possible to evaluate the potential results of different policy implementations by creating various scenarios. Targeting to

[1] Value Chain Analysis Software: FAO VCA Tool 3.2, URL: http://www.fao.org/sustainable-food-value-chains/training-and-learning-center/details-materials/en/c/327858/

provide a comprehensive guide for policy makers, the tool offers the ability to build a consistent value chain accounting framework, measuring physical production in monetary terms, value added and income, and calculating competitiveness and protection indicators for agriculture and rural development.

RICCI et al. (2019) analyzed vertical price transmission in wheat chains (for pasta and bread) in Italy. In their study, a cointegration methodology was applied and price transmission elasticities were investigated for the wheat chains which were split into two sides: upstream (farm-wholesale) and downstream (wholesale-retail). It was revealed that the price transmission in the bread chain was associated with structure of the market, while farmers were found to be price-takers in the pasta chain.

LIE et al. (2018) used a System Dynamics (SD) modelling approach to quantify the impact of policy options on dairy production in Nicaragua. SD modelling is a simulation approach that maps the interactions and feedback effects among multiple components in a system. It represents the results in a graphical format to examine multiple components in a system. Whereas conventional methodology in value chain analysis can be unsuited to evaluate the impact of interventions on multidimensional aspects of the value chain, SD modelling can be used to simulate a variety of policy interventions throughout the value chain. Thus, the SD approach allows analysis of the problems facing the sector from a whole-chain perspective. Their research focused on the impact of policies in the Matiguás dairy value chain in Nicaragua. Through developing and running a SD model, policy options were identified to upgrade the value chain, and the impact of policy interventions could be evaluated over the medium to long-term. The model results revealed that milk production could be increased by 30% during the wet season and 35% during the dry season, over the long-term, through increased investment and training in pasture management. Furthermore, the SD simulation highlighted long-term profitability through greater milk yield from strategies to improve the feeding system. By utilising a SD model, the researchers identified areas such as improved pastures and increasing use of concentrates that, though expensive in the short-term for smallholder producers, are profitable in the long term. SD modelling can offer a broader understanding of the dynamic components of value chains and their interactions, as well as a deeper understanding of the impact of individual policy interventions. Through this approach a clearer understanding can be developed of the value chain actors (producers, intermediaries, consumers) and the interactions between markets, biophysical phenomena, and policymaker strategies. DIZYEE et al. (2017) constructed a SD model in an

analysis of policy options for the beef sector in Botswana. By using a SD model, they were able to capture the impact of multiple dynamics in the sector including biological and environmental effects, as well as market economics and the impact of policy options on chain actors. They point out that following this approach enables a "holistic evaluation of policy options".

As the importance of bio-based value chains has been increasing in the EU, LOKESH et al. (2018) used a systematic approach to determine the potential bio-based value chains by applying a two-stage multi-criteria decision analysis (MCDA). Their research also included a detailed mapping of the identified bio-based value chains and a systematic review of some bio-based value chains in the EU, such as starch to bio-plastics and waste agricultural biomass to insulation material.

A comprehensive methodology on performing value chain research can be found in "A Handbook for Value Chain Research" written by KAPLINSKY & MORRIS (2000). By discussing whether a value chain is a heuristic device or an analytical tool, the authors conclude that although the value chain is a descriptive construct, the latest progress in value chain approach has begun to present an analytical structure. According to their approach, value chain analysis aims to reveal the way chain activities are performed, as well as the characteristics of creation and distribution of added value between stakeholders. Kaplinsky and Morris focuses on introducing guidance for value chain research alongside providing a conceptual framework and uses survey instruments such as interviews and discussions.

As is seen, there has been a growing interest in the value chain approach and its implementations in the existing literature, particularly in the agri-food sector for the purpose of economic development policies and strategies both on a local and national level. Different value chain methodologies offer a great variety of analyses for a broad array of agri-food products. Since each value chain has its own structure, features and bottlenecks, elaborate results can be obtained by combining these approaches and methods according to the characteristics and needs of the analysed chain. It is also worth noting that a sustainable development policy should take into account socio-cultural and environmental factors besides economic factors. Therefore, the inclusion of these elements in value chain analysis is important in terms of creating more effective policies.

3.4. Turkey and Its Agriculture

3.4.1. Turkish Economy Overview

Turkey is a developing country which is ranked 19th in the world based upon its value of GDP (The World Bank, 2021a). Taking a closer look into the developments in the Turkish economy in the last decade, it can be said that it was affected by the conditions in the world economy. In 2009, the economy shrank drastically following the economic crisis, which affected the world markets. Then economic growth reached its highest level in 2011 with the subsequent recovery. While economic growth remained around 5.9% on average in the following years, it decreased to 2.8% in 2018 (Table 2).

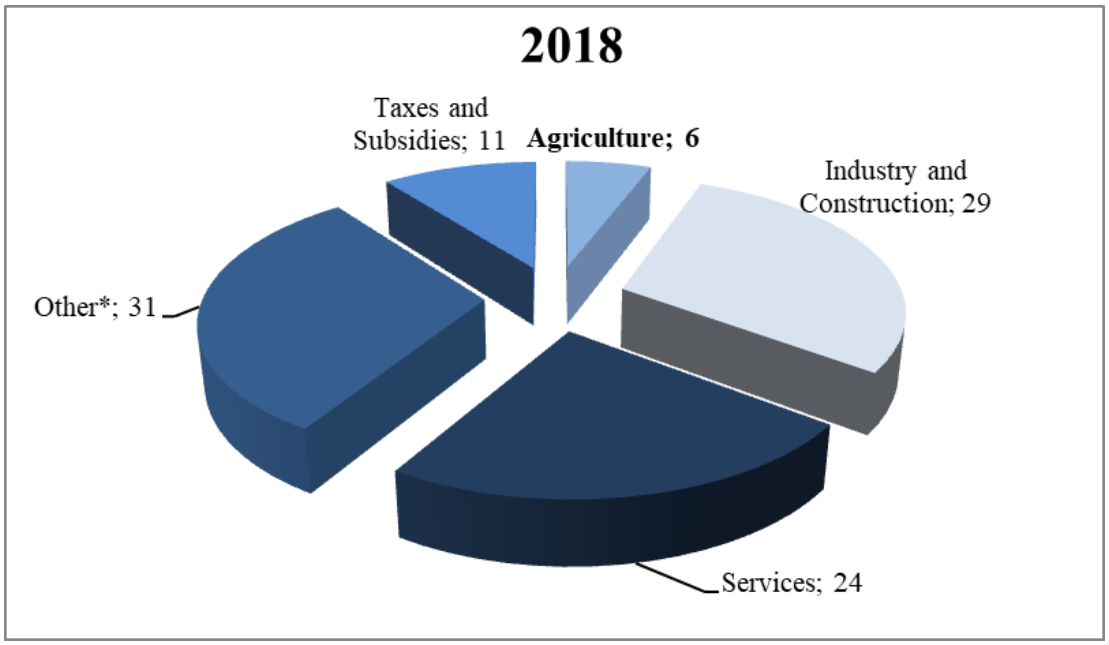
Table 2: Major indicators of the Turkish economy

Year	GDP (Million TL)	GDP (Million US $)	Growth Rate (%)	Exports (Thousand US $)	Imports (Thousand US $)	Proportion of Imports Covered by Exports (%)
2009	999 192	646 893	-4.7	102 142 613	140 928 421	72
2010	1 160 014	772 365	8.5	113 883 219	185 544 332	61
2011	1 394 477	831 696	11.1	134 906 869	240 841 676	56
2012	1 569 672	871 125	4.8	152 461 737	236 545 141	64
2013	1 809 713	950 355	8.5	151 802 637	251 661 250	60
2014	2 044 466	934 857	5.2	157 610 158	242 177 117	65
2015	2 338 647	861 879	6.1	143 838 871	207 234 359	69
2016	2 608 526	862 746	3.2	142 529 584	198 618 235	72
2017	3 110 650	852 618	7.5	156 992 940	233 799 651	67
2018	3 724 388	789 043	2.8	167 920 613	223 047 094	75

Source: (International Trade Centre, 2019a), (Ege Bolgesi Sanayi Odasi, 2019) based on TUIK data.

In 2013, GDP per capita in Turkey reached its highest level (USD 12,614), however, in subsequent years it has shown a consistently downward trend. Compared to 2017, in 2018, GDP per capita in Turkey declined almost 11% to USD 9,456 level (the first time since 2010 under USD 10,000). While average GDP per capita for EU-28 and OECD were USD 35,734 and USD 39,330 respectively in the same period (The World Bank, 2020a). The major reasons for the decline in per capita GDP were factors such as the decline in economic growth rate, population growth and the rapid increase in the dollar exchange rate. Besides the decrease in GDP per capita, high inflation has also been one of the important challenges for the Turkish economy.

Considering the breakdown of sectors in GDP (Figure 2), the industry and construction sectors in Turkey had a total share of 29.4%, followed by the services sector with 23.5% while agriculture constituted only 5.8% of GDP in 2018. The Turkish economy is substantially market oriented, with industry, construction and service sectors comprising more than half of the share in GDP in 2018, while the share of agriculture in overall GDP gradually declined to 5.8% in the last decade. In 2018, the value added of the agricultural sector increased by 1.3% and the value added of the industrial sector increased by 1.1%, while the value added of the construction sector decreased by 1.9% (TOBB, 2019).



* Includes information and communication, finance and insurance activities, real estate activities, professional, administrative and support service activities, public administration, education, human health and social work activities and other service activities.

Figure 2: GDP structure breakdown of Turkish economy in 2018 (Per cent)
Source: (TOBB, 2019), based on TUIK data.

Looking at foreign trade balance of Turkey, the 10-year average (from 2009 to 2018) of the proportion of imports covered by exports was 66%, while imports and exports increased 58% and 64% respectively, in the relevant period (Table 2). The EU-28 has been the major export destination from Turkey, constituting almost 50% of the country's exports in 2018. Major import partners of Turkey include the Russian Federation (9.9%), China (9.3%), Germany (9.1%), USA (5.5%) and Italy (4.6%). Imports from the Russian Federation to Turkey increased 12.7% in this period; therefore, Russia had the highest share in Turkey's imports (International Trade Centre, 2019b).

As of 2018, the top five product groups exported by Turkey were: consumer goods (46.4%), intermediate goods (24.6%), capital goods (20.1%), and transportation (17.1%); while the country imported mostly intermediate goods (32.4%), capital goods (24.4%), consumer goods (20.8%), and fuels (19.3%) in the same period (The World Bank, 2020b).

The unemployment rate in Turkey has been around 11% in the last three years (2016-2018). While the non-agricultural unemployment rate was 12.9% in 2018, the youth unemployment rate was 20.3%. Comparing the unemployment rate in Turkey (11%) with some European countries, it is seen that this rate was 3.4% in Germany, 4.1% in the United Kingdom, 9.1% in France and 15.3% in Spain in 2018. In addition, the unemployment rate in the USA was 39%, 2.4% in Japan and 4.8% in the Russian Federation in the same year (Ege Bolgesi Sanayi Odasi, 2019).

3.4.2. Role of Agriculture in Turkish Economy

Table 3: Main agricultural indicators -2018[2]

Main Agricultural Indicators	Value (US $)
Value of Agricultural Production: Value of Crop Production (1000 US $)	32 946 393
Value of Agricultural Production: Value of Livestock (1000 US $)	30 315 433
Value of Agricultural Production: Value of Animal Production (1000 US $)	16 414 054
Value of Crop Production per People	402
Value of Livestock per Capita	370
Value of Animal Production per Capita	200
Harvested Area of Cereals and Other Crops (Ha)	15 798 163
Production Amount of Cereals and Other Crops (Tons)	116 517 269
Vegetable and Fruit Production for Land Under Protective Cover (Tons)	8 071 026

Source: (Ministry of Agriculture, 2019a), based on TUIK data.

Regarding the value of agricultural output, Turkey is ranked as the 11th largest producer in the world in 2018 (FAO, 2020). In 2018, harvested area of cereals and other crops was around 15.8 millon Ha, while their production amount was 116.5 million tons (Table 3). In the recent period, the share of agriculture in GDP showed a constant decline in the Turkish economy while services and industry sectors' share increased. Although the share of agriculture in total GDP in Turkey follows a downward trend, it is still considerably higher than the European Union average and

[2] Values have been converted from Turkish Lira into US Dollars by taking into account the exchange rate of the relevant period.

the USA average. On the other hand, agricultural growth rate showed sharp fluctuations when compared with the overall growth rate trend, implying more sensitiveness to the developments in the economy (Figure 3).

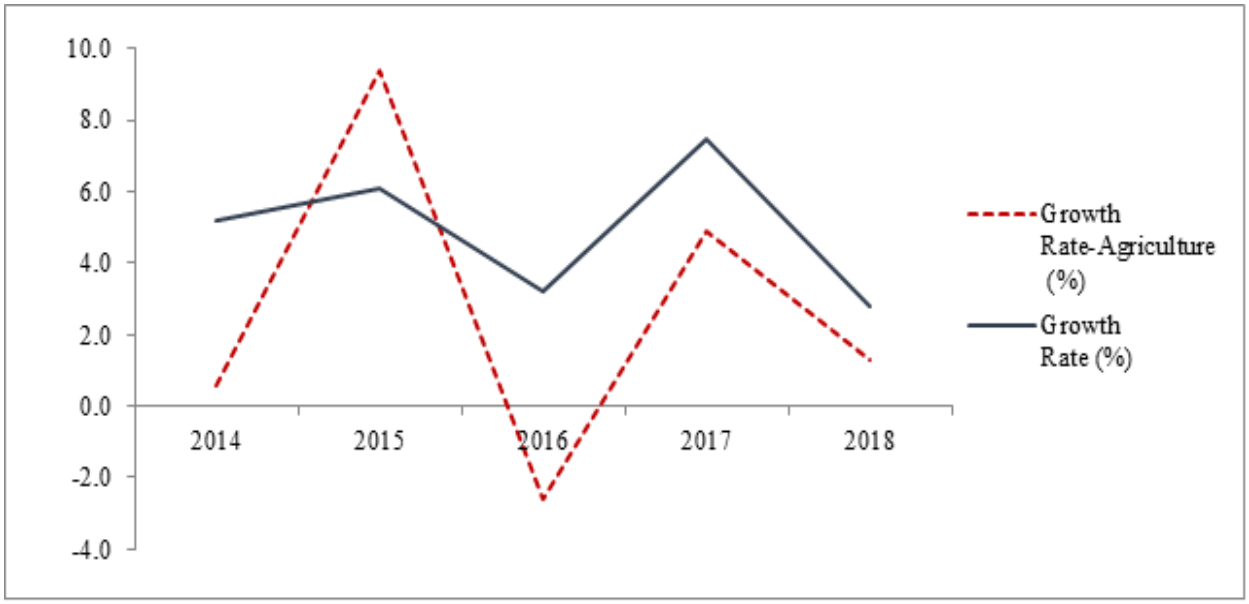


Figure 3: Agricultural growth rate trend in Turkey in the 2014-2018 period
Source: (TOBB, 2019), (Ege Bolgesi Sanayi Odasi, 2019), based on TUIK data.

By 2018, the population in Turkey was estimated around 82 million. Despite the ascending trend of population, the rural population has fallen dramatically in the last decade (Ministry Of Agriculture, 2019a). According to TUIK data, the share of agricultural employment as a percentage of labour force in Turkey has shown a considerable decrease since 2000, with 36% share in 2000, falling to 18.4% in 2018. In 2018, the agriculture sector's share of total labour force was 18.4%, while the service sector had a 54.9% share of the labour force, 19.7% in industry and 6.9% in the construction sector (Figure 4), (Ege Bolgesi Sanayi Odasi, 2019).

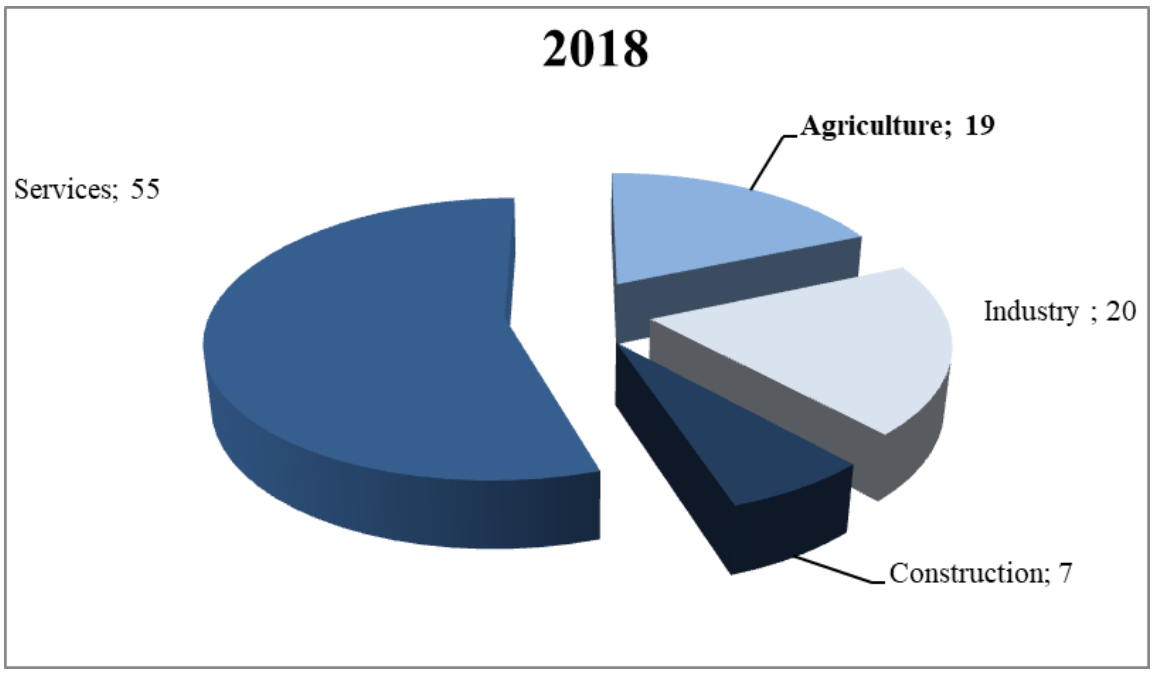


Figure 4: Sectoral distribution of labour force in 2018 (Per cent)

Source: (Ege Bolgesi Sanayi Odasi, 2019), based on TUIK data.

Turkey's major export destinations for processed food and agro-based products have been the EU-28, Middle East countries and the United States in 2018, while the EU-28, Russian Federation and Asian countries have been leading processed food and agro-based products suppliers to Turkey (International Trade Centre, 2019b). The data for the last ten years shows that both import and export values have increased in volatility, however, the agricultural foreign trade balance has developed in favor of imports (Table 4).

Table 4: Agricultural trade balance of Turkey (2009-2018)

Year	Exports (Million US $)	Imports (Million US $)	Trade Balance
2009	4 536	4 625	- 89
2010	5 091	6 490	- 1 399
2011	5 353	8 944	- 3 591
2012	5 379	7 503	- 2 124
2013	5 912	7 776	- 1 864
2014	6 376	8 658	- 2 282
2015	6 125	7 265	- 1 140
2016	5 811	7 097	- 1 286
2017	5 738	9 045	- 3 307
2018	6 042	9 335	- 3 293

Source: (Ege Bolgesi Sanayi Odasi, 2019), based on TUIK data.

As stated in the 11th Development Plan (2019-2023), the agriculture sector is considered one of the priority development areas. According to the plan, in the 2019-2023 period, increases in plant and animal production are prioritised in addition to targets such as land consolidation and improving the effectiveness of agricultural support. Another noteworthy policy target included in the plan is keeping a record of data on the entire chain from seed to table in agriculture and institutionalizing monitoring-evaluation studies (The Official Gazette, 2019).

In Turkey, production of 21 different products, including wheat, is supported under the Basin-based Support Model, which was started to be implemented in 2017. In this context, several standards were determined for agricultural support, considering various conditions of each regional agricultural basin (such as water sources, climate conditions etc.). Within the framework of a "basin-based subsidy system", farmers receive payments for producing specific products which are determined by the government. In addition to this support, farmers also receive several payments that are provided by the government (Table 5).

Table 5: Agricultural support payments

Subsidy Type	Value (Million TL)		Share (%)		Change (%)
	2017	2018	2017	2018	2018
Area-based agricultural support payments	3 006	3 892	23.6	26.9	29.5
Area-based additional payments (organic farming, good agricultural practices, soil analysis, smallholder support)	295	342	2.3	2.4	15.9
Diesel	700	1 900	5.5	13.1	171.4
Fertiliser	805	553	6.3	3.8	-31.3
Certified seed use	211	168	1.7	1.2	-20.4
Protection of agricultural lands	160	79	1.3	0.5	-50.6
Hazelnut	835	850	6.6	5.9	1.8
Compensatory payments	191	186	1.5	1.3	-2.6
Deficiency payments	3 888	3 456	30.6	23.9	-11.1
Cereals and legumes	1 207	998	9.5	6.9	-17.3
Tea	165	170	1.3	1.2	3.0
Supply deficient products	2 516	2 289	19.8	15.8	-9.0
Animal husbandry support payments	3 848	4 103	30.2	28.3	6.6
Rural development agricultural subsidies	795	1 724	6.2	11.9	116.9
Agricultural insurance support services	860	958	6.8	6.6	11.4
Other agricultural subsidies	133	171	1.0	1.2	28.6
Total	**12 722**	**14 489**	**100.0**	**100.0**	**13.9**

Source: Adapted from (TOBB, 2019), based on the Strategy and Budget Directorate of Turkey data.

In the basin-based subsidy system, the production area – crop – subsidy designations are based on historical productiveness of crops in each planted area. Producing strategic crops like wheat and barley is supported by the government in the majority of the regions. With this system, the Turkish government aims to boost efficiency in agricultural production where there is a high

potential for particular crops, while reducing production of some crops in areas where farmers would get lower yields or poorer quality (USDA, 2020a).

In 2018, animal husbandry support payments had the highest share in overall support payments at 28.3%. It was followed by area-based agricultural support payments at 26.9% and deficiency payment support services at 23.9%. While the share of area-based agricultural support payments increased compared to the previous year, the share of deficiency payment support services and livestock support payments decreased (TOBB, 2019).

3.5. Wheat Value Chain in Turkey

Wheat can be used for human consumption, animal feed, and industrial use, and is of great importance in terms of food safety. From the perspective of human consumption, wheat is seen as a basic source of energy. However, it also contributes considerable amounts of vital components that are necessary for a healthy diet (SHEWRY & HEY, 2015). Globally, wheat production reached 731 million tons (more than one third of total grain production) in 2018, while total consumption was 733 million tons. The share of FSI (Food-Seed-Industrial) use and feed use in overall consumption were around 81% and 19% respectively. Due to its widespread use for food and feed, wheat is also the major trading commodity among all grains, with more than 170 million tons of trade volume in 2018 (USDA, 2020b).

Wheat is a staple product that grows in almost every region of Turkey. Turkey was ranked as the 11th highest wheat producer and the country's self-sufficiency was 100.5% in 2018 (FAO 2020; TUIK 2020b). Due to relatively low profitability and high input prices, the wheat harvested area was reduced from 8.1 million hectares to 6.8 million hectares in the period of 2009-2018 (TUIK, 2020a). Although the planted area showed a decreasing trend, the yield increase prevented sharp falls in production volume. Taking into consideration the growth trend of the population (Figure 5) and the decreasing planted wheat area, it can be said that yield enhancement plays a significant role in achieving sustainable food production and ensuring food security over the long term.

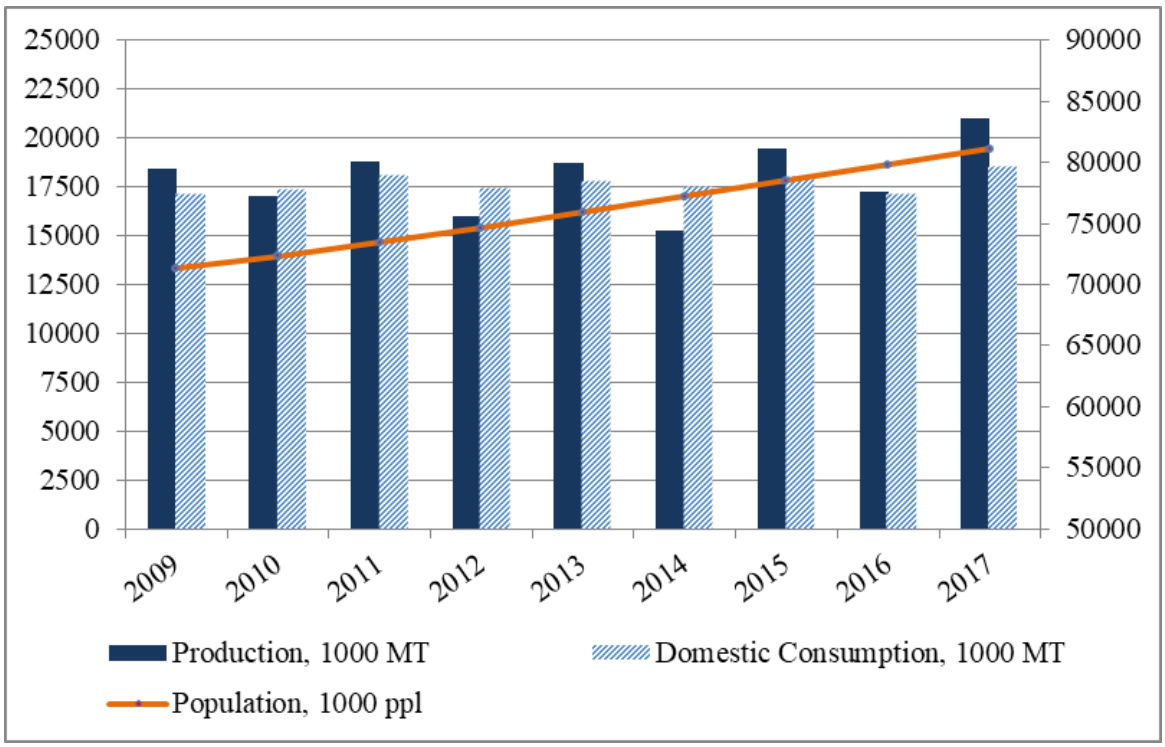


Figure 5: Domestic consumption, production and population growth

Source: (USDA, 2020b), (The World Bank, 2020c)

As illustrated in Figure 5, with the exception of some years, domestic consumption was generally below the production level. In the last decade, the highest production volume was obtained in 2015 and 2017, which can be attributed to yield increase rather than a rise in planted area. In these relevant years, wheat yield was at the highest of the last 10 years, reaching 2.5 Tons/Ha and 2.7 Tons/Ha. The greatest increase in wheat consumption was seen in the 2011-2013 period (USDA, 2020b).

In 2018, wheat production volume was 19 million tons in Turkey. The total supply reached 28.9 million tons, with around 5.5 million tons imported wheat (Table 6). The export volume attributed to the same year was 6.3 million tons, including the wheat equivalent of processed wheat products such as wheat flour, pasta, biscuits, and semolina.

All wheat utilisation in Turkey falls into the category of food, feed, seed, and industrial consumption. In the 2018/2019 marketing year, total domestic consumption was 18 million tons, at the same level compared to the previous season. Food, seed and industrial utilisation of wheat took the biggest share of total consumption, while feed use was only 1.2 million tons (Table 6). According to the wheat balance, the country seems self-sufficient with regard to wheat production. On the other hand, it is possible to say that, as adverse climatic conditions play a

significant role in production volume, it can be seen that for some years, production could not meet demand.

Table 6: Wheat supply & demand balance of Turkey (1.000 MT)

Wheat (1 000 MT)	**2017/18**	**2018/19**
Production	21 000	19 000
Imports	6 130	5 500
Total Supply	28 553	28 859
Exports	6 218	6 300
Feed & Residual	1 300	1 200
FSI* Consumption	16 700	16 800
Total Consumption	18 000	18 000

*Food, Seed and Industrial

Source: (USDA, 2019)

3.5.1. Production

Wheat can be grown in all regions of Turkey, but it is produced widely in the Central Anatolia region. In 2018, the Central Anatolia Region took first place with a share of 34.4% for the production of common wheat, while the Marmara and the Southeast Anatolia regions followed it with 16.4% and 13.6% shares respectively. The regions with the lowest wheat production were the Mediterranean and the Black Sea regions, with shares of less than 10% (Turkish Grain Board, 2019). Looking at the production data on a province basis, it can be seen that Konya province-which is located in the Central Anatolia Region-has the highest wheat production with a share of over 10%, and it is followed by Diyarbakır and Ankara provinces (Table 7).

Table 7: Wheat production by province (Tons)

Province	**2015**	**%**	**2016**	**%**	**2017**	**%**
Konya	2 554 256	11.3	2 045 298	9.93	2 192 410	10.2
Diyarbakır	1 192 796	5.28	1 151 524	5.59	1 129 383	5.25
Ankara	1 150 555	5.09	1 205 676	5.85	1 090 500	5.07
Şanlıurfa	1 087 746	4.81	917 545	4.45	1 044 645	4.86
Tekirdağ	744 257	3.29	825 714	4.01	882 674	4.11
Mardin	795 245	3.52	702 032	3.41	833 009	3.87
Yozgat	830 939	3.68	734 593	3.57	699 052	3.25
Adana	730 873	3.23	621 872	3.02	690 411	3.21
Çorum	622 946	2.76	607 956	2.95	581 078	2.70
Sivas	751 925	3.33	578 709	2.81	569 158	2.65
Kırklareli	412 341	1.82	475 796	2.31	552 431	2.57
Eskişehir	498 223	2.20	580 788	2.82	546 296	2.54
Edirne	488 125	2.16	522 970	2.54	505 460	2.35
Afyon	484 527	2.14	397 191	1.93	454 010	2.11
Other provinces	10 255 246	45.38	9 232 336	44.82	9 729 483	45.25
Total	22 600 000	100.0	20 600 000	100.0	21 500 000	100.0

Source: (TMMOB, 2018) based on TUIK data

Crop yield is one of the main determinants of production volume besides climate conditions and harvested area. Although the average yield of wheat production in Turkey has shown an upward trend over time, it has been 26% lower than the world average of 3.39 Ton/Ha. As seen from Figure 6, the European Union had the highest yield for wheat, which was more than two-fold higher compared with the yield obtained in Turkey in 2018. Likewise, Canada (3.26), Argentina (3.22) and the USA (3.20) also have high average wheat yields, which are close to the world average. While being one of the important countries in the wheat market, Kazakhstan had the lowest wheat yield (1.23) as of 2018 compared to the aforementioned countries.

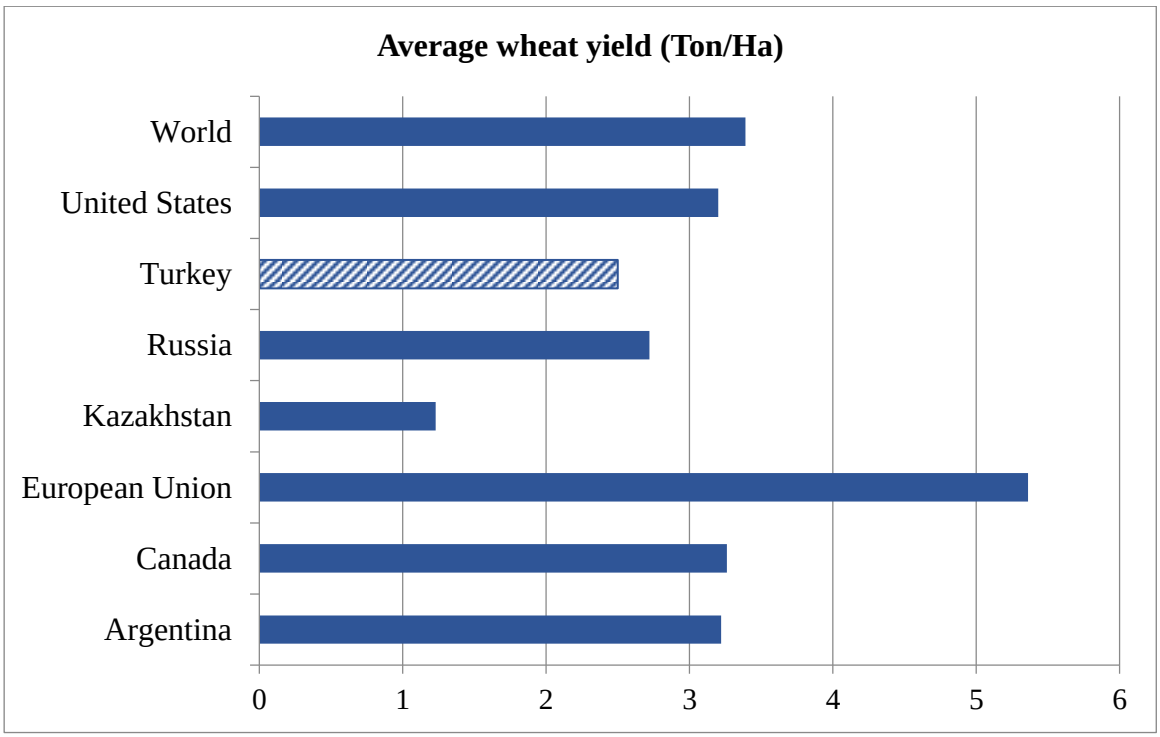


Figure 6: Wheat yield comparison by country- 2018

Source: (USDA, 2020b)

The quality of seed for wheat production is one of the essential factors for high yield. The seed sector in Turkey has been developing since the new seed law came into force in 2006. The Turkish Ministry of Agriculture has been implementing a subsidy program for farmers to expand domestically produced certified seeds. By 2018, support payment for certified seed for wheat production was 8.5 TL/Da (see Table 10). With the assistance of government regulations on certified seed usage and domestic seed production, the public and private sector's production capacity has improved over time. The amount of certified wheat seed produced in the country was around 80 thousand tons in 2002, which increased to 427 thousand tons in 2018. The rate of certified wheat seed production over demand on an annual basis was only 4.9%, while this rate increased to 29.2% in 2018 (TIGEM, 2019). Turkish wheat producers reduced the use of saved seeds for the following year's planting season for all crops, but still saved seeds represents a large part of the seed sources for wheat production.

3.5.2. Post Production

3.5.2.1. Milling Industry

The processed wheat products sector has a considerable share of Turkey's agricultural exports. Turkey has become a leading wheat flour exporter in the world over the years. According to the International Trade Centre data, Turkey was ranked as the top wheat flour exporter in 2018 (International Trade Centre, 2020). Besides domestic consumption, an important amount of wheat demand in the sector comes from the wheat milling industry.

Table 8: Turkish milling industry statistics

Type of Product	Active Factories	Production Capacity (Year/MMT)	Yearly Capacity Usage (%)
Wheat flour	730	30	50
Pasta	25	2	80
Bulgur	103	1.8	65
Biscuit/Cracker	30	1.3	60
Semolina	13	0.8	75

Source: (USDA, 2018) based on industry sources.

As seen from Table 8, there are 730 active flourmills in Turkey as of 2018, with a total yearly capacity of 30 million tons. Flourmills in Turkey are mostly concentrated in areas where production is high. Most of these factories are located in the Central Anatolia and Marmara regions, which are the largest wheat producers. The Black Sea region also has flour-milling facilities due to its geographical proximity to the main import points. The wheat flour sector has improved in the Black Sea region due to high quality wheat imports from the Russian Federation with freight advantage. Yearly wheat flour production forms almost half of the total capacity, yet the current production capacity is three times more than yearly domestic consumption. The world average capacity utilisation is 65%, while this ratio is only 45% for Turkey (Cerkezkoy Ticaret ve Sanayi Odasi, 2017).

Turkey’s geographical closeness to the major wheat exporter countries and wheat flour importers has accelerated the development of the milling sector. Exporters have the advantage of buying relatively low-priced, high-protein wheat from the Black Sea region. The wheat flour export market of Turkey includes the Middle Eastern, African and Asian countries. The sector is

supported by the government's "Inward Processing Regime" (IPR) regulation that aims to support the Turkish milling industry exporters to supply their products at the world market price level. Under the IPR, grain processors have the opportunity to import wheat without paying a custom rate, on condition that they register their processed grain exports (wheat flour, pasta, biscuits etc.). In general, the majority of wheat exports have been conducted under IPR. However, import operations can also be conducted by TMO (authorized by the Turkish Government) with zero tariffs (USDA 2018, 2020a).

3.5.2.2. Feed Production

Wheat is commonly used as an energy source for animal husbandry alongside other grains such as barley and corn. Feed use of wheat constitutes around 19% of overall world wheat consumption, while approximately a yearly average of 136 million tons[3] of wheat is used as animal feed. Compared with other feed grains such as maize and barley, the feed use of wheat is relatively low in general. In 2018, feed corn and barley use in Turkey was 7.4 and 6.6 million tons respectively, while feed wheat use was only 1.3 million tons (USDA, 2020b).

With around 25 million tons of production volume in 2018, Turkey was ranked 7th in compound feed production in the world. Due to rapid urbanisation and intensive farming, Turkish feed production has shown considerable growth. In the 2000-2017 period, compound feed production in Turkey increased from 6.7 million tons to 22 million tons. As of 2018, there are around 525 feed factories in Turkey. The regions with the highest compound feed production in Turkey are the Aegean and Marmara regions, where the population is dense. The Central Anatolia Region follows these regions. As of 2018, these three regions have more than 70% of the total compound feed production (Turkyembir, 2019).

[3] Ten year average, USDA (2020b).

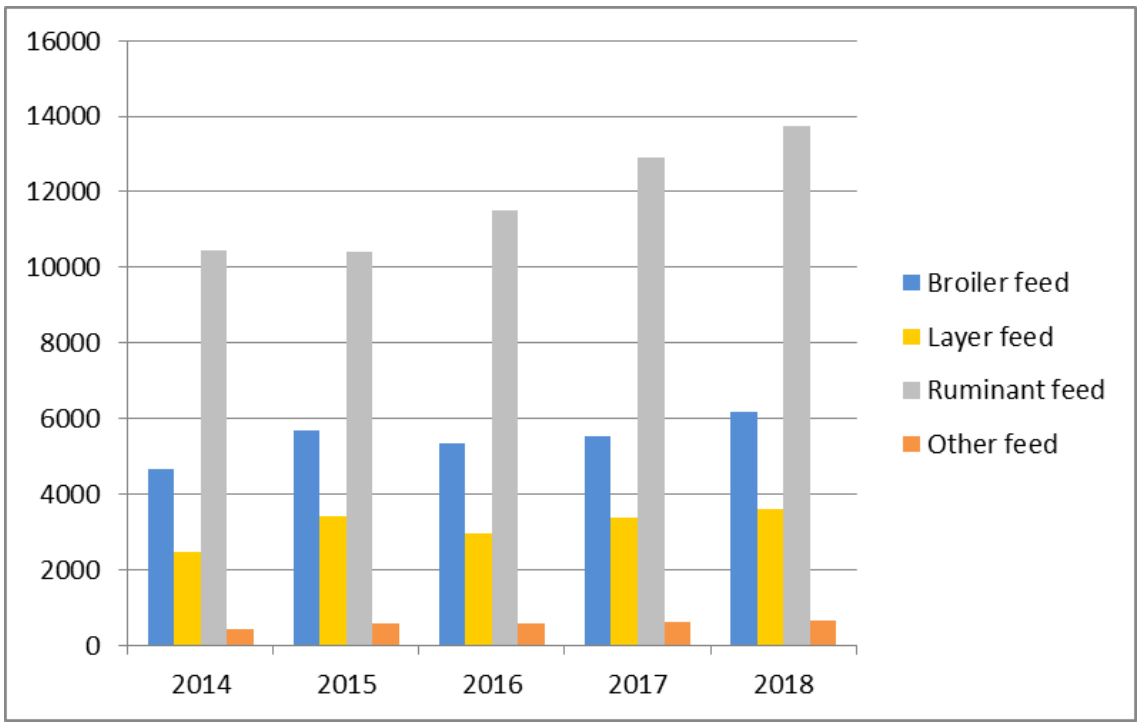


Figure 7: Composition of compound feed production in Turkey (Thousand Tons)

Source: (USDA, 2019), based on Turkyembir.

Figure 7 illustrates the composition of compound feed production in Turkey. As seen from the figure, ruminant feed forms the largest part of total feed production, while broiler and layer feed together form less than half of the production. Layer feed production is the lowest among ve all the main types of feed, with a share of 15% in 2018.

3.5.3. Transport and Storage

Transport and storage systems play a crucial role in each stage of the value chain, especially for food chains with characteristics of seasonality. Density problems tend to occur, particularly in the harvest season[4] and the following months due to heavy supplies. The state grain market regulation agency, the Turkish Grain Board (TMO), which has branches with silos in many regions of the country, aims to balance the price changes due to the supply intensity that occurs during this period by purchasing grains generally during the harvest period. However, in the harvest period, storage facilities that are operated by private farms and farming cooperatives may face difficulties, as they are the first to handle the harvested crop. In the case of a storage

[4] The wheat harvest season in Turkey starts in June in most parts.

shortage, farmers have no choice but to sell their crops as quickly as possible, which causes a price disadvantage for them. Alongside state purchasing campaigns, agribusiness cooperatives may also operate as processors with considerable storage capacity. This can help to ease some of the pressure felt by individual farmers and farming cooperatives during excessive harvest periods. It is also worth noting that adequate storage and preservation systems are also necessary to prevent food losses along the value chain. The provision of appropriate storage and preservation infrastructure for each agricultural product can significantly mitigate food losses. Storage conditions in Turkish agriculture, which is generally characterised by small-medium scale producers, are quite different from countries with large-scale producers such as the USA. As of 2017, the total grain storage capacity was 24.5 million tons, with around 20 million tons of it belonging to the private sector. The TMO owns 4.3 million tons of storage capacity, with 486,200 tons of it consisting of horizontal storage facilities and silos located in ports. In addition to these, in 2014, TMO started to use silo bags, an alternative storage method (Turkish Grain Board, 2018). The TMO supports the agricultural industry by providing temporary purchasing centres across the country to increase their operations during busy procurement periods.

Since the Licensed Warehousing Law of Agricultural Products was enacted in 2005, the government has been supporting the establishment of licensed warehouses. As of 2017, 40 licensed warehouses (with capacity of 1.8 million tons) operate in 24 provinces. Improvements, such as a Warehouse Receipts System transaction process for delivery of agricultural commodities and futures markets in Turkey via commodity exchanges, continue to expand the functions of the Licensed Warehousing system (USDA, 2018). The warehouse receipt system offers several advantages for the agri-business, such as storing crops under favourable conditions and launching agricultural products into the market with certain quality standards (CETINER & KOKSEL, 2015).

3.5.4. Sales

3.5.4.1. Domestic Market

Although there are various types of wheat that are subject to trade in the domestic market, Anatolian Hard Red Wheat (AKS) is usually considered as an indicator of the common wheat price in Turkey. Table 9 illustrates prices in the wheat sector at different stages of the value chain, also including the import prices in the last 5 years. The Russian wheat price was taken to

compare the domestic price with the imported wheat price as large portions of imports were from the Russian Federation (Figure 8). In the Turkish wheat market, Russian wheat is more advantageous than other origins due to its quality and freight benefits.

Table 9: Wheat price comparison along the chain

Year	**Producer Price**	**AKS Wheat** (TMO Purchasing Price)	**AKS Wheat** (Commodity Exchange Price)	**Wheat Flour Price**	**Russian Wheat** (FOB $/Ton)	**$/TRY Exchange Rate**	**Russian Wheat** (FOB TL/Ton)	**Import Tariff Rate** (%)
2014	737	_	870	1 234	265	2.1918	581	130
2015	775	862	860	1 248	205	2.7249	559	130
2016	802	910	940	1 300	180	3.0267	545	130
2017	882	940	990	1 376	190	3.6543	694	45
2018	964	1 050	1 000	1 436	215	4.8221	1 037	45

Source: Author's construct, based on (TUIK, 2019)[5], (Turkish Grain Board, 2020)[6], (TEPGE, 2019a)[7], (USDA 2015, 2016, 2019)[8], (TCMB, 2019)[9] data.

As seen from the Table 9, all price categories in the domestic market show an increasing trend in relevant period, while world prices are on a decreasing trend. In the last five years, the common wheat price increased 30%, from 737 TL/Ton to 964 TL/Ton. Contrarily, the Russian wheat price fell 19%, from 265 $\Ton to 215 $/Ton. The increase in domestic wheat prices can be attributed to high production costs in the country. The tariff rate for wheat import in the 2014-2017 period was 130% an it was decreased to 45% in 2017 (USDA, 2018), indicating high protection of the domestic market.

[5] Farm-gate prices.
[6] TMO purchasing prices and Russian wheat prices.
[7] Commodity exchange prices.
[8] Domestic wheat flour prices.
[9] Exchange rates.

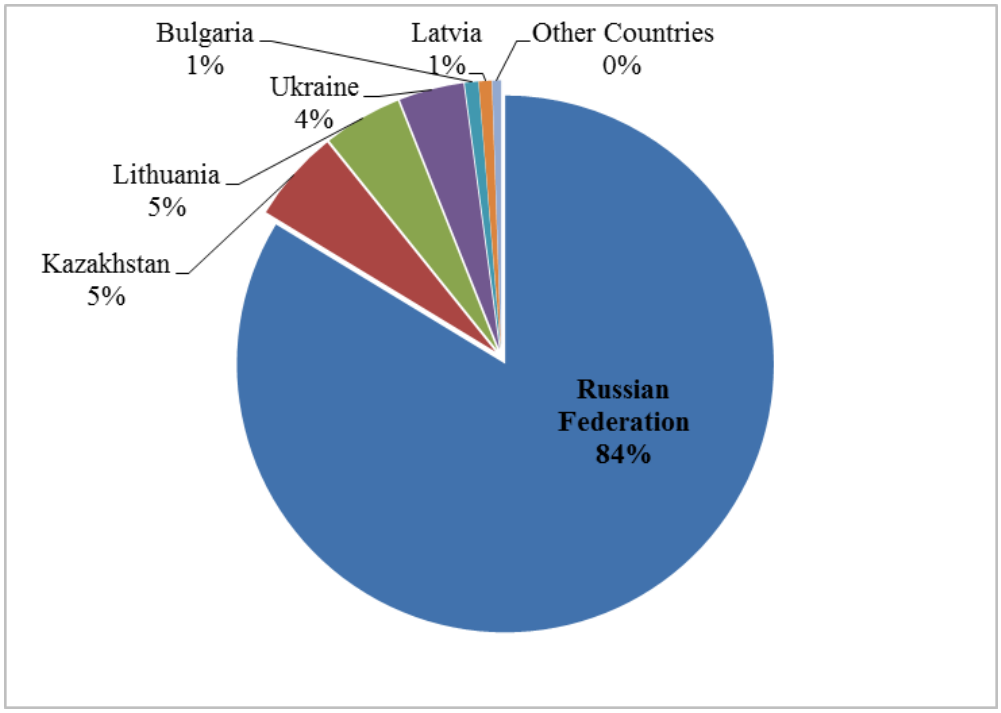


Figure 8: Major wheat imports origins -2018

Source: (International Trade Centre, 2019b) data.

3.5.4.2. International Market

As a self-sufficient country with regard to wheat production, Turkey's wheat trade largely serves the milling sector. The country imports wheat as raw material and exports processed wheat products (wheat flour, pasta, biscuits, etc.) to the world market. In the last decade, wheat flour exports have grown with strong demand from neighbouring countries, export subsidy policies and available plant capacity. On the other hand, another benefit of growth in the wheat processing industry is the value of its by-products for feed use. Due to to high demand for by-products of flour production, Turkish flour industry exports in the global market competitively (USDA, 2018).

The export market of Turkish wheat flour is usually neighbouring countries. Figure 9 shows the main importers of Turkish wheat flour. As seen from the figure, the Middle Eastern countries like Iraq and Syria make up the largest share, with 49% for Iraq and 11% for Syria in 2018. The Middle East countries are followed by North Africa and East Asia.

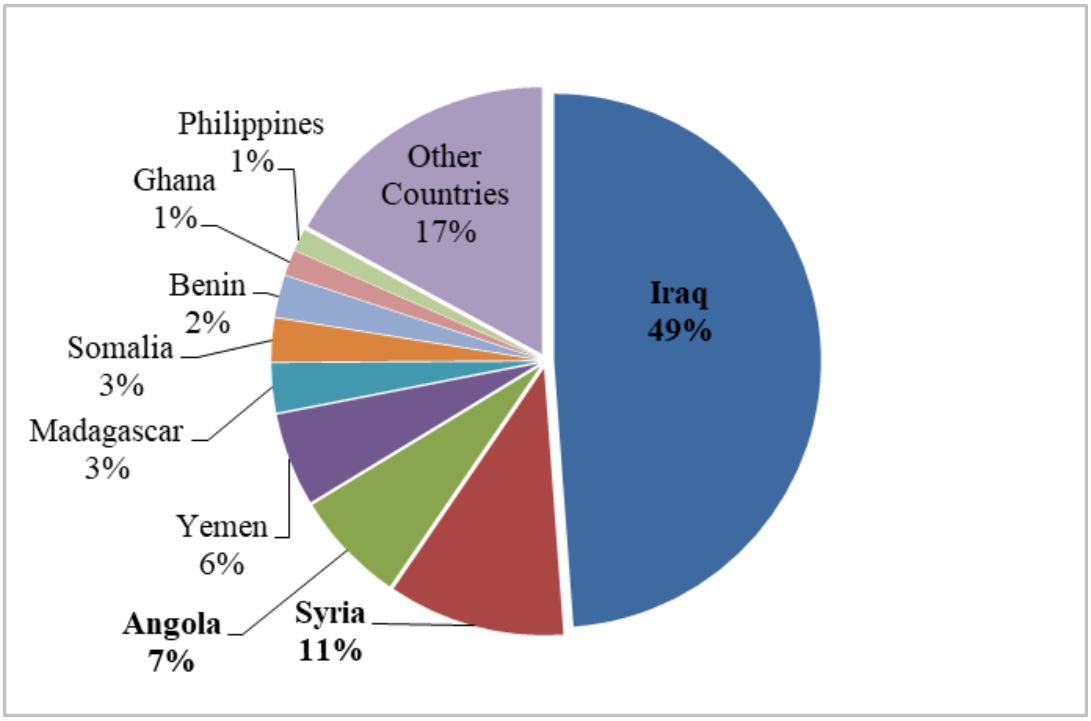


Figure 9: Major wheat flour export destinations -2018
Source: (International Trade Centre, 2019b) data.

3.5.5. Market Regulations

Wheat market is subject to many different regulations by the state to ensure sustainable production. The government supports wheat production by providing various input subsidies alongside production premium programs (Table 10). The production premium amount of 50 TL/Ton has not changed in the last nine years while soil analysis and fertiliser support showed a decreasing trend over that time. The government also encourages certified seed usage; therefore support for certified seed was increased gradually over the last decade. In 2018, despite the reduction of soil analysis and fertiliser support, total government support for wheat production was at its highest, mostly due to dramatic increase of diesel subsidy.

Table 10: Government support for wheat production

Year	Premium TL/Ton	Fertiliser TL/Ha	Diesel TL/Ha	Soil analysis TL/Ha	Certified seed TL/Ha
2009	45	38.3	29.3	22.5	50
2010	50	42.5	32.5	25	50
2011	50	47.5	37.5	25	60
2012	50	50	40	25	60
2013	50	55	43	25	75
2014	50	60	46	25	75
2015	50	66	48.5	25	85
2016	50	110*			85
2017	50	40	130	8	85
2018	50	40	150	8	85
10-years-average	49.5	129**			71

*Total value of three categories combined.
**Average value of three categories combined.

Source: (USDA, 2018) based on the Official Gazette.

Another market regulation tool implemented by the government is market interventions, which are largely conducted by the TMO. The TMO operates selling and procurement campaigns whenever necessary. During the harvest period, procurement operations are done in line with the minimum purchasing prices determined for that year. In 2018, the amount of wheat purchased was around 2.3 million tons (Turkish Grain Board, 2019), which constituted more than 10% of total wheat production.

Besides the above-mentioned practices, import tariffs have been put into effect from time to time to protect grain producers in the domestic market. In 2017, the Turkish government reduced the import tariffs for grains such as wheat, barley and corn from 130% to 45%, 35% and 25% respectively. In addition, the TMO can import wheat tariff-free when necessary and sell imported wheat in the domestic market.

4. MATERIALS AND METHODS

A comprehensive value chain analysis requires interdisciplinary methodology. A combination of qualitative and quantitative data was used in this study to achieve illuminative and broad-in-scope outcomes. Therefore, my study is based on analyses from economic, social and statistical perspectives. Different type of analyses and methods were applied for each stage of the study.

4.1. Research Design

The study consists of three stages of analyses (Table 11) to measure different parameters for the value chain:

- The first stage mainly focuses on reaching a deeper understanding of the value chain concept and establishing the major characteristics of the Turkish wheat sector. In the first stage, the general situation of the Turkish wheat sector in the international market has been examined and the revealed comparative advantage of the Turkish wheat sector against the wheat sectors of major producer/exporter countries has been measured.

- In the second stage, the profitability and competitiveness of the wheat sector and the effects of the current policies on the sector were analyzed. Furthermore, reflections of different market conditions on the wheat sector were measured by creating various scenarios in the second stage of the analysis.

- The third stage of the research presents a regional-scale case study and analysis to reveal the major challenges that are experienced in the sector. For this part of the study, the Central Anatolia Region was selected as the target region as it is the leading region in wheat production in the country. In this last stage of the research, the insights of the wheat sector were examined by collecting primary data from sector stakeholders. By using a survey method, sector opinions were collected under three different categories: (i) Infrastructure and technology, (ii) Marketing and communication and (iii) Financing. The main constraints in the sector were revealed by statistically analysing primary data obtained from the survey.

Table 11: Three-stage methodology of the research

Stages of the research			
	Stage 1	**Stage 2**	**Stage 3**
Aim	Measuring comparative advantage	Examining impact of the existing policies	Revealing major constraints in the sector
Data type	Secondary data	Secondary data	Primary data
Applied methodology	RCA index	The Policy Analysis Matrix	Questionnaire
Scope of the analysis	International level	Country level	Regional level
Output	Comparative advantage	Policy impact	Sector insights

Source: Author's construct.

4.2. Description of Methods

4.2.1. Revealed Comparative Advantage

The analyses used in this research are conducted at international level, country level and finally at regional level, respectively. The method used in the study for the analysis of the Turkish wheat sector at international level is the "Revealed Comparative Advantage" method (RCA). The RCA method has been used in many studies for analyzing different sectors in international economics. The main purpose of this method is to reveal whether a country has a comparative advantage in a particular product or service. In this study, it has been evaluated whether the Turkish wheat sector has a comparative advantage, and the results were compared with some of the major wheat producer/exporter countries' RCA indexes.

Comparative advantage is defined as "an advantage a country has over another country because it can produce a particular type of product more efficiently" (Cambridge Dictionary, 2020). In his comparative advantage theory, RICARDO (1817) suggested that a country's economic growth can be boosted by specialising in the sector in which it has the most comparative advantage, under free trade. Since then, various theories and analytics have been put forward on the comparative advantage of a country over other countries in terms of production of a certain product or product group. It is also important for a country to determine the sectors in which it has a competitive advantage, as well as the factors affecting competitiveness in the sectors in which it operates, in order to increase its performance in international trade. A widely used

approach that helps to measure comparable advantages is the RCA methodology. It is possible to measure the trade performance of a country's specific sector through comparison with the world average and reveal if this specific sector has a comparative advantage. The most prominent RCA indexes are (CAI et al., 2009):

- Standard RCA index developed by BALASSA (1965), considering the export performance of a country.
- RCA index proposed by DONGES & RIEDEL (1977), which includes imports as well as exports.
- RCA method developed by BOWEN (1983) where production, net trade and GNP are used in the calculation.
- RCA index developed by VOLLRATH (1991) in which both imports and exports are included in the calculation in relation to the rest of the world.

Among the above-mentioned RCA approaches, Balassa's RCA index was calculated in this study in order to examine whether the Turkish wheat sector has a comparative advantage compared to other leading wheat producing countries (USA, Russian Federation, and EU-28[10]). The RCA index is calculated in order to measure the trade specialisation of a specific sector in a country, and it is as follows:

$$RCA_i = \left[\left(\frac{X_{i,j}}{\sum X_j}\right) / \left(\frac{X_{i,w}}{\sum X_w}\right)\right],$$

where $(X_{i,j})$ denotes exports of goods (i) by country (j) and $(\sum X_j)$ denotes total exports by country (j). The denominator represents the share of world exports of the relevant goods $(X_{i,w})$ in total world exports $(\sum X_w)$. If the share of the examined sector in a country's total exports is higher than its share in world trade, the RCA index has a value above 1, which means that there is a comparative advantage. As an indicator of competitiveness, the higher the RCA index is, the higher the competitive advantage of the country. On the contrary, if the RCA index has a value below 1, a country is said to have a comparative disadvantage in the examined sector.

The limitation of this index is that government interventions can diverge trade patterns. In their study on applying various indices to examine the competitiveness of the Hungarian agri-food

[10] Since the United Kingdom was a part of the European Union in the examined period, data for the EU-28 was used in the analysis.

sector, FERTO & HUBBARD (2002) emphasised that the level of interventionist state policies on import and export might distort RCA indices. However, they also pointed out that, despite the impact of government interventions on the agricultural sector, RCA indices are useful in determining competitiveness and comparative advantage.

4.2.2. Policy Analysis Matrix

The method used in the study for the analysis at country level is the "Policy Analysis Matrix" (PAM) approach. The purpose of this method - which is used especially in analyses for agricultural markets - is to analyze the impact of existing policies on a particular product's production. The PAM methodology allows for measuring the profitability of producing a certain product, as well as policy impact. In this study, besides examining the effects of the current policies within the framework of the PAM approach, different scenarios were created, and the profitability of wheat production were examined under various possible market conditions.

The PAM is a useful methodology that serves to reveal distorting effects caused by applied policies. It offers a framework to calculate the costs and benefits of those policies to several interest groups (KIRSTEN et al., 1998). A PAM table consists of three rows:

- Private prices
- Social prices
- Divergences

and three columns:

- Revenues
- Costs (tradable inputs and domestic factors)
- Profits

In the context of the PAM approach, private prices refers to the observed market prices of a certain commodity, while social prices in the PAM are defined as the prices that result the highest income generation with optimal use of resources. As seen in Table 12, the matrix requires the calculation of revenues, tradable inputs, domestic factors and ultimately private and social profits for both types of prices. Divergences, which corresponds to the third row in the table, shows the difference between private and social prices in the aforementioned categories.

In the table, the symbol D is refers to private profitability. It demonstrates whether an agricultural system is profitable under existing conditions technologies, prices and policy transfers. On the other hand, the symbol H refers to social profitability and helps to reveal the impact of the policy implications. If the value of social profitability is negative, it means that the system is unsustainable. The difference between private and social prices is shown in the third row of the matrix. The divergences row represents the distortions as result of implemented policies.

Table 12: Policy Analysis Matrix

	Revenues	Costs		Profits
		Tradable Inputs	Domestic Factors	
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Divergences	I	J	K	L

Source: (MONKE & PEARSON, 1989)

i) Private profits (D = A – B – C) are the values of the profits that producers earn within the existing market conditions. The term "private" denotes actual revenues and costs earned/paid by the farmers. Private profits (D) are calculated as the difference between private revenues (A) and private costs (B + C). The private profitability values represent an agricultural system's competitiveness under current technologies, input costs, output values and applied policies.

ii) Social profits (H = E – F – G) are the indicators of comparative advantage of an agricultural commodity system. Social profits (H) are calculated as the difference between social revenues (E) and social costs (F + G).

iii) Divergences are values that represent the transfers, and they are calculated as the differences between private and social valuations of revenues, costs, and profits. The third row of the PAM demonstrates the transfers. There are 4 different types of transfers that can be measured in PAM;

- Output transfers (I = A – E)
- Input transfers (J = B – F)

- Factor transfers (K = C – G)
- Net transfers (L = D – H)

There are several indicators that can be derived from PAM:

- The Nominal protection coefficient (NPC): This is the ratio of the observed -private- prices to the world -social- prices. If the NPC is higher than 1, it implies market price is higher than the world price due to applied policies. The value of NPC can also be measured for tradable inputs (NPCI) as a ratio of private prices (B) of tradable inputs to their social value (F).
- The Effective Protection Coefficient (EPC): This coefficient is the ratio of value added (A - B) in private prices to value added (E - F) in social prices. EPC demonstrates the policy impact (commodity policies) in product markets and tradable input markets. If the EPC value is less than 1, it indicates that the private profits are lower than they would be without policies. An opposite result is observed if the ratio is higher than 1.
- The Domestic Cost Ratio (DRC): This is the ratio of social costs of domestic factors (G) to the value added (E – F) in social prices to produce a certain amount of output. If the DRC value is less (greater) than 1, it indicates positive (negative) net benefits.
- The Private Cost Ratio (PCR): PCR coefficient is measured by using private prices. It is the ratio of domestic factors (C) to the revenues (A) minus tradable inputs (B).

The PAM approach has also been a part of several scientific studies for various products in different countries. For instance, NELSON & PANGGABEAN (1991) examined the policy impact on sugar production in Indonesia and determined the resource transfer distributions. Their study revealed that sugar production was not profitable in Indonesia, not only in terms of private profitability but also in terms of social profitability. Another study, conducted by YAO (1997), analysed the policy of agricultural diversification in Thailand for the 1994-1996 period by using PAM methodology. The study involved three different crops: rice, soybeans and mung beans. According to the results of the study, it was revealed that soybean and mung bean production were less profitable than rice production.

ADESINA & COULIBALY (1998) used the PAM approach to analyse the competitiveness of agroforestry-based technologies for corn production in Cameroon. A high comparative advantage in corn production was found as a result of the study. In their study about protection and the comparative advantage of production of various crops (such as wheat, rice, sorghum, etc.) in China, FANG & BEGHIN (2000) revealed that there was a comparative advantage in

producing labor-intensive crops while there was a disadvantage in producing land-intensive crops. In the context of the PAM methodology, MOHANTY et al. (2002) determined the cotton production efficiency in several producing states in India. The results of the study indicated that there was a significant level of inefficiency due to implemented policies targeted at maintaining cheap cotton availability for relevant sectors.

BAHADIR (2006) examined the competitiveness of cotton production in the Cukurova region in Turkey. The study compared the competitiveness of cotton production with other alternative crops such as wheat and corn. The PAM analysis results showed that cotton production has very high social profitability compared to wheat and second crop maize, although its private profitability was negative. MARTINEZ et al. (2008) used data envelopment analysis techniques with a policy analysis matrix to find out the profitability of rice production in Eastern Spain. According to the study, the average farm in the analysed region made losses both at private and social prices under conventional conditions. It is highlighted that, due to a lack of international competitiveness, the system was not sustainable. However, under profit-efficient conditions, rice production can be profitable.

The above-mentioned studies provide valuable examples in terms of revealing the profitability of producing a certain crop and the impact of implemented policies on agricultural markets in the context of the PAM approach.

4.2.2.1. Private Prices

To implement the Policy Analysis Matrix and to determine the policy impact primarily requires a calculation of private prices. Government subsidies in 2018 were based on The Official Gazette (2018a), while average yield and wheat farm gate-price was taken from the TUIK (2019) database. Average straw price from various wheat growing areas[11] was included in the revenue calculation in private prices (Ministry of Agriculture 2018a, 2018b, 2018c). It is necessary to specify unit prices and quantities of the inputs that are used in the wheat production process to form a Policy Analysis Matrix. To this end, quantities of inputs per decare were estimated based on the TAGEM (2018) report and Ministry of Agriculture (2018c)[12] Tokat province crop report and Eskisehir Odunpazari Ziraat Odasi[13] (2019) crop report, while the input prices were taken

[11] Provinces from 3 different regions; Tokat, Manisa and Antalya.
[12] An estimated average was taken into account based on these reports.
[13] Eskisehir Odunpazari Chamber of Agriculture.

from several sources (TUIK 2019; TEPGE 2019a; Ministry of Agriculture 2019b, 2018b, 2018c), and some estimations based on industry sources. The opportunity cost of working capital is also involved in total production costs. Opportunity cost of working capital refers to the expected rate of return that would have been obtained if the capital was used for different production activity or investment. The nominal interest rate of 10% (considering interest rates of the Ziraat Bank in 2018) was estimated to measure the cost of working capital. Taking into account the 50% government support of the interest rates on credit for crop production (The Official Gazette, 2018b), the interest on working capital was taken as 5%. In addition to these, the rate of 3% of all expenses was used for the calculation of general administrative costs.

4.2.2.2. Social Prices

After the calculation of private prices of revenues (A), tradable inputs (B) and domestic factors (C), it is essential to construct social prices on the PAM table for the analysis. Social prices represent the value of the commodities without any policy impact. In the PAM approach, social prices are based on the "opportunity cost" principle. In economic terms, the opportunity cost is defined as "the opportunities forgone in the choice of one expenditure over others" (Britannica, 2020). The essence of the opportunity cost approach is to maintain effective use of limited resources.

For calculation of social revenues, 210 $/Ton CIF Marmara (12.5% protein wheat) import price was used (USDA, 2018). Social price assessments for tradable inputs (seed, fertiliser and pesticides) were based on their border prices. By using trade data (International Trade Centre, 2019b), the market prices were adjusted to the farmgate level prices. The average exchange rate of Turkish Lira against 1 US Dollar[14] published by the TCMB (2019) was used for the assessment of social prices of tradable inputs. For the adjustment of the exchange rate, a 10.9% exchange rate risk premium, estimated in the Central Bank report (ONAY & KORKMAZ, 2018), was taken into account. Assessments for social prices of inputs such as pesticide and fertilisers were based on their import parity prices. By adding transportation and handling costs to the border price, the import parity prices were calculated for aforementioned importable inputs. On the other hand, wheat-seed border-price was based on export parity price. Therefore,

[14] 1 USD = 4.8294 TRY

similar methodology was applied for the assessment of wheat seed by using export parity price[15]. For the calculation of farm-gate prices, transport and handling costs were estimated as 20 $/Ton based on sector interviews[16]. Social prices for domestic factors such as land, capital and labour were estimated in accordance with the opportunity cost principle. Using the opportunity cost principle helps to determine how much output and income is forgone by using above mentioned factors to produce wheat. For social assessment, transfer payments (such as subsidies or taxes) were not included. This is because their social values equal to zero as they are transferred from one entity to another (AGRAJA, 2006). Calculation of capital and labour social prices require adjustment of their market prices by some compensatory conversion factors to reveal the estimated distortions that exist in the economy (MORRIS, 1990). Therefore, the social price of labour was estimated by using the shadow wage rate factor of 0.64 (BAHADIR, 2006). Assessment of social price of the capital based on a shadow interest rate of 12% calculated by MASHAYEKHI (1980), and the social discount rate for working capital of 5.06% estimated by HALICIOGLU & KARATAS (2011) and also used by MACIC (2015), was applied for the assessment of interest rate on working capital. The social cost for land was calculated by taking into account the estimated profit of an alternative crop, barley[17].

4.2.3. Case Study: The Central Anatolia Region Wheat Sector

In this part of the study, primary data on regional level was collected and analysed. After using the PAM methodology carried out the analysis of the production stage of the wheat value chain, the challenges encountered in the wheat sector were examined by the quantitative survey method. The region that was chosen for the research is the Central Anatolia Region, which ranks first in wheat production in the country. In addition to wheat production, the Central Anatolia Region stands out in production of processed wheat products as well. Bottlenecks in the wheat value chain were identified through a questionnaire that was conducted among sector stakeholders in the Central Anatolia Region.

[15] Appendix A3 presents detailed calculations of the border parity prices.
[16] Estimated transportation and handling costs from Samsun port to domestic market (Ankara or Konya).
[17] Estimation based on 2018 barley farm gate price (TUIK, 2019), yield (USDA, 2020b) and data from industry sources.

4.2.3.1. Introduction to the Case Study Area

Geographically, Turkey is divided into seven regions. In terms of acreage, the largest is the Eastern Anatolia Region and the smallest is the Southeastern Anatolia Region. The capital of the country is located in the Central Anatolia Region. As the country is surrounded by seas on three sides, four of these seven regions are named after the sea on which they have a coast: Marmara Region, Mediterranean Region, Agean Region and Black Sea Region. Every region in Turkey has different characteristics depending on its climate and landforms.

The subject of this case study is the Central Anatolia Region, which ranks second in terms of both acreage and population within these regions. The Central Anatolia Region stands out among all regions in terms of both the fact that the capital of the country is located in this region, as well as its significant share in agricultural production, especially grain production. The region consists of 13 provinces: Aksaray, Ankara, Çankırı, Eskişehir, Karaman, Kayseri, Kırıkkale, Kırşehir, Konya, Nevşehir, Niğde, Sivas, Yozgat, and 4 sections: Konya, Middle Kızılırmak, Upper Kızılırmak and Upper Sakarya.

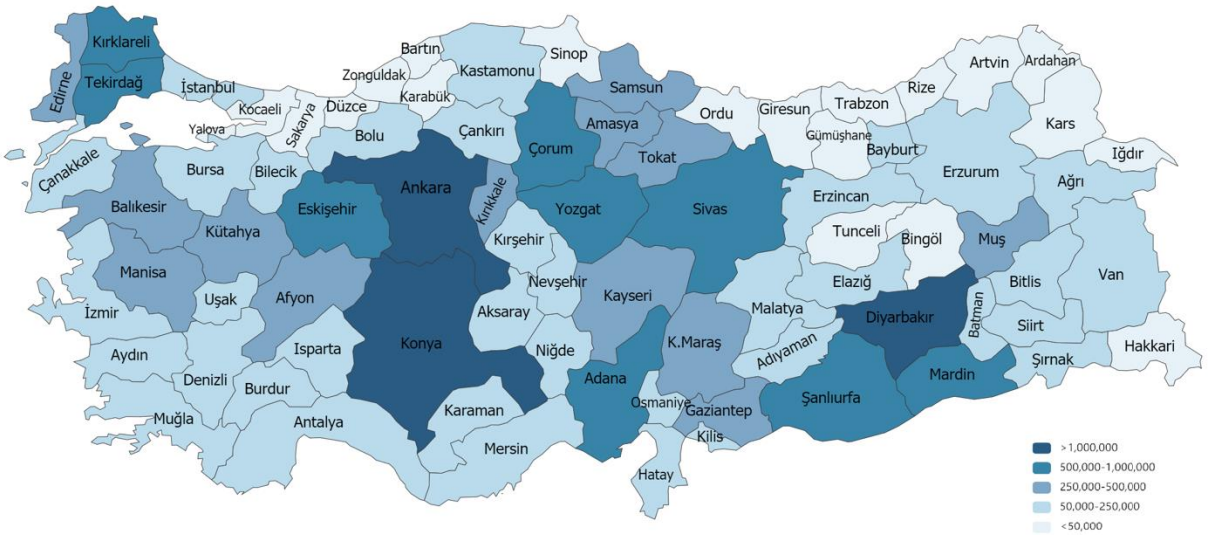


Figure 10: Wheat production by province in Turkey - 2018 (Tons)

Source: Author, based on (TUIK, 2019)

The total area of the Central Anatolia region is approximately 151,000 km2, which corresponds to almost 21% of the country's total territory. Generally, continental climate conditions dominate the region, with hot and dry summers, and cold and snowy winters. In terms of rainfall, it can be said that a large part of the region has semi-arid climatic conditions. The Central Anatolia

Region receives a low level of rainfall - Çankırı 400 mm, Konya 326 mm, Karapınar 250 mm - (ONER et al., 2016). According to the Turkish State Meteorological Service, the suitable planting period (considering soil temperature levels) for winter grains is October and November for the Central Anatolia Region (TSMS, 2021).

Wheat is planted in almost every region of Turkey (Figure 10). As can be seen on the map, the regions with the highest wheat production are the inner provinces of Anatolia and the southeastern regions. Konya province has the highest wheat production in the Central Anatolia Region. Ankara and Yozgat follow Konya in wheat production in the region.

In addition to wheat, the region is also a leader in sugar beet production, which is of industrial importance. The provinces with the highest cultivation are Konya, Yozgat and Eskişehir, respectively. In 2018, Konya, located in the Central Anatolia Region, ranked first in sugar beet production with a share of 29.1% (TEPGE, 2020a). Some other agricultural products in which the region ranks highest in production are:

- Potato (Niğde-18.8%, Konya-11.6%, Kayseri-6.4%), (TEPGE, 2019b).
- Green lentils (Yozgat-39.5%, Konya-25.1%, Kırşehir-11.3%), (TEPGE, 2021).
- Chickpea (Kırşehir-11.2%, Yozgat-10.9%, Ankara-10.8%), (TEPGE, 2020b).

4.2.3.2. Case Study Design

Research design is necessary for research results to be understandable and measurable. In this study, descriptive design was applied. The primary data was collected by using a quantitative survey method. The opinions of wheat value chain stakeholders in the Central Anatolia Region are analyzed under three subtopics:

- Infrastructure and technology
- Marketing and communication
- Financing

With this research design, it was aimed at taking the opinions of the wheat sector stakeholders on the above-mentioned subtopics as a whole, as well as comparing the sector stakeholders by dividing them into groups. The survey questions were designed to record responses in a Likert-type scale, in order to collect standardised and numerically measurable data. The Likert scale is a rating system to improve the levels of measurement in social research by using standardised responses.

4.2.3.3. Operationalisation of the Case Study

The operationalisation in this study included the development of specific research steps or operations that resulted in experimental observations to represent problems encountered in the wheat value chain. This section explains the various choices made in operationalising the study to address the challenges faced in the Central Anatolia Region of Turkey from the perspective of industry stakeholders.

a. Sources of Data

In addition to primary data sources, secondary data sources were also used for this case study. Primary data was obtained from wheat value chain actors operating in the Central Anatolia Region. Secondary data sources have been extracted from books, industry reports, journal articles and the Internet.

b. Target Population

The target population for the study was chosen from wheat sector stakeholders in the Central Anatolia Region. Sector stakeholders operating in the wheat sector are grouped as follows:

- Wheat trading/transportation firms
- Firms engaged in the production/trade of processed wheat products (wheat flour, pasta, bulgur)
- Firms engaged in seed production/trade
- Feed production/trading companies
- Other industry stakeholders (such as commodity exchanges, public institutions, associations)

c. Research Instruments

Survey method was used to acquire primary data from wheat industry stakeholders on their opinions about sector constraints. The questionnaire consisted of a series of open and closed-ended questions. Five scale Likert-style questions (from ‘strongly disagree’ to ‘strongly agree’) were generated alongside demographic questions. The questions were designed to examine the opinions of the survey participants under three different fields related to the sector: infrastructure and technology, marketing and information, and financing. Establishments operating in the region were reached via e-mail and telephone during the period of March-April 2021. In this

case-study research process, social science research ethical principles such as anonymity and confidentiality were applied.

4.2.3.4. Data Processing and Analysis

A survey was conducted on the market views of wheat sector stakeholders operating in the Central Anatolia Region in Turkey and analysis was conducted of the questionnaire answered by a total of 114 stakeholders. The survey consists of two parts: demographic and 5-point Likert scale (1-Strongly disagree; 2-Disagree; 3-Neither agree nor disagree; 4-Agree; 5-Strongly agree). In the first part demographic data were collected. In the second part the scale contained 15 questions, which are equally divided into three sub-scales: Marketing and Communication (M), Infrastructure and Technology (I) and Financing (F).

Results were obtained by using Microsoft Excel 365 and IBM SPSS Statistics 21 (2012) package programs. Before analysis, the answers given to the questionnaire in Part 2 were collected for each sub-scale, and for the total scale. Total scores were obtained (M Total, I Total, F Total and Grand Total) to be used as dependent variables. In order to determine the appropriate comparison tests, whether these variables are suitable for normal distribution was determined by K-S (Kolmogorov-Smirnov) Goodness of fit test (MASSEY, 1951).

For the comparison of the mean, parametric tests were used if the variable had an appropriate distribution (normal distribution), and non-parametric tests were applied if the variable did not have a distribution suitable for normal distribution. In order to compare the mean of groups with more than two groups such as: (i) provinces of operation, (ii) area of activity, (iii) business sizes and (iv) business structures the ANOVA (Analysis of Variance) test was used parametrically and the Kruskall-Wallis (KRUSKALL & WALLIS, 1952) test was used non-parametrically. If a significant difference was detected, the Least Significant Difference (LSD) test, one of the post-hoc tests, was applied to determine which groups the difference occurred from.

In the next stage of the analysis, reliability and validity analyses were performed on the Likert scale responses. Cronbach's alpha (CRONBACH, 1951) coefficient method was used to test the reliability of the scale. Cronbach's alpha is a measure of internal consistency that is, how closely related a set of items is as a group. Validity is the extent to which the construct measures what it says it is measuring. Factor analysis was used for measuring the validity of the scale. Factor analysis is a construct validity technique used to reveal whether there is a certain order between the responses of the respondents in the measurement tool being developed. Various variables can be grouped under several headings with factor analysis. To test the feasibility of factor analysis;

the items are desired to be highly correlated, the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (CERNY & KAISER, 1977) test result is expected to be greater than 0.7, and the Bartlett's test of sphericity is need to be statistically significant.

In addition, in the findings sections, the frequencies and percentages (with graphs of the distribution of demographic data), showing the percentage of the answers given to each question, and the correlations of the sub-scale totals are also given.

4.3. Limitations of the Study

Value chain analysis can be either qualitative or quantitative, and although these methods are both prominent in the current literature, there is no definitive way. Due to this situation, in this study, a sophisticated and descriptive output has been obtained by combining more than one methodology. In addition to this, it is also worth to noting that the agricultural conditions in Turkey differ from region to region and dependent on climate, geographical conditions and infrastructure. The yield figures, production costs — and hence profitability — might be different for each region. Therefore, outcomes acquired in this study are not equally applicable for every region in Turkey. The study tries to draw a picture that reflects the outline of the existing situation in general. Furthermore, the country-level analysis represents an average approximation, in order to reflect the policy implications, and provide an estimation of the country average.

4.4. Delimitations of the Study

Although it was studied in a relatively simplified manner within the scope of the research, in reality value chains have a much more complex composition. The concentration of the research was on major elements of the chain that includes fundamental stages such as production, post-production (processing), transport, storage and sales. The focus of the case study was limited only to the Central Anatolia region for the sector insights research among the wheat value chain stakeholders, even though this region was not the only region where wheat is produced in Turkey. However, the fact that the selected region is highest in wheat production and has an important share in processed wheat production has been beneficial in terms of obtaining general information about the whole sector.

5. RESULTS AND THEIR DISCUSSION

5.1. Revealed Comparative Advantage of Turkish Wheat Sector

According to the TUIK (2020b), the wheat self-sufficiency degree for the 2018/2019 period was 100.5% in Turkey. However, in some years, due to shortages in production and quality due to adverse climatic conditions, demand can not be met. The most important reason for the country to import wheat is the gradual increase in the export of products based on wheat, such as flour, pasta, biscuits, etc. (Turkish Grain Board, 2019). Hence, besides wheat trade data, wheat milling sector data was taken into account while analysing the Turkish wheat sector.

Table 13: Wheat trade balance of Turkey by years (US Dollar thousand)[18]

Years	Export	Import	Balance
2009	641 731	903 240	-261 509
2010	797 130	655 122	142 008
2011	894 324	1 623 129	- 728 805
2012	875 065	1 126 074	-251 009
2013	1 025 922	1 289 381	-263 459
2014	966 588	1 547 448	-580 860
2015	1 011 002	1 104 835	-93 833
2016	1 089 928	913 647	176 281
2017	1 067 409	1 076 545	- 9 136
2018	1 030 196	1 293 789	-263 593

Source: Author's calculations, based on (International Trade Centre, 2020) data.

Table 13 presents Turkey's wheat and wheat flour foreign trade balance between the years 2009 and 2018. As seen from the table, the wheat and wheat flour trade has increased in the last decade. The long-term trade data shows that there were positive balances in the wheat trade only in 2010 and 2016, while the balances were negative in the remaining years, highlighting the sector’s dependency on imports. Besides domestic factors, seasonal supply and price changes in international markets also have a substantial impact on the sector. The primary export product of

[18] Wheat (HS 1001) and wheat flour (HS 1101) together.

the Turkish wheat sector is wheat flour, and it has a significant share of the country's agricultural trade. The main export destination for Turkish wheat flour is the Middle Eastern region due to its geographical proximity and strong demand from the region. Among the wheat flour export destinations on a country basis, Iraq accounts for approximately half of the total volume.

Looking at the world's leading countries in wheat production and trade, the EU-28 had a share of 19% of world wheat production with 138 million tons in 2018. High crop yield, when compared to the rest of the world, is one major factor in the EU-28's large wheat production. The wheat yield of the EU-28 has been between 5.20 Ton/Ha and 5.97 Ton/Ha in the 2009-2018 period. In 2018/2019, the wheat production of the Russian Federation was 72 million tons, which corresponds to almost 10% of the total world wheat production. The wheat yield in the Russian Federation has been very low compared to other major producers, ranging between 1.77 Ton/Ha and 3.11 Ton/Ha in the last decade. The wheat production figures for the USA -one of the major wheat producers- were 51 million tons and 7%, respectively (Turkish Grain Board, 2019). On the other hand, foreign trade data of these countries, which were the subject of the comparative RCA analysis, showed that, in the 2009-2018 period, the foreign trade balance of wheat and wheat flour of the EU-28, the Russian Federation, and the USA were mostly in favour of exports.

Table 14: RCA Indices of Turkey vis-a-vis major wheat exporters

	RCA_TR	**RCA_RUS**	**RCA_EU28**	**RCA_USA**
2009	2.15	3.26	0.88	1.79
2010	2.87	2.17	1.00	2.22
2011	2.26	2.57	0.89	2.60
2012	1.95	2.97	0.87	1.83
2013	2.34	2.32	1.00	2.34
2014	2.18	3.91	1.01	1.74
2015	2.65	4.49	1.03	1.45
2016	2.95	5.79	0.99	1.47
2017	2.72	6.56	0.85	1.61
2018	2.57	7.93	0.80	1.41

Source: Author's calculations, based on (International Trade Centre, 2020) data.

Table 14 demonstrates the trade performances of Turkey and the major wheat producers/exporters for the years between 2009 and 2018. These analyses were based on the measurement of revealed comparative advantages. The index that was defined above measures the competitiveness of Turkey's trade performance in the wheat and wheat flour sector during the aforesaid period, against the USA, the Russian Federation, and the EU-28.

In the table, the RCA indices of each country were calculated on a yearly basis for the examined period. For the calculation of indices, the Harmonised Commodity Description and Coding System (HS) classification was used by taking into account the HS codes for wheat (1001) and wheat flour (1101). The data utilised to measure comparative advantages of Turkey, the EU-28, the USA and the Russian Federation was obtained from the International Trade Centre database (International Trade Centre, 2020).

As seen from the table, RCA values for the wheat sector in Turkey are higher than the threshold value of 1. The RCA indices have shown values between 1.95 and 2.95 in the last ten years and, with the exception of 2012, have been above 2. On the other hand, the RCA analysis results provide a different picture of the Russian Federation. As can be seen, the competitiveness of the industry has been steadily increasing since 2010 and it has reached 7.93 in 2018, the highest in the last decade. Especially since 2014, the Russian Federation seems to have the highest comparative advantage in the wheat sector, among the examined countries. As a result of the calculations made for the EU-28, the RCA values generally remained below the threshold value of 1, although the values reached the threshold occasionally. The RCA index of the USA varied between 1.41 and 2.60 during this period. Although the USA's RCA values are over 1, implying a comparative advantage of the wheat industry, it stands at a point between Turkey and the EU-28, particularly in the last five years.

Measurements presented in Table 14 showed that the Russian Federation (RCA_RUS=7.93) had the highest competitive advantage in 2018, followed by Turkey (RCA_TR=2.57), the USA (RCA_USA=1.41), and the EU-28 (RCA_EU28=0.80). High RCA values can be explained by the large share of wheat and wheat flour exports among the total exports of the examined countries. The EU-28 ranks the lowest among the others, mostly showing a comparative disadvantage in wheat production.

Table 15: RCA Indices by country for wheat (HS 1001)

	RCA_TR	RCA_RUS	RCA_EU28	RCA_USA
2009	0.23	3.50	0.88	1.95
2010	0.81	2.39	1.02	2.43
2011	0.01	2.71	0.90	2.87
2012	0.08	3.24	0.86	1.99
2013	0.20	2.54	1.00	2.56
2014	0.09	4.29	1.03	1.89
2015	0.10	4.95	1.06	1.59
2016	0.03	6.44	1.03	1.62
2017	0.04	7.29	0.85	1.77
2018	0.07	8.80	0.80	1.54

Source: Author`s calculations based on (International Trade Centre, 2020) data.

The situation observed in Turkey implies that the structure of its wheat sector has different patterns compared to other examined countries. If the competitiveness of wheat alone were calculated instead of wheat and wheat flour together, the RCA index of Turkey would be below the threshold value of 1 (Table 15), due to the high volume of processed wheat exports and very low wheat exports. The country’s high level of wheat imports and wheat flour exports can be interpreted as the wheat flour industry's dependence on imports. This situation also highlights that the Turkish wheat sector is fragile against fluctuations in international markets, as well as domestic dynamics.

5.2. A Policy Analysis Matrix for the Turkish Wheat Sector

It is very important for a country to use its limited resources in its economic activities in the most optimal way to achieve sustainability over the long run. In this context, the cost-benefit approach helps to reveal the profitability of an economic activity, and contributes to decision making and policy development processes. Costs and Benefits quantify the profitability of an economic activity by taking into account the amount of gain obtained by performing an activity and the amount it costs to carry out.

Table 16: Wheat Cultivating Activity

Activity: Cultivating 1 da of wheat		
Input quantities per da		
	Unit	Quantity
Fertiliser	Kg	25
Pesticide	Lt	0.2
Seed	Kg	25
Land	Da	1
Labour [Sowing]*	Hour/Da	0.68
Labour [Crop Care]*	Hour/Da	0.34
Labour [Harvest]*	Hour/Da	0.28
Capital [Machinery use]**	Hour/Da	0.81
Output quantities per da		
Wheat***	Kg	274

* (Eskisehir Odunpazari Ziraat Odasi, 2019)
** Based on the study on the Cukurova Region by ALEMDAR et al. (2014)
*** (TUIK, 2019)
Source: Author's construct, based on aforementioned sources and estimations.

The wheat cultivating activity table shows the approximative quantities of the output and the total cost of inputs required for the production of wheat (Table 16). If the total value of the inputs in the table is greater than the output value, the difference will be negative, which indicates a loss. The output value above the input value indicates that profit is obtained from the production of the relevant product. In some cases, producing a certain crop may be profitable for the farmers but still may not ensure efficient resource use from a national perspective and vice versa (KRISTEN et al., 1998).

In this context, the Policy Analysis Matrix (PAM) approach takes into account concepts such as cost-benefit and opportunity cost, and allows for the examination of a particular commodity in detail. MONKE & PEARSON (1989) developed the PAM methodology as an analytical framework and a widely used tool to measure the policy impact on producer income and transfers in an agricultural system.

The basic outcomes of the PAM analysis are illustrated in Table 17. The comparison between social and private prices and profitabilities of wheat production are also shown in the table.

According to the data, when expenses are deducted from the revenue, the average profit of 167.2 TL/Da (D) was received by wheat producers in 2018. On the other hand, the social profitability of wheat production is calculated 86.3 TL/Da lower (the difference between private and social profitability) which indicates that the farmers were functioning under the conditions of the existing market and state policy. In other words, divergence between private and social revenues implies strong domestic support (input subsidies, deficiency payment etc.).

Table 17: PAM for wheat production in Turkey in 2018

Wheat	Revenues	Tradable Inputs	Domestic Factors	Profits
Private Prices	A	B	C	D
	450.0	92.2	190.6	167.2
Social Prices	E	F	G	H
	337.5	87.8	168.7	80.9
Divergences	I	J	K	L
	112.5	4.4	21.8	86.3
PCR (Private Cost Ratio): C/(A-B)			0.53	
DRC (Domestic Resource Cost Ratio): G/(E-F)			0.68	
NPCO (Nominal Protection Coefficient on Tradable Outputs): A/E			1.33	
NPCI (Nominal Protection Coefficient on Tradable Inputs): B/F			1.05	
EPC (Effective Protection Coefficient): (A-B)/(E-F)			1.43	

Source: (CEYLAN, 2020)

According to the PAM results, Turkish wheat producers paid higher prices for internal resources. Estimated expenses on domestic production factors were 190.6 TL/Da, while their social prices were 22 TL/Da lower. Similarly, domestic input costs were higher than social costs as the tradable production factors in social prices were 4.4 TL/Da lower than private prices, revealing the distorting effects in the economic system. Wheat producers in Turkey were estimated to pay 92.2 TL/Da for seed, pesticide and fertiliser in the period analysed.

In addition to profitabilities and divergences, various indicators were obtained as a result of the PAM calculation. For instance, the effective protection coefficient was measured as 1.43, inferring that the applied policies caused a net positive incentive, or an equivalent subsidy to wheat production. Furthermore, another indicator, the domestic resource cost (0.68) implies that the value of domestic resources used in wheat production was less than the value added. On the

other hand, the policy effects on tradable input markets are represented by the nominal protection coefficient for tradable inputs (NPCI). According to the PAM results, the value of the NPCI was 1.05. NPCI above 1 means that, in the period analysed, private prices of inputs used in wheat production were higher than their social prices. Another indicator, similar but for tradable outputs, is nominal protection coefficient for tradable outputs (NPCO) was 1.33, implying that the government policy was protective against output. In another saying, policy implemented by the government could maintain the price of agricultural production output of domestic wheat at a rate of 33% higher than social prices.

5.2.1. Sensitivity Analysis

The PAM analysis of wheat production in Turkey in 2018 showed that wheat producers received a certain level of profit both in private and social prices. Mainly due to subsidies, profitability in private prices was higher than profitability in social prices. The PAM methodology does not reflect the possible changes that may occur in productivity (e.g. yield change) and prices as it is a static model (KIRSTEN et al., 1998). Therefore, the outputs of the policy analysis are sensitive to potential changes in wheat market conditions.

Results of the PAM revealed that the input prices for wheat production were higher than their social prices. It is important to examine the impact of different market conditions to understand the main target areas for more profitability and competitiveness. The sensitivity analysis helps to measure the effects of different input prices. To conduct sensitivity analysis, various scenarios were analysed[19]:

i) Single input price changes
ii) Multi-input price changes
iii) Changes in fertiliser use and wheat yield

5.2.1.1. Scenario 1: Single Input Price Changes

<u>Increase in fertiliser prices by 30%</u>:

[19] Appendix A4 gives detailed PAM tables of the each scenario.

Production costs play a significant role in the profit obtained for wheat production. The increase in the prices of the inputs used in wheat production causes the profit to decrease and the farmers to decide to plant more profitable products. In this context, by using the sensitivity analysis, the effects of different market conditions on wheat producers were measured by creating scenarios of increase or decrease in input prices. In the first scenario, possible effects of a 30% increase and decrease in fertilizer prices were analyzed.

Table 18. PAM indicators as a result of fertiliser price increase

PCR (Private Cost Ratio)	0.55
DRC (Domestic Resource Cost Ratio)	0.68
NPCO (Nominal Protection Coefficient on Tradable Outputs)	1.33
NPCI (Nominal Protection Coefficient on Tradable Inputs)	1.18
EPC (Effective Protection Coefficient)	1.39

Source: Author's calculations, based on PAM results.

Table 18 illustrates the effect of fertiliser price increases on PAM results. As can be seen from the table, a rise in fertiliser costs (DAP and AS) by 30% cause a 13% increase in costs of tradable inputs in total and consequently 8% decrease of the profit (see Appendix A4, Table A4.1.). In case of the projected scenario, producers still get profit from wheat cultivating activity, however the sector's competitiveness decreases slightly as pointed out by the PCR figures. Divergence effect is positive for fertilisers and the NPCI value increases from 1.05 to 1.18 while the EPC value decreases from 1.43 to 1.39.

Decrease in fertiliser prices by 30%:

A possible effect of lower fertiliser prices is illustrated in Table 19. A fall in fertiliser costs (DAP and AS) by 30% causes a 13% decrease in costs of tradable inputs in total and consequently an 8% increase of the profit (see Appendix A4, Table A4.2.). Here the interesting reflection of the decrease can be seen from the table, as the NPCI value falls to below 1, to 0.92, indicating the private prices of fertilisers are lower than their social prices.

Table 19. PAM indicators as a result of fertiliser price decrease

PCR (Private Cost Ratio)	0.51
DRC (Domestic Resource Cost Ratio)	0.68
NPCO (Nominal Protection Coefficient on Tradable Outputs)	1.33
NPCI (Nominal Protection Coefficient on Tradable Inputs)	0.92
EPC (Effective Protection Coefficient)	1.48

Source: Author's calculations, based on PAM results.

5.2.1.2. Scenario 2: Multi-input Price Changes

Multi-input price changes reflect a similar trend as the single input price changes, but to a broader extent. Scenario 2 examines a market condition where the tradable input prices for wheat production are 25% higher/lower than the basic scenario.

Increase in fertiliser, pesticide and wheat seed prices by 25%:

Table 20 presents the possible results of a higher cost of wheat production by increasing each of the tradable input prices (fertilizer, wheat seed and pesticide) by 25%. A 25% increase causes overall costs to increase by 9% and profits to decrease by around 15% (see Appendix A4, Table A4.3.). The EPC value decreases from 1.43 to 1.34 and the NPCI value increases to 1.31, demonstrating that the market prices will be 31% higher than world prices in this scenario.

Table 20: PAM indicators as a result of multiple input price increases

PCR (Private Cost Ratio)	0.57
DRC (Domestic Resource Cost Ratio)	0.68
NPCO (Nominal Protection Coefficient on Tradable Outputs)	1.33
NPCI (Nominal Protection Coefficient on Tradable Inputs)	1.31
EPC (Effective Protection Coefficient)	1.34

Source: Author's calculations, based on PAM results.

Decrease in fertiliser, pesticide and wheat seed prices by 25%:

The reverse effect is observed in the case of a possible decrease in multiple-input prices as overall profit of wheat cultivation increases by 25%. As a result of this scenario, the cost of tradable inputs become 21% lower than their social cost. The NPCI value significantly falls to below 1, to 0.79, implying that the market prices of tradable inputs are lower than their world prices in case of a 25% decrease scenario (Table 21).

Table 21: PAM indicators as a result of multiple input price decreases

PCR (Private Cost Ratio)	0.50
DRC (Domestic Resource Cost Ratio)	0.68
NPCO (Nominal Protection Coefficient on Tradable Outputs)	1.33
NPCI (Nominal Protection Coefficient on Tradable Inputs)	0.79
EPC (Effective Protection Coefficient)	1.53

Source: Author's calculations, based on PAM results.

5.2.1.3. Scenario 3: Changes in Fertiliser Use and Wheat Yield

Increase in fertiliser use by 30% and increase in yield by 20%:

Wheat yield in Turkey is relatively low, compared with the world average and the major wheat producing/exporting countries. According to the USDA (2020b) figures, the last five-year-average (from 2016 to 2020) of wheat yield was 249.4 kg/Da in Turkey, while the five-year-average wheat yields were 558.2 kg/Da, 333.6 kg/Da and 284 kg/Da for the European Union, the United States and the Russian Federation respectively. Since agricultural cultivation areas are limited, one of the most effective ways to achieve higher production and income is to increase yield. By increasing the yield, farmers' revenue could increase, and higher profits would encourage farmers to plant more wheat. Yield increase would also boost overall domestic wheat supply, therefore helping to decrease import volume.

There are several factors affecting wheat yield, such as climate conditions, irrigation and seed quality. For instance, depending on the climate conditions, wheat yield may vary significantly from region to region. Additionally, irrigated wheat results in higher yields, however, Turkish wheat comprises mainly of rainfed wheat. In dry conditions recommended use of Ammonium

Sulphate is 20-25 kg/Da, while the recommended use for phosphorus containing fertilizers is 12-16 kg/Da (SUZER, 2013). However, Turkey's fertilizer use per hectare in 2018 was 20% lower than the world average and 29% lower than the European Union (The World Bank, 2021b). Therefore, a scenario where fertilizer consumption is 30% higher and crop yield is 20% higher than the basic scenario was analysed to reveal the possible impact of higher fertiliser use on costs and profits. Indicators of the PAM are summarized in Table 22.

Table 22: PAM indicators as a result of yield increase

PCR (Private Cost Ratio)	0.48
DRC (Domestic Resource Cost Ratio)	0.55
NPCO (Nominal Protection Coefficient on Tradable Outputs)	1.24
NPCI (Nominal Protection Coefficient on Tradable Inputs)	1.05
EPC (Effective Protection Coefficient)	1.30

Source: Author's calculations, based on PAM results.

In case of higher fertiliser use, the overall cost of tradable inputs increases around 12%. On the other hand, higher yield, in turn, leads to a further increase in revenue. Private revenue inreases around 11%, while social revenue increases 20%. As a result, farmers receive higher profits compared to the basic scenario. The profit raises 24%, from 167.2 TL/Da to 207.2 TL/Da (see Appendix A4, Table A4.5.). The overall effect of the above-mentioned changes in social costs and revenues on the comparative advantage of wheat can be seen in the DRC value. The DRC value changes from 0.68 to 0.55, pointing out a higher comparative advantage than the basic scenario.

5.2.2. Remarks on the Findings

Wheat has an important share in international trade both as a raw material and as a processed product. It is also an essential crop for Turkey both economically and socially. The cultivation area of wheat tended to decline over the last decade. In addition to this, Turkey is one of the leading wheat flour exporter countries. In 2018, the country's wheat imports increased by around 70% compared to the volume of wheat imported in 2009 (International Trade Centre, 2020). Although the country's wheat imports are mostly for the wheat flour industry, this increase is an important indicator for the sustainability level of the sector. Therefore, in addition to the growing

population and the developing wheat flour industry, current agricultural policies for wheat production play a more critical role than ever in the context of food security.

In this sub-chapter, firstly the profitability of wheat production and then the effects of the existing agricultural policies were examined by applying the PAM method. According to the results of the analysis, producers gain a certain amount of profit from wheat production. However, state supports have an important share in this. As it is known, as the profitability of wheat production decreases, farmers tend to plant more profitable crops. In the current situation, although domestic production meets domestic consumption, the increase in wheat imports (other than the flour sector) may lead to import dependency and a decline in sustainability of wheat production.

Another result revealed by the PAM analysis is that the prices of basic inputs used in wheat production (wheat seed, fertilisers, pesticides) are higher than their social prices, which were calculated based on world prices. High input cost is one of the main obstacles against achieving profitable and sustainable wheat production. The sensitivity analyses on single and multiple input price changes also showed that higher input prices affect profitability negatively and extends the gap between private and social prices. The competitiveness of wheat that produced at higher costs cannot be strong in international markets. As the cost of production is an important factor affecting profitability, incentives to make wheat production more profitable and productive can help farmers increase the cultivation of this substantial crop.

In addition to all the factors mentioned above, the productivity of wheat also affects farmers' incomes. Major wheat producer and exporter countries obtain higher level wheat yields per decare, while the yield of wheat produced in Turkey appears to be relatively low. Sensitivity analysis through PAM also highlighted that farmers can receive higher profits and the sector can have better comparative advantage by increasing fertiliser use, thus raising yield. Policies targeting advanced wheat yield can help to improve farmers' incomes and also can increase competitive power of the sector and allow access to the international markets.

Consequently, results of the analysis pointed out that the support mechanism of the Turkish wheat sector needs to be improved to enhance competitiveness. In particular, policies that reduce production costs and increase productivity need to be addressed within the framework of a more sustainable understanding. Additionally, it is also necessary to note that wheat planting areas in Turkey are mostly characterised with rainfed wheat cultivation - rainfed wheat 77%, irrigated

wheat 23% - (Turkish Grain Board, 2019). Therefore, it should also be taken into account that rainfed wheat production will be more affected by hard-to-control factors such as weather conditions compared to irrigated wheat production. Due to the widespread production of rainfed wheat in Turkey, the risk of fluctuations in annual wheat production volume linked to weather conditions is high. In addition, considering the expectations of temperature changes due to climate change, it is of great importance for the future of the sector that the policies for the wheat sector are long-term and that they are developed by taking environmental factors into account. For this reason, infrastructure improvements are also of critical importance to provide less expensive and more accessible resources to help increase efficiency and reduce wheat production costs.

Since each stage of the value chain is connected and affected by each other, it is useful to evaluate this comprehensive analysis in the light of the outputs obtained with PAM methodology. In this way, it is possible to determine the sector problems more accurately and develop more realistic solutions to overcome these obstacles.

5.3. Case Study: The Central Anatolia Region

5.3.1. Analysis of the Demographic Part

The case study results are presented in this chapter. Table 23 shows the frequencies and the percentages of the cities of stakeholders. As can be seen from the table, the city with the highest frequency is Konya (41), where wheat production is by far the highest in the region. Konya is followed by Ankara (24), which ranks second in wheat production in the region. Industry stakeholders from almost all cities in the region were included in the study in order to represent the region accurately. Consequently, a total of 114 industry stakeholders, representing the region, participated in the survey. Similarly, the figure (Figure 11) presents the distribution of cities in bar chart form.

Table 23: Distribution of the cities

Cities	*Frequency*	*Percent*
Ankara	24	21.1
Kayseri	5	4.4
Karaman	8	7.0
Eskişehir	4	3.5
Konya	41	36.0
Nevşehir	2	1.8
Kırşehir	16	14.0
Kırıkkale	3	2.6
Sivas	2	1.8
Aksaray	3	2.6
Yozgat	5	4.4
Niğde	1	0.9
Total	114	100.0

Source: Author, based on survey data.

As can be seen from the figure, while participation is high from some cities in the region such as Konya and Ankara, participation from other cities is relatively low. In fact, this situation reflects the sector quite accurately. Especially the city of Konya is the city with the highest wheat and wheat products production in the region, and therefore has the highest number of establishments.

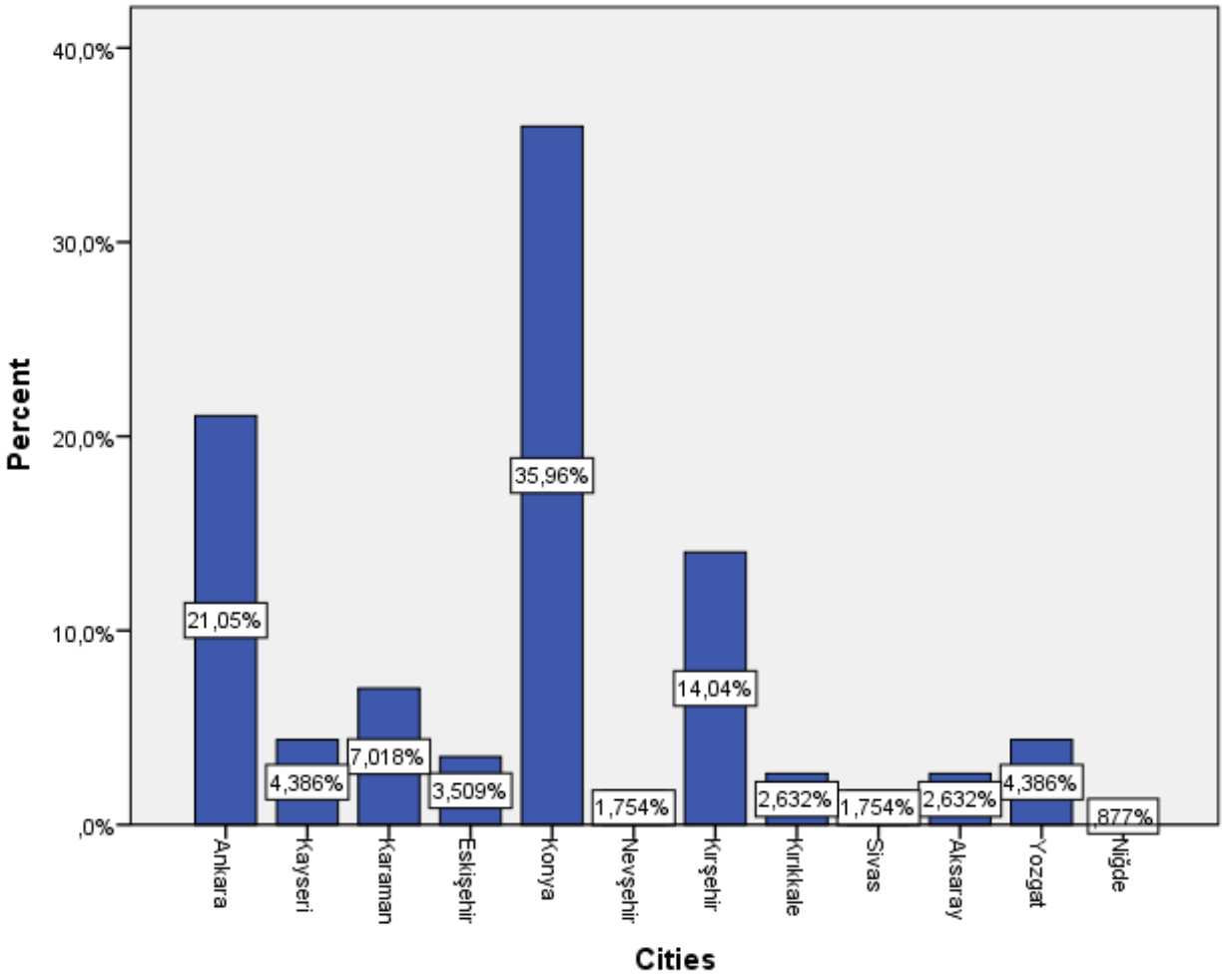


Figure 11: Bar chart of the distribution of the cities

Source: Author, based on survey data.

Table 24: Distribution of activity areas

Area	*Frequency*	*Percent*
Seed	24	21.1
Grain Trade/Transport	24	21.1
Feed	20	17.5
Processed Wheat Products	38	33.3
Others	8	7.0
Total	114	100.0

Source: Author, based on survey data.

Table 24 shows the frequencies and the percentages of the activity areas of stakeholders. It shows the distribution of the Central Anatolia region sector stakeholders, who participated in the study, by field of activity. As can be seen from the table, stakeholders in the sector are divided into five different groups such as "Seed", "Grain trade and transport", "Feed", "Processed wheat products" and "Other". While the frequency of the "Processed wheat products" group, which is the most developed field of activity in the region, is 38, this group is followed by "Seed" (24), "Grain trade / transport" (24), "Feed" (20) and "Other" categories, respectively. Similarly, the figure (Figure 12) shows the distribution of activity areas in bar chart form.

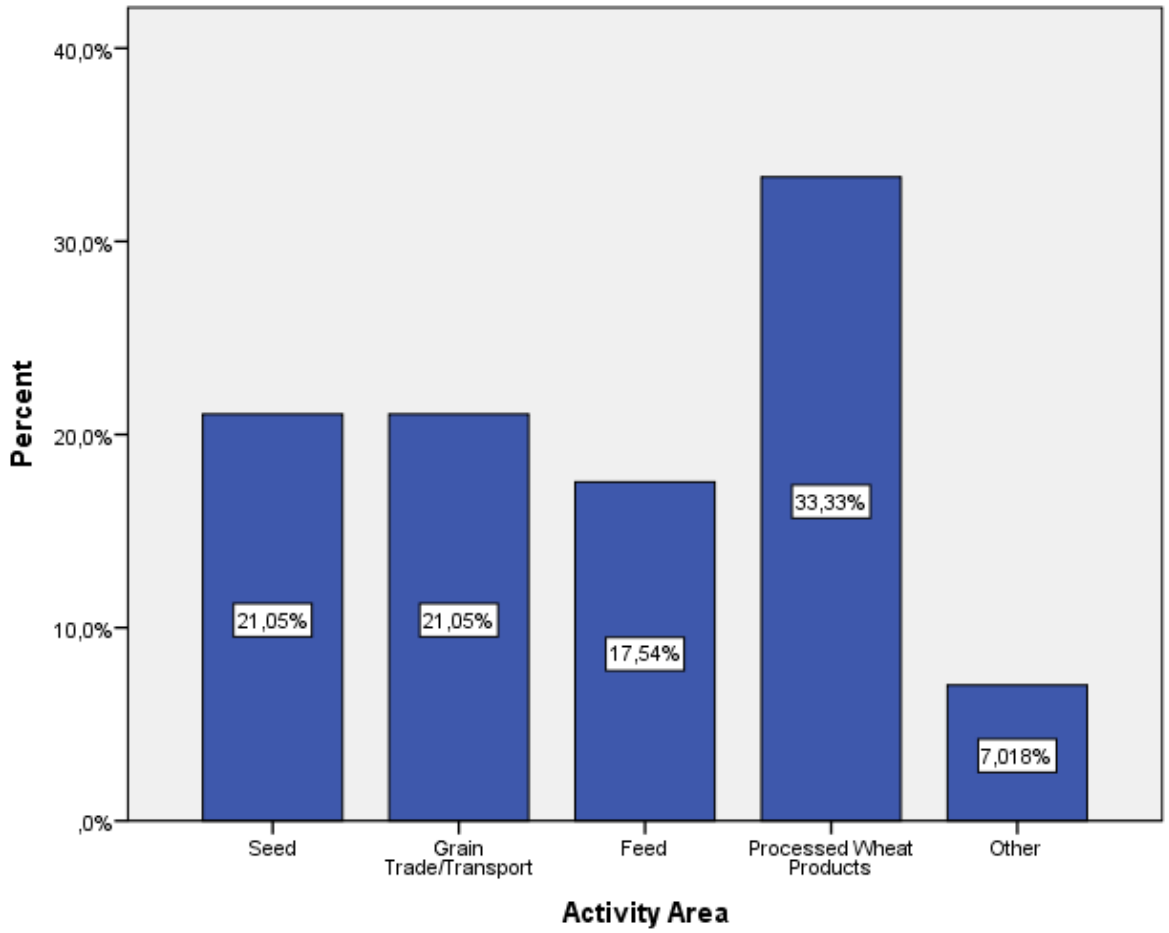


Figure 12: Bar chart of the distribution of activity areas

Source: Author, based on survey data.

For the classification of enterprises according to their size, three different categories were used: enterprises with less than 50 employees, enterprises with 50-250 employees and enterprises with more than 250 employees. Table 25 presents the frequencies and the percentages of the establishment size of stakeholders. As can be seen from the table, approximately 72% of the sector stakeholders that participated in the survey were small-scale establishments (less than 50 employees). While 20% of the participants were medium-sized establishments (number of employees between 50-250), the percentage of large-scale establishments was 8%. Figure 13 below shows the distribution of establishment size in pie chart form.

Table 25: Distribution of establishment sizes

Size	*Frequency*	*Percent*
More than 250	9	7.9
Between 50 and 250	23	20.2
Less than 50	82	71.9
Total	114	100.0

Source: Author, based on survey data.

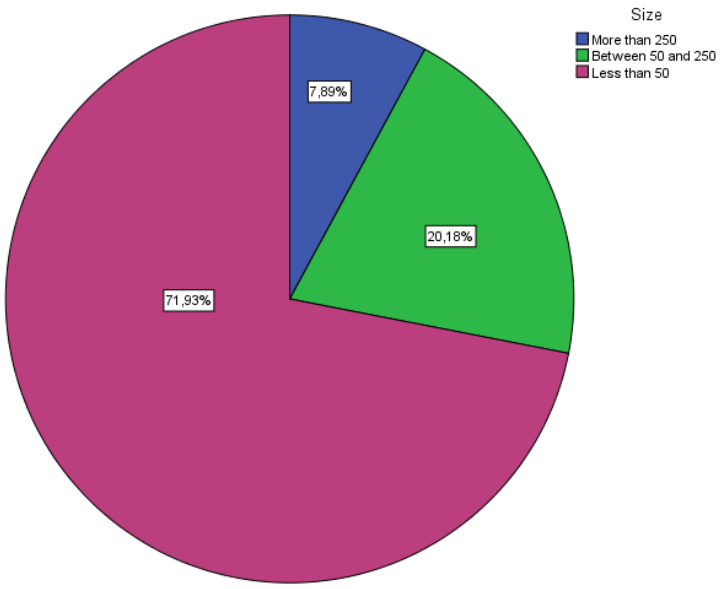


Figure 13: Pie chart of the distribution of establishment sizes

Source: Author, based on survey data.

Figure 14 shows the structure of participating establishments. While approximately 91% of the survey respondents were identified as private sector, the ratio of those defined as state and mixed is 2% in total. The institutions included in the "other" group are commodity exchanges and associations, with ratio of 7%.

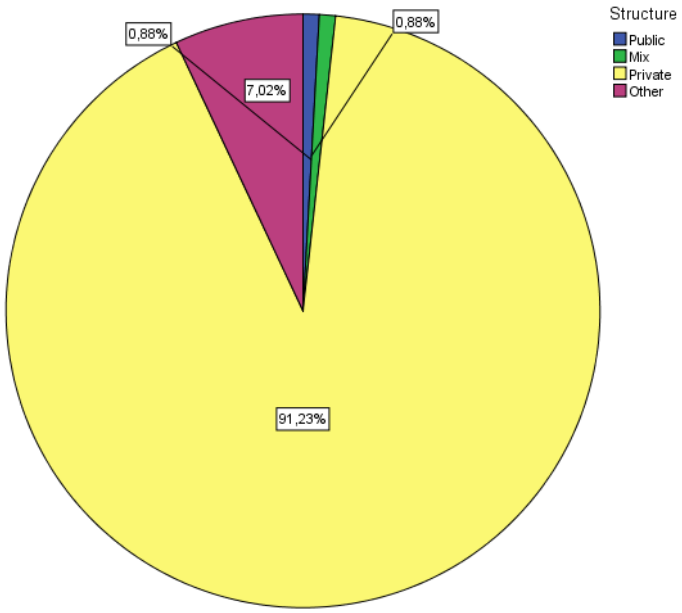


Figure 14: Pie chart of the distribution of organizational structures

Source: Author, based on survey data.

5.3.2. Distribution of the Data

Table 26 shows the Kolmogorov-Smirnov Goodness of Fit test results. K-S Goodness of Fit test is suggested the following hypothesis; if the significance level of the test is above 0.05 then the tested data conforms to normal distribution. According to this table "M total", "F total" and "Grand Total" variables are normally distributed ($p>0.05$). However, the "I total" variable is not suitable to normal distribution ($p<0.05$)[20]. Therefore, parametric tests were conducted to analyze "M total", "F total" and "Grand Total" variables, and non-parametric tests were applied for the "I total" variable.

Table 26: Kolmogorov-Smirnov test results

Variable	*Z-value*	*P-value*
M total	0.980	0.275
I total	1.446	0.028
F total	0.998	0.237
Grand Total	0.858	0.385

Source: Author, based on survey data.

5.3.3. Analyses of the Scale

5.3.3.1. Reliability Analysis

The reliability of the scale was determined by the alpha coefficient method developed by Cronbach for Likert-type scales and named after him (CRONBACH, 1951). According to the criteria used in the evaluation of the alpha coefficient; if $0.00 \leq \alpha < 0.40$, the scale is considered "unreliable", if $0.40 \leq \alpha < 0.60$, the scale is "low reliable", $0.60 \leq \alpha < 0.80$ "the scale is reliable", if $0.80 \leq \alpha < 1.00$ the scale is "highly reliable". The Cronbach α coefficient calculated for the scale was 0.846. This coefficient shows that the scale is highly reliable. The calculated Cronbach α

[20] The sub-groups that could not be tested for normality were assumed as normally distributed. It is also found that the normality test applied to the applicable sub-groups are also consistent with each other.

coefficients for the sub-scales are: 0.695 for “M Total”, 0.679 for “I Total” and 0.639 for “F Total” which show that the sub-scales are reliable for the further analysis. The *Item-Total Statistics* and *Cronbach’s Alpha if Item Deleted* values can be seen in Table 27.

Table 27: Item-total statistics and Cronbach’s alpha if item deleted values

Questions	*Corrected Item-Total Correlation*	*Squared Multiple Correlation*	*Cronbach's Alpha if Item Deleted*
M1	.466	.391	.837
M2	.554	.337	.833
M3	.605	.437	.829
M4	.528	.401	.834
M5	.383	.242	.842
I1	.571	.399	.832
I2	.585	.577	.830
I3	.433	.414	.839
I4	.475	.343	.837
I5	.304	.197	.847
F1	.474	.379	.837
F2	.494	.433	.836
F3	.434	.384	.839
F4	.469	.492	.837
F5	.368	.192	.843

Source: Author, based on survey data.

5.3.3.2. Validity Analysis

Exploratory factor analysis was used to examine the validity of the scale. In the first analysis performed for this purpose, the correlation matrix between all items was calculated. It was examined whether there were significant correlations between the items (Table 28), and it was seen that there were statistically significant relationships suitable for factor analysis. Later, KMO sample suitability and Bartlett's test of sphericity were performed. In order for the data to be suitable for factor analysis, the KMO should be higher than 0.70 and the Bartlett Sphericity test should be significant.

Table 28: Correlations between items of the scale

		M1	*M2*	*M3*	*M4*	*M5*	*I1*	*I2*	*I3*	*I4*	*I5*	*F1*	*F2*	*F3*	*F4*	*F5*
M1	Corr.	1	.286**	.287**	.408**	.317**	.308**	.284**	.085	.352**	.058	.263**	.439**	.297**	.174	.143
	Sig.		.002	.002	.000	.001	.001	.002	.368	.000	.537	.005	.000	.001	.062	.128
M2	Corr		1	.389**	.294**	.262**	.419**	.401**	.289**	.305**	.282**	.297**	.335**	.300**	.334**	.152
	Sig.			.000	.001	.005	.000	.000	.002	.001	.002	.001	.000	.001	.000	.106
M3	Corr			1	.480**	.278**	.417**	.376**	.409**	.377**	.216**	.461**	.340**	.264**	.260**	.217**
	Sig.				.000	.003	.000	.000	.000	.000	.021	.000	.000	.004	.005	.020
M4	Corr.				1	.126	.312**	.320**	.280**	.416**	.088	.343**	.394**	.224**	.269**	.220**
	Sig.					.179	.001	.000	.002	.000	.348	.000	.000	.016	.004	.018
M5	Corr.					1	.239**	.145	.127	.205**	.284**	.202**	.190**	.299**	.196**	.192**
	Sig.						.010	.123	.175	.028	.002	.030	.042	.001	.036	.039
I1	Corr.						1	.419**	.418**	.368**	.229**	.430**	.275**	.184**	.303**	.157
	Sig.							.000	.000	.000	.014	.000	.003	.049	.001	.095
I2	Corr.							1	.506**	.281**	.114	.210**	.285**	.213**	.600**	.328**
	Sig.								.000	.002	.227	.024	.002	.022	.000	.000
I3	Corr.								1	.369**	.117	.259**	.092	.076	.231**	.200**
	Sig.									.000	.211	.005	.331	.419	.013	.032
I4	Corr.									1	.207**	.291**	.159	.103	.161	.206**
	Sig.										.026	.002	.090	.275	.085	.027
I5	Corr.										1	.242**	.155	.256**	.128	.150
	Sig.											.009	.098	.006	.174	.110
F1	Corr.											1	.396**	.145	.050	.214**
	Sig.												.000	.123	.593	.022
F2	Corr.												1	.461**	.207**	.183
	Sig.													.000	.026	.050
F3	Corr.													1	.399**	.206**
	Sig.														.000	.027
F4	Corr.														1	.322**
	Sig.															.000
F5	Corr.															1
	Sig.															

** Significant result according to p<0.01

* Significant result according to p<0.05

Source: Author, based on survey data.

Bartlett's test of sphericity tests the hypothesis that the correlation matrix between items is an identity matrix, which would indicate that variables are unrelated and therefore unsuitable for structure detection. Small values (less than 0.05) of the significance level indicate that a factor analysis could be applicable with the data.

In this study, the KMO sample fit coefficient for the scales was 0.826, and the Bartlett Sphericity test 2 (chi-square) value was found to be 488.850 ($p < 0.001$). This means that exploratory factor analysis can be used for validity of the scale.

The scale in this study consists of three sub-scales. In factor analysis, the results of "oblimin rotation" factor analysis with the principal components technique were limited to three factors.

Table 28 shows the correlation coefficients among 15 questions and their significance values. According to these values, it can be said that there are quite high and significant correlations between the survey questions. This result provides an assumption for a factor analysis to be made among the survey questions.

Table 29: Correlations between total scales

		M total	*I total*	*F total*	*Grand Total*
M total	Correlation Coefficient	1.00	.559**	.580**	.861**
I total	Correlation Coefficient	.559**	1.00	.435**	.789**
F total	Correlation Coefficient	.580**	.435**	1.00	.802**
Grand Total	Correlation Coefficient	.861**	.789**	.802**	1.00

** Significant result according to $p<0.01$

Source: Author, based on survey data.

Table 29 shows the correlation coefficients for the subtotals of the survey questions and their significance levels. According to the table, M, F and I subtotals are highly correlated with each other and all the p values are <0.01, which means the correlation coefficients are statistically significant.

Table 30: Total variance explanations with eigenvalues

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.878	32.518	32.518	4.878	32.406	32.518
2	1.413	9.420	41.938	1.413	9.420	41.938
3	1.309	8.730	50.667	1.309	8.730	50.667
4	1.129	7.526	58.193			
5	.894	5.959	64.152			
6	.876	5.838	69.991			
7	.731	4.873	74.864			
8	.667	4.444	79.308			
9	.577	3.845	83.154			
10	.554	3.692	86.846			
11	.505	3.365	90.212			
12	.428	2.851	93.063			
13	.416	2.770	95.833			
14	.375	2.500	98.333			
15	.250	1.667	100.00			

Source: Author, based on survey data.

Table 30 contains the initial eigenvalues obtained as a result of factor analysis, the contribution of each factor to the variance, the contribution percentage and the cumulative percentage. From the table it can be seen that the three components cumulative percentage of variance is 50.667, which is an adequate amount of explanation of the scale.

Table 31: Factor loadings for the scale

Item	Component		
	1	2	3
I4			.708
F1		.642	
I3			.656
M3	.632		
I1			.619
M4	.550		
M2	.334		
F3		.775	
F2		.636	
M1	.581		
M5	.522		
I5			.393
F4		.835	
I2			.749
F5		.461	

Source: Author, based on survey data.

As a result of the analysis, it can be seen from Table 30, a measuring tool consisting of 15 items and three sub-scales explains 50.667% of the total variance. Information about the factor loads of the scale and the variance rates they explain are given in Table 31. According to these results, the scale was properly divided into sub-scales and the validity of the scale was shown.

5.3.4. Mean Difference Tests

5.3.4.1. Mean Difference Test Results Between Provinces

The results given in Table 32 show whether there is a difference in terms of the answers given to the questionnaire between the participants in different provinces. “M total”, “F total” and “Grand total” variables are tested with ANOVA since they are normally distributed, “I total” data were tested with Kruskal-Wallis because it does not fit the normal distribution. For “M total” variable there is a significant difference among provinces.

Table 32: Mean difference test results between provinces

Variable	*Test statistics*	*P-value*
M total	2.420	0.006*
I total	15.562[1]	0.158
F total	0.103	0.442
Grand Total	0.858	0.080**

[1] Kruskal-Wallis test statistics
* Significant result according to $p<0.05$
** Significant result according to $p<0.10$
Source: Author, based on survey data.

Post-hoc tests could not be conducted for this case, due to the low number of participants corresponding to some provinces. However, an interpretation can be made by using the rank median of the provinces. According to rank medians the difference is due to the fact that the Eskişehir, Konya and Yozgat provinces gave more positive answers compared to others, thus having higher medians in the M sub-scale. Also, according to $p<0.10$ “Grand total” variable has a significant difference among provinces. The difference is due to the fact that the establishments, which operated in the Eskişehir, Aksaray and Niğde provinces, were more optimistic about the conditions of the wheat sector.

5.3.4.2. Mean Difference Test Results Between Activity Areas

Table 33 shows whether there is a difference between the participants in different activity areas in terms of the answers given to the questionnaire. Same as above "M total", "F total" and "Grand total" variables are tested with ANOVA. Since they are normally distributed, "I total" data were tested with Kruskal-Wallis because it does not fit the normal distribution. According to $p<0.06$ "M total" variable has a significant difference among activity areas.

Table 33: Mean difference test results between activity areas

Variable	*Test statistics*	*P-value*
M total	2.371	0.059*
I total	5.127[1]	0.274
F total	1.572	0.191
Grand total	2.051	0.097**

[1] Kruskal-Wallis test statistics
* Significant result according to $p<0.06$
** Significant result according to $p<0.10$
Source: Author, based on survey data.

A LSD test, one of the post-hoc tests, was used to detect the differences between activity areas. According to LSD test result, the difference is due to the fact that the answers of participants from "Seed" and "Feed" areas have higher means than the "Grain trade/transport". This means participants from "Seed" and "Feed" areas gave more positive answers to the questions in the M sub-scale. Also, according to $p<0.10$ Grand total variable has a significant difference among activity areas. Like "M total" the difference is due to the fact that the answers of participants from the "Seed" group has a higher mean than the "Grain trade/transport".

It is also worth noting that, according to the analyses results, there is no significant difference in the answers given between establishment sizes as well as between organizational structures.

Table 34: Mean and std. dev.[21] values of the total answers according to activity area

		N	*Mean*	*Std. Dev.*
M total	Seed	24	18.00	3.65
	Grain Trade/Transport	24	15.17	3.23
	Feed	20	17.15	3.57
	Processed Wheat Products	38	16.16	3.13
	Other	8	16.25	4.40
	Total	114	16.52	3.52
I total	Seed	24	19.00	2.38
	Grain Trade/Transport	24	16.79	4.61
	Feed	20	17.75	3.73
	Processed Wheat Products	38	17.24	3.05
	Other	8	17.63	5.55
	Total	114	17.63	3.66
F total	Seed	24	16.50	3.13
	Grain Trade/Transport	24	14.42	3.76
	Feed	20	15.70	3.08
	Processed Wheat Products	38	15.89	3.32
	Other	8	17.13	4.19
	Total	114	15.76	3.44
Grand Total	Seed	24	53.50	7.16
	Grain Trade/Transport	24	46.38	10.29
	Feed	20	50.60	9.03
	Processed Wheat Products	38	49.29	8.07
	Other	8	51.00	12.60
	Total	114	49.91	9.09

Source: Author, based on survey data.

[21] Standard deviation

Table 34 shows the mean and the standard deviation values of the answers of the survey questions according to the different activity areas. The results are shown as subtotals and the grand total of the scale. As can be seen from the table, while the "Seed" group gave the most positive answers (mean value = 18.00) to the questions in the "Marketing and communication" category in the survey, the "Grain trade/transport" group gave the lowest (15.17). Similarly, the "Seed" group gave the most positive answers (19.00) to the questions in the "Infrastructure and communication" category, while the least positive answers came from the "Grain trade/transport" group (16.79). In the “Financing” question category, which shows the least positive answers among all categories, the "Other" group had the highest mean value (17.13), the "Grain trade/transport" group had the lowest (14.42). When looking at the “Grand Total” including all the question categories, it is possible to see that the "Seed" group has the highest mean value among the sector stakeholders. The "Grain trade/transport" group has the lowest mean in the “Grand Total”. The mean and the standard deviation values of the answers to the survey questions according to the different establishment sizes are presented in the Appendix A6.

5.3.5. Figures Based on Questionnaire

In this sub-section, the answers given by the sector stakeholders to the questions in the survey are examined one by one under three different question categories. The answers, which reflect the views of the sector stakeholders of the Central Anatolia Region, are presented as bar chart visuals in order to better reflect the general picture.

Marketing and Communication:

1. Quality of Wheat Produced in the Central Anatolia Region

In the wheat sector, the wheat quality required by each value chain segment differs. Wheat quality can be evaluated differently depending on the purpose of its use. For the farmer who grows the wheat, the most required specifications can be high yield and profitable varieties, while for the trader; wheat that is clean, robust, and disease-free and has a high-volume weight is required. For the miller, the quality can be evaluated by high flour efficiency and easy grinding. The baker prefers flour that is easy to knead, swells well and is suitable for the bread structure, while the biscuit producers prefer flour that is easy to knead and gives a good spread in biscuits. In the pasta and semolina industry, features such as protein ratio, semolina feature, and colour come into prominence (BIGICLI & SOYLU, 2016).

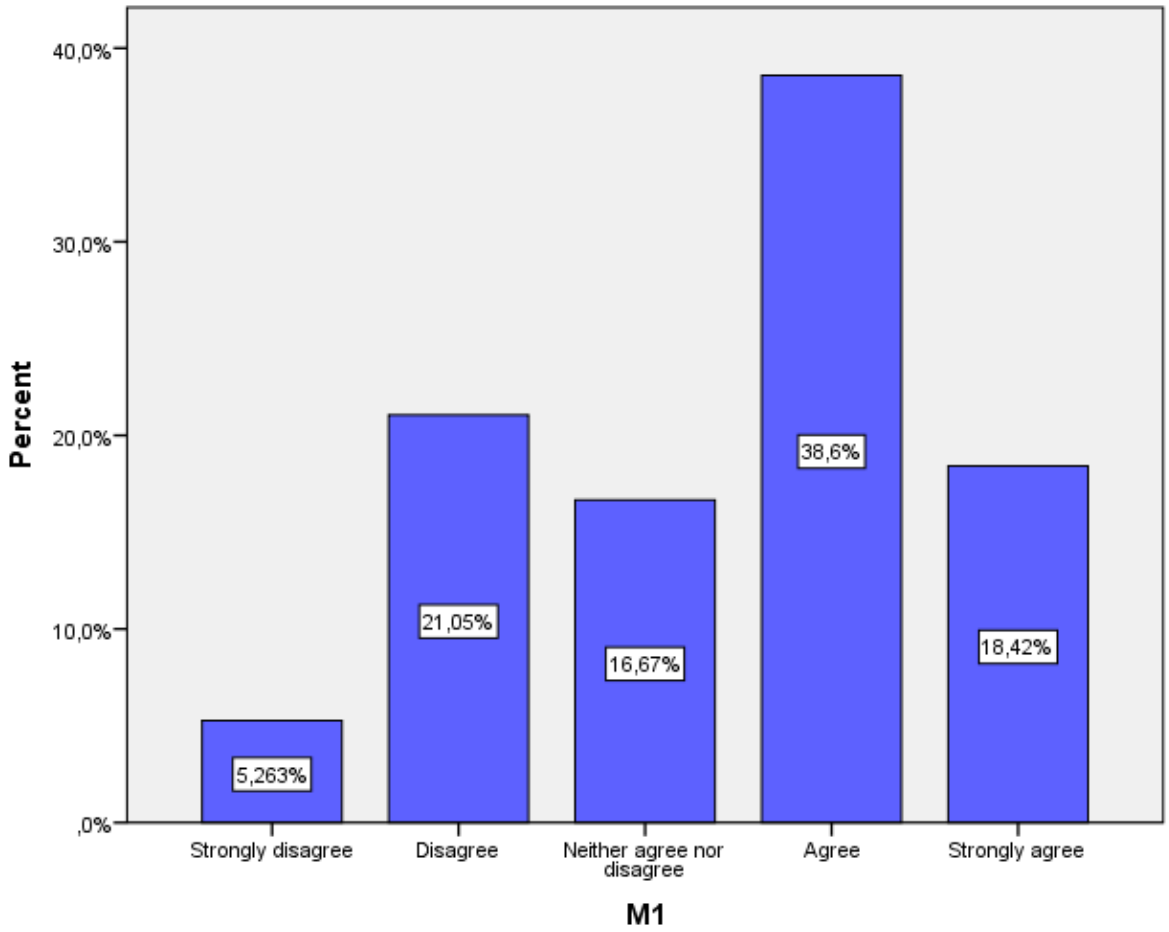


Figure 15: Distribution of the answers to the question on wheat quality

Source: Author, based on survey data.

As can be seen in the Figure 15, approximately a quarter of the stakeholders of the sector stated that the wheat produced in the Central Anatolia Region is not of the quality suitable for the needs of the sector. However, the rate of responses stating that the wheat produced in the region is suitable for the needs of the sector is around 57%.

Planting varieties which provide high quality and yield, and the application of appropriate growing techniques are necessary methods to obtain high wheat yield and quality. In addition to these methods, the protein-based purchasing system that TMO has been implementing since 2011 can be seen as an important step in solving the wheat quality problem in the sector (BILGICLI& SOYLU, 2016).

2. Access to Information

In light of information such as prices, production expectations and regulations for the sector; with producers, traders, government agencies and other value chain stakeholders direct the sector with their decisions. Therefore, access to up-to-date information on the wheat market plays an important role in the decision-making process of industry stakeholders.

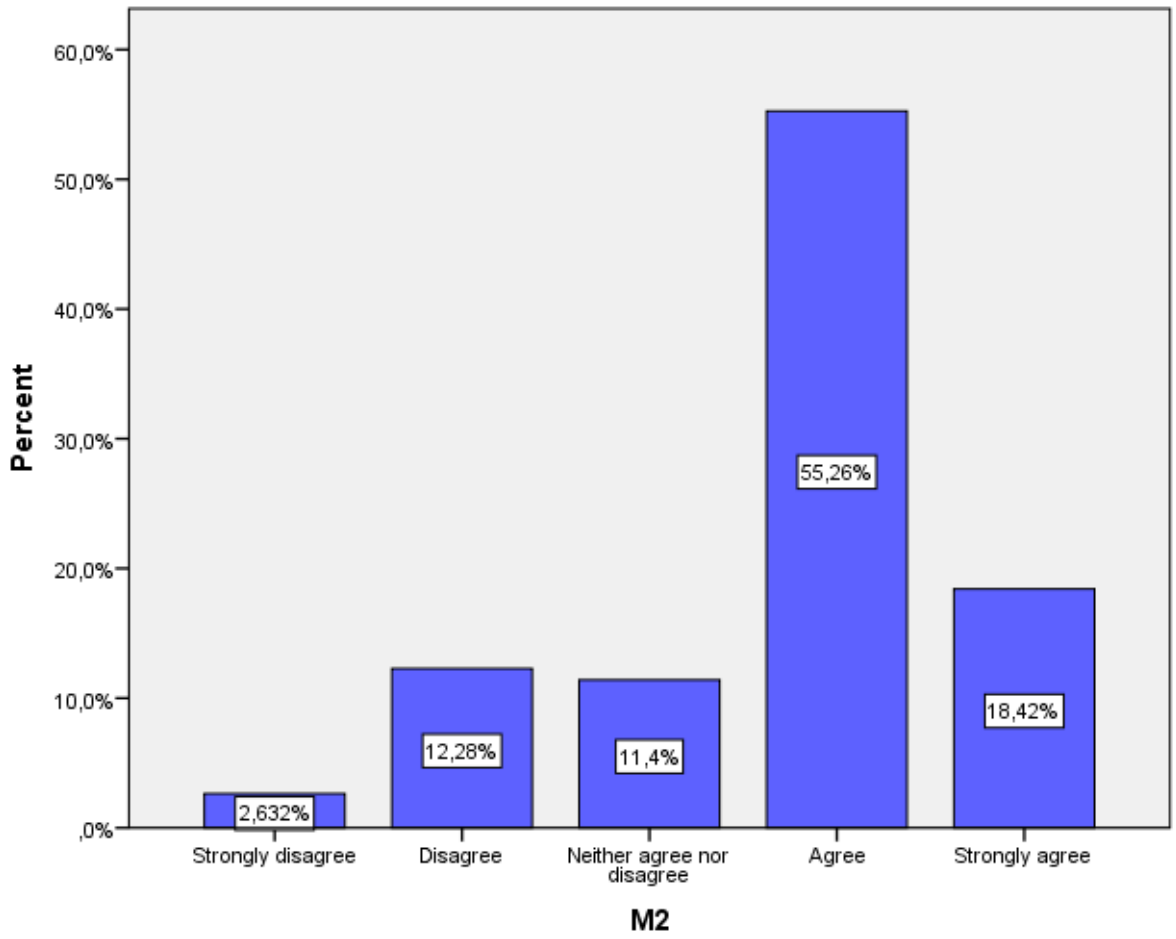


Figure 16: Distribution of the answers to the question on access to information

Source: Author, based on survey data.

Regarding the question on the easiness of access to information on developments in the wheat market, 73.6% of the stakeholders answered as either agree or strongly agree. While 14.9% of the participants responded negatively about the easiness of access to up-to-date information, 11.4% of the participants gave neither positive nor negative answers (Figure 16). The fact that the majority of the responses to the question regarding access to market information were positive can be explained by the development of communication technologies, the widespread

use of smart phones, digitalisation, and the information and reports published regularly by various organizations in the wheat market.

3. Communication within the Wheat Value Chain

Despite the positive responses about easiness of access to information in the market (73.6%), more than half (53.5%) of the market stakeholders do not find the activities and platforms where stakeholders come together in the wheat sector sufficient (Figure 17).

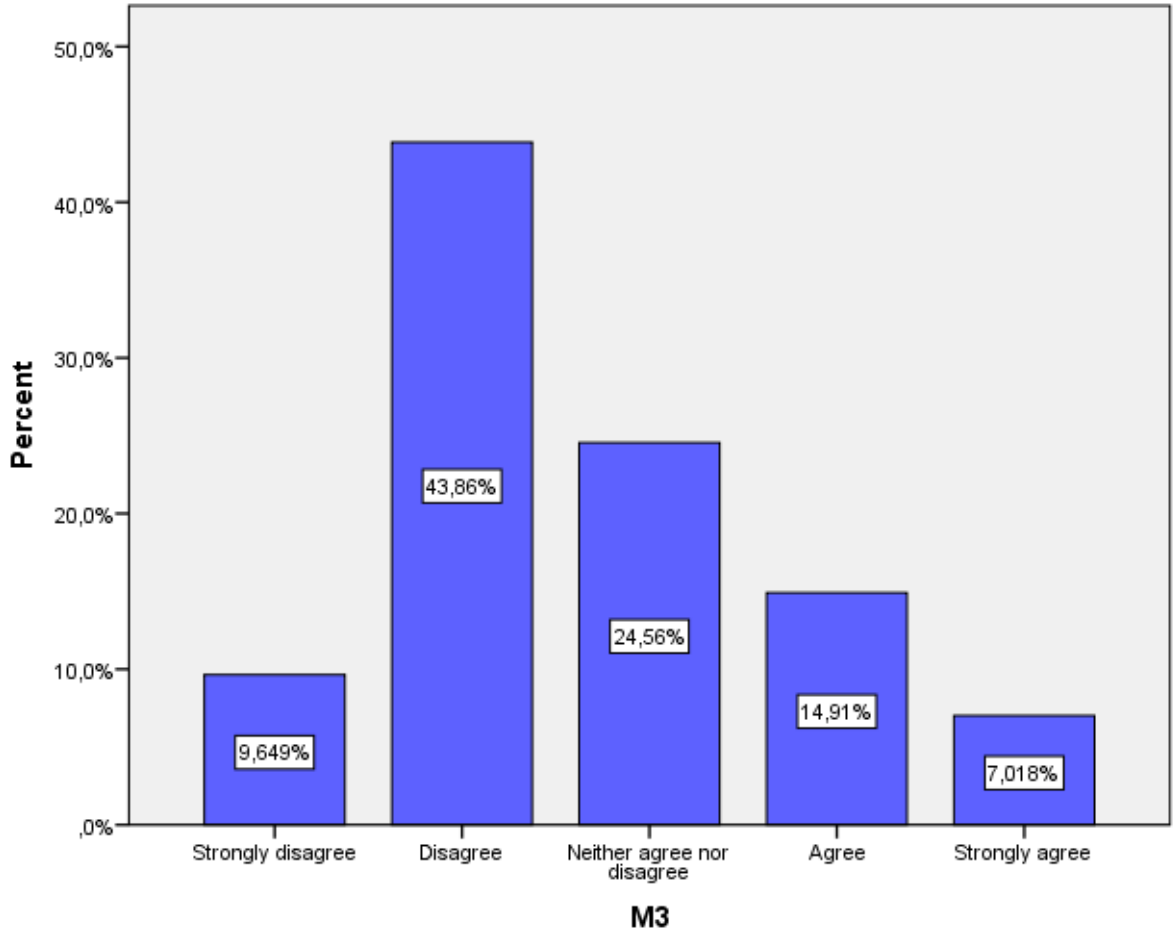


Figure 17: Distribution of the answers to the question on communication

Source: Author, based on survey data.

Multi-stakeholder platforms are useful tools to strengthen the linkages among value chain actors. With the latest technological developments, utilisations of mobile and web-based platforms are also being scaled up. In the value chain context, electronic and digital platforms developed by various enterprises enable value chain actors to connect. There are two types of linkages these platforms provide which facilitate business transactions and flow of information: (i) Platforms enabling backward links: These are platforms that offer farmers the ability to connect with other

producers, input providers, non-governmental organizations, public institutions, extension agents and finance sources about information on production-related matters. (ii) Platforms enabling forward linkages: These are platforms that offer connection with other value chain actors (processors, quality assessment certifiers etc.) to improve the value of products after harvest (TINSLEY & AGAPITOVA, 2018).

4. Smallholder Participation in the Value Chain

Turkey is self-sufficient with most agricultural products, however, agricultural holdings are generally small in scale in the country and this situation affects productivity. While the average agricultural holding size in Turkey is 6.5 ha, this figure is 15.8 ha for the European Union (VAN LEEUWEN et al., 2011). In some major wheat producer/exporter countries such as the Russian Federation and the USA, the average farm size are 19 hectares and 162 hectares, respectively[22] (LERMAN & SEDIK, 2013).

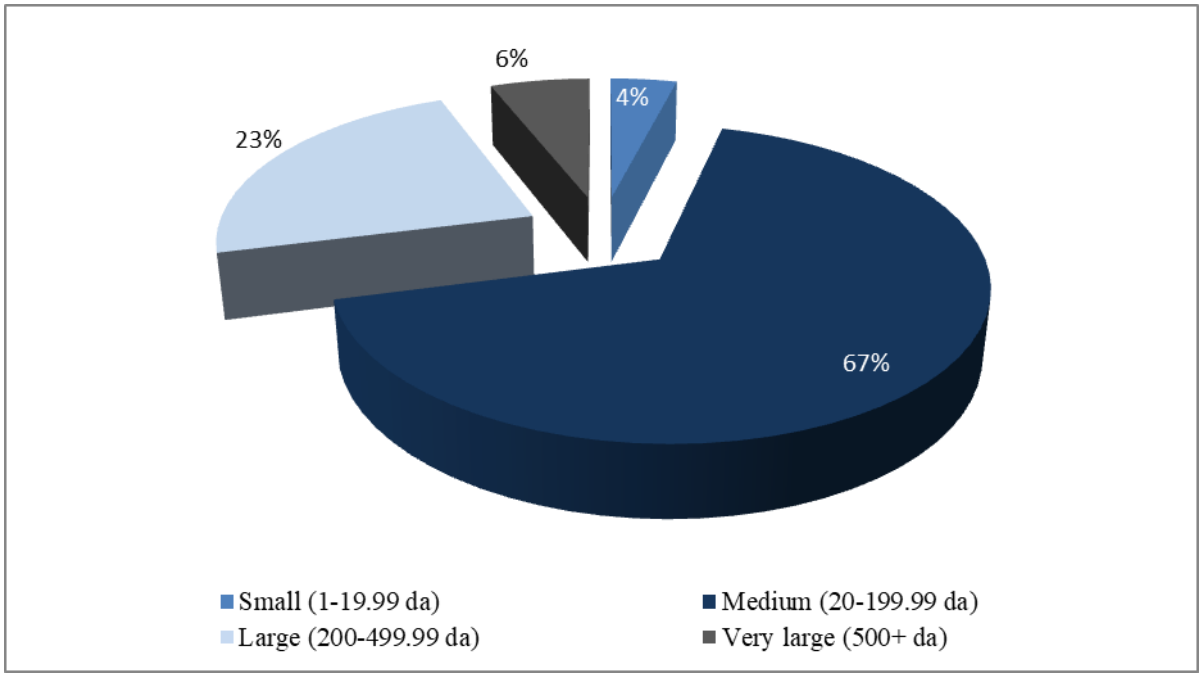


Figure 18: Types of farms in the Central Anatolia Region

Source: Author, (UNAL, 2008) based on Quantitative Household Survey[23] data.

[22] Based on agricultural census data from Russia and survey data from the United States (LERMAN & SEDIK, 2013).

[23] QHS. 2002. Quantitative Household Survey. Ankara: Ministry of Agriculture, ARIP office.

Considering the average farm size on the basis of regions, the region with the lowest share of small-scale farms among all regions was the Central Anatolia Region, while the region with the highest share of small-scale farms was the Black Sea Region. In the Central Anatolia Region 67% of the farms was medium scale while 23% were large-scale (Figure 18). The share of very large-scale farms in the region was only 6% (UNAL, 2008).

Land consolidation works started to be implemented in Turkey in 1961 in order to alleviate land fragmentation and increase efficiency in agricultural production, and to ensure rural development. Land fragmentation causes low productivity and prevents some advantages of modern agriculture, and therefore, results in increased costs and a decrease in production (SAYILAN, 2014).

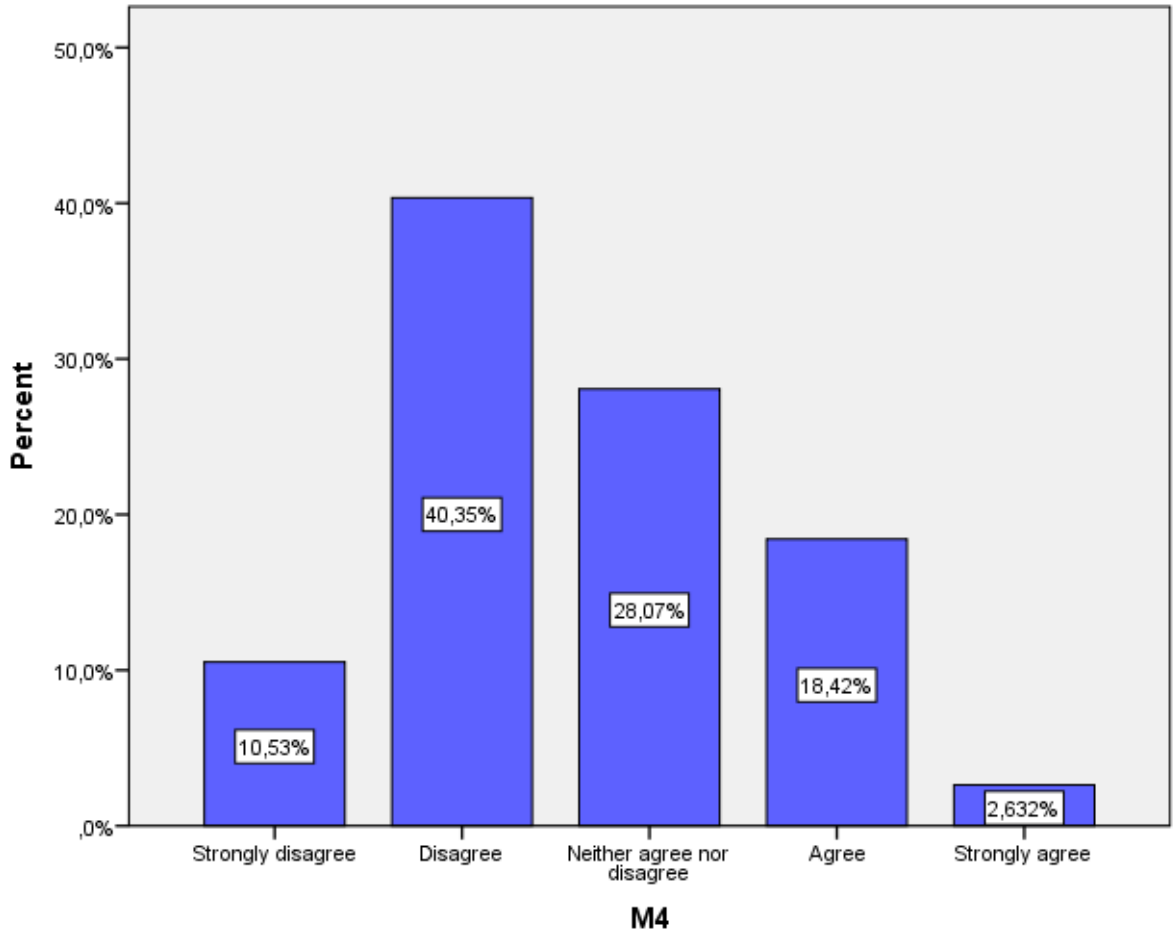


Figure 19: Distribution of the answers to the question on smallholder participation

Source: Author, based on survey data.

As can be seen from the Figure 19, 50.9% of the respondents disagreed or strongly disagreed in their answer to the question whether smallholder participation in the wheat value chain in the Central Anatolia Region is sufficient. Results also indicated that around 21% of the participants expressed that smallholder participation is sufficient in the wheat value chain.

HANF & GAGALYUK (2018) highlighted two major challenges that small-scale producers face in the value chain. The first is that their supply quantities insufficient. The second is that they can not meet the quality requirements sufficiently. Therefore, these two obstacles should be taken into account in policies being developed for the integration of small-scale producers into the value chain.

5. Certified Seed Usage

Input supply constitutes the first stage of many agricultural value chains. Similar with other agricultural crops, seed is a critical input in wheat production as it has a significant effect on the final product. The seed sector in Turkey, which was mostly under state control before 1980, has developed over time and has been restructured with various laws implemented in the 2000s (BAGCI & YILMAZ, 2016). Especially in the last decade, the certified seed market in Turkey has shown considerable development. Certified seed production in Turkey grew significantly between 2000 and 2017, reaching around 1 million tons. Wheat, barley, corn and potato seeds were the leading products in certified seed production. Seed export in Turkey grew by 5.5 times in the period 2002-2017, to 44 thousand 353 tons as of 2017, and seed imports increased by 2 times to 39 thousand 294 tons (TAGEM, 2018).

Considering the above-mentioned developments in the market, the question was asked to sector stakeholders whether the increase in the use of certified seeds positively affect the quality and yield of wheat. As can be seen from Figure 20, the majority of organizations (82%) participating in the survey found the increase in the use of certified seeds positive for the yield and quality of wheat. The percentage of disagree or totally disagree is only 8.7%, while percentage of neither agree nor disagree is 8.8%.

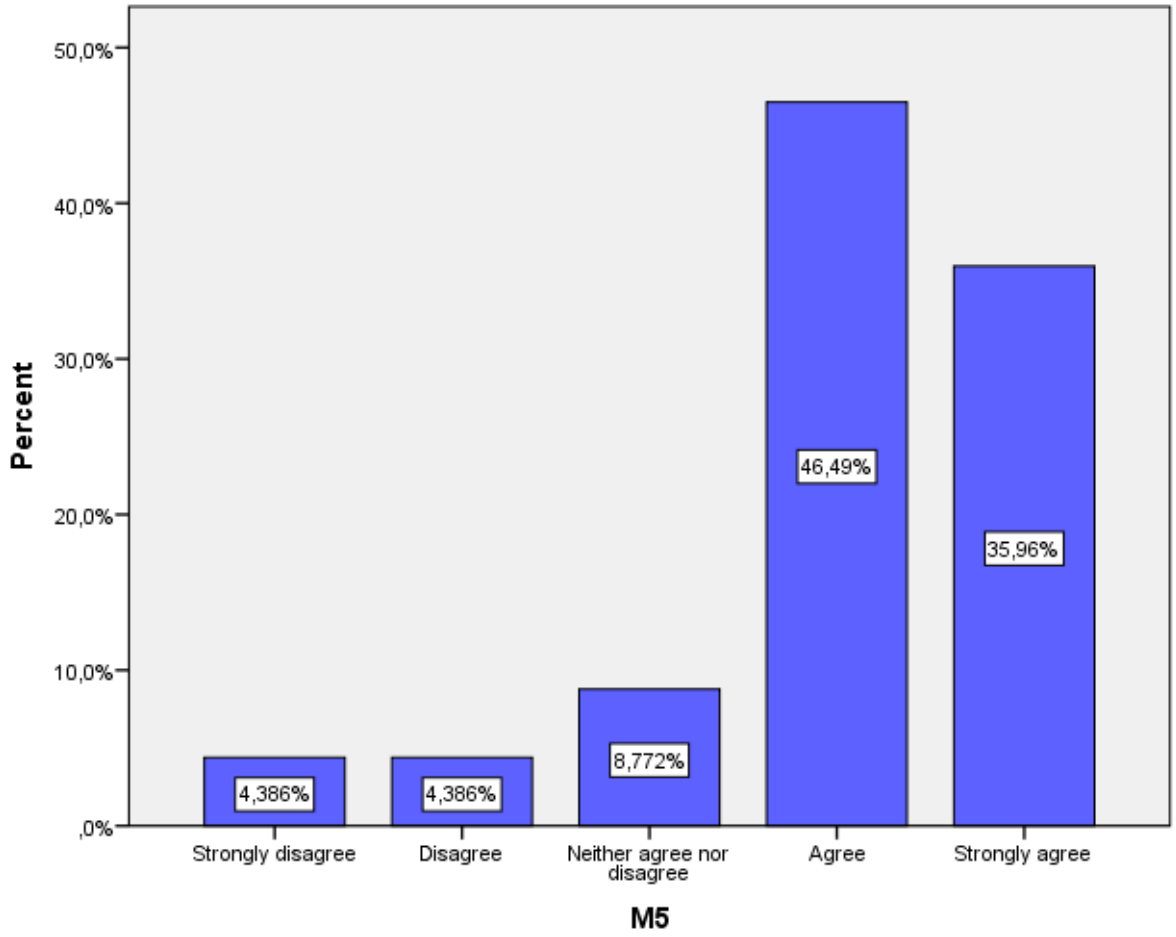


Figure 20: Distribution of the answers to the question on certified seed usage

Source: Author, based on survey data.

State support policies have a significant impact on the use of certified seeds. In 2009, certified seed support for wheat was 5 TL per decare, and it was increased to 8.5 TL per decare in 2018. According to a study conducted in Ankara province, which is located in the Central Anatolia Region, the certified wheat seed adoption rate was 58.7%. While 90.6% of producers expressed that seed support was insufficient, 88.7% of them stated that seed prices were high. In the same study, it was found that certified seed support has an impact on quality seed use, causes mitigation in production costs and a rise in the value of gross production (CEVHER & ALTUNKAYNAK, 2019).

Infrastructure and Technology:

1. Grain Storage and Preservation

In an agricultural value chain, the stages after the harvest are as important as the production phase. After harvest, wheat needs to be properly stored and preserved. Inadequate grain storage and preservation infrastructure prevent efficient use of resources and the well-functioning of the value chain. Grain storage is a critical issue especially for small scale producers. Producers who do not have sufficient storage facilities may try to sell the harvested product as soon as possible. This may adversely affect the incomes of the producers as the supply is abundant right after the harvest and the prices are relatively low.

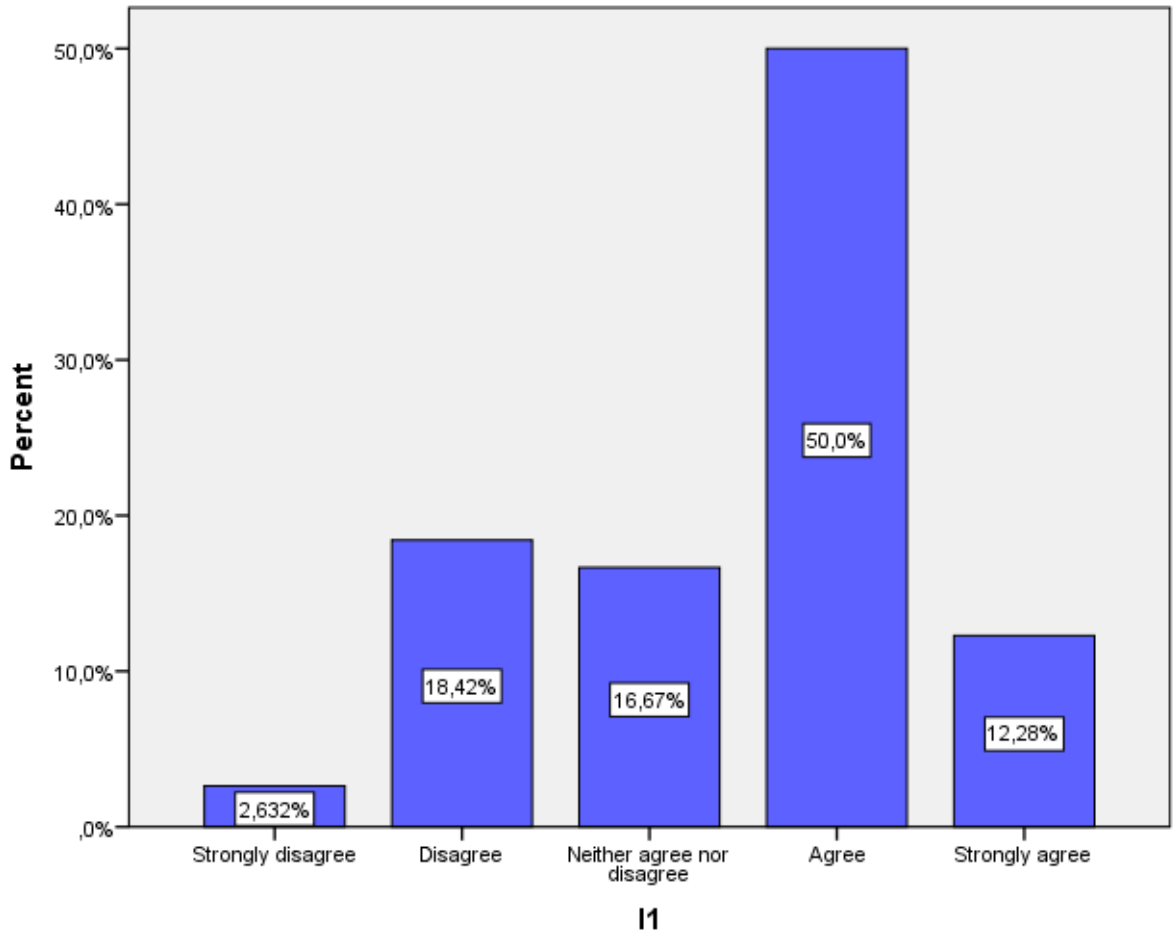


Figure 21: Distribution of the answers to the question on grain storage

Source: Author, based on survey data.

Grain storage capacity differs in each region. For this reason, it was investigated whether the grain storage infrastructure in the Central Anatolia Region was found sufficient by sector stakeholders. Figure 21 shows that 62.3% of the participants agreed/strongly agreed to the statement that the grain storage/preservation facilities are sufficient in the Central Anatolia

Region, while 21% of the participants stated that they disagreed/strongly disagreed to the statement.

As of 2018, grain storage capacity in Turkey is approximately 24.5 million tons. While 20.2 million tons of the storage capacity belongs to the private sector, the remaining 4.3 million tons belongs to the TMO (Turkish Grain Board, 2018). Considering that annual wheat production alone is approximately 20 million tons, storage problems become more explicit, especially in times of abundant supply. Several regulations have been made on the storage of agricultural products in the last decades in Turkey. In terms of efficient use of resources, obtaining maximum benefit from the crop produced, and reducing waste in the value chain, the development of storage and preservation facilities greatly contributes to the sector.

2. Licensed Warehousing System

In Turkey the Licensed Warehousing Law of Agricultural Products was accepted in 2005. Licensed warehousing is a system that provides storage for agricultural products under certain standards and allows their trading through warehouse receipts representing product ownership. There are various advantages of this system for the wheat industry, such as providing storage opportunity to the producers, ensuring storage of agricultural products under qualified conditions, giving producers the opportunity to sell their product whenever they want, and the possibility of receiving loans in return for warehouse receipts.

Due to its significant effect on the wheat sector, stakeholders in the value chain were asked whether they found the Licensed Warehousing System beneficial for the development of the sector. The results (Figure 22) showed that, more than 70% of the participants agreed/strongly agreed that the Licensed Warehousing System is beneficial for the development of the wheat sector, while approximately 18% of the participants disagreed/strongly disagreed to the statement.

In addition to these, it is worth noting that, according to a survey on licensed warehousing in wheat sector conducted in Turkey, approximately 30% of participants stated that they did not have sufficient information as their reason for not using licensed warehousing. The results from the same research showed that the other major reasons for not using licensed warehousing were lack of licenced warehousing service in the region (18.3%) and finding incentives insufficient (15.1%) (KAYA, 2017).

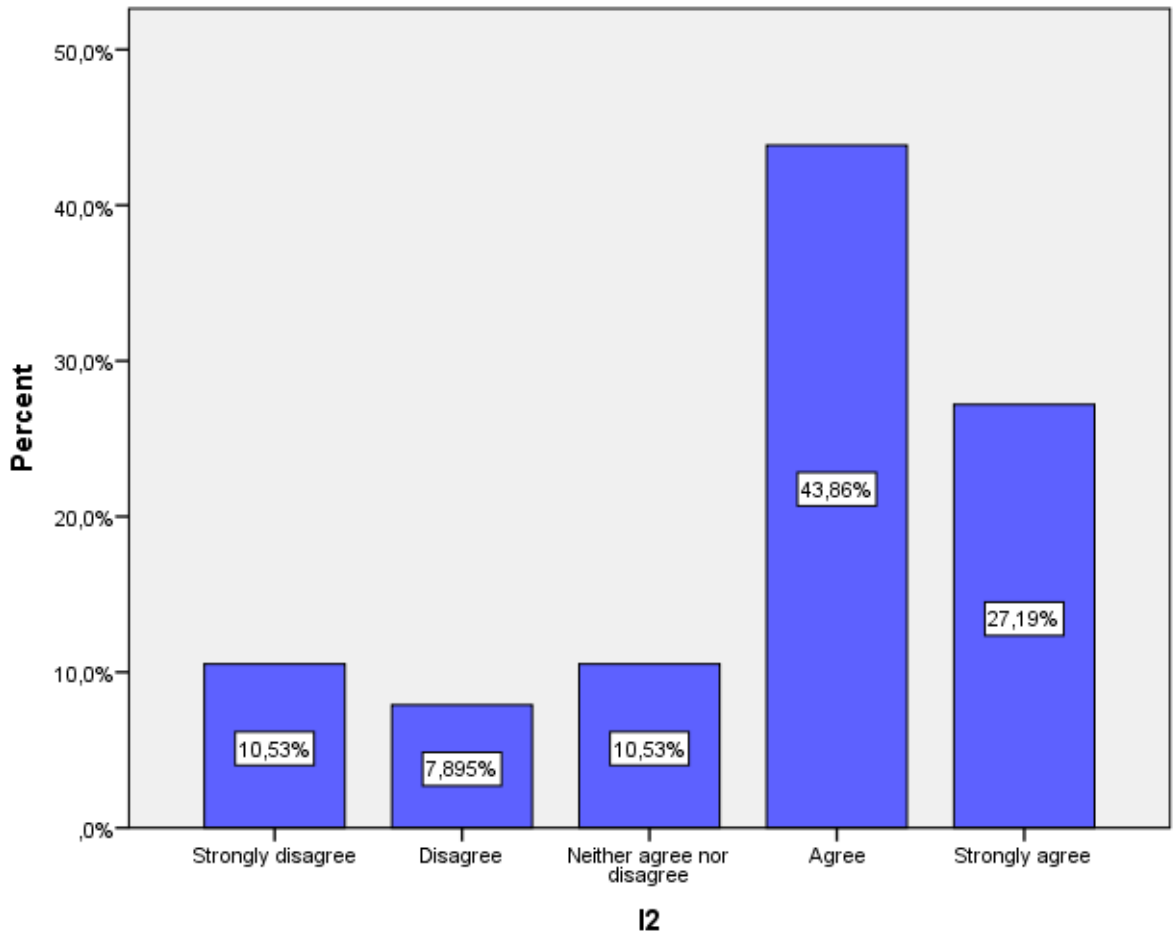


Figure 22: Distribution of the answers to the question on licenced warehousing

Source: Author, based on survey data.

3. Logistics Infrastructure

When asked whether the logistics infrastructure used for wheat supply in the Central Anatolia Region is sufficient, 58.8% of the participants answered that the logistics infrastructure is sufficient. While 20% of the sector stakeholders stated that the logistics infrastructure in the region was insufficient, the percentage of those who answered the question "neither agree nor disagree" was around 21% (Figure 23).

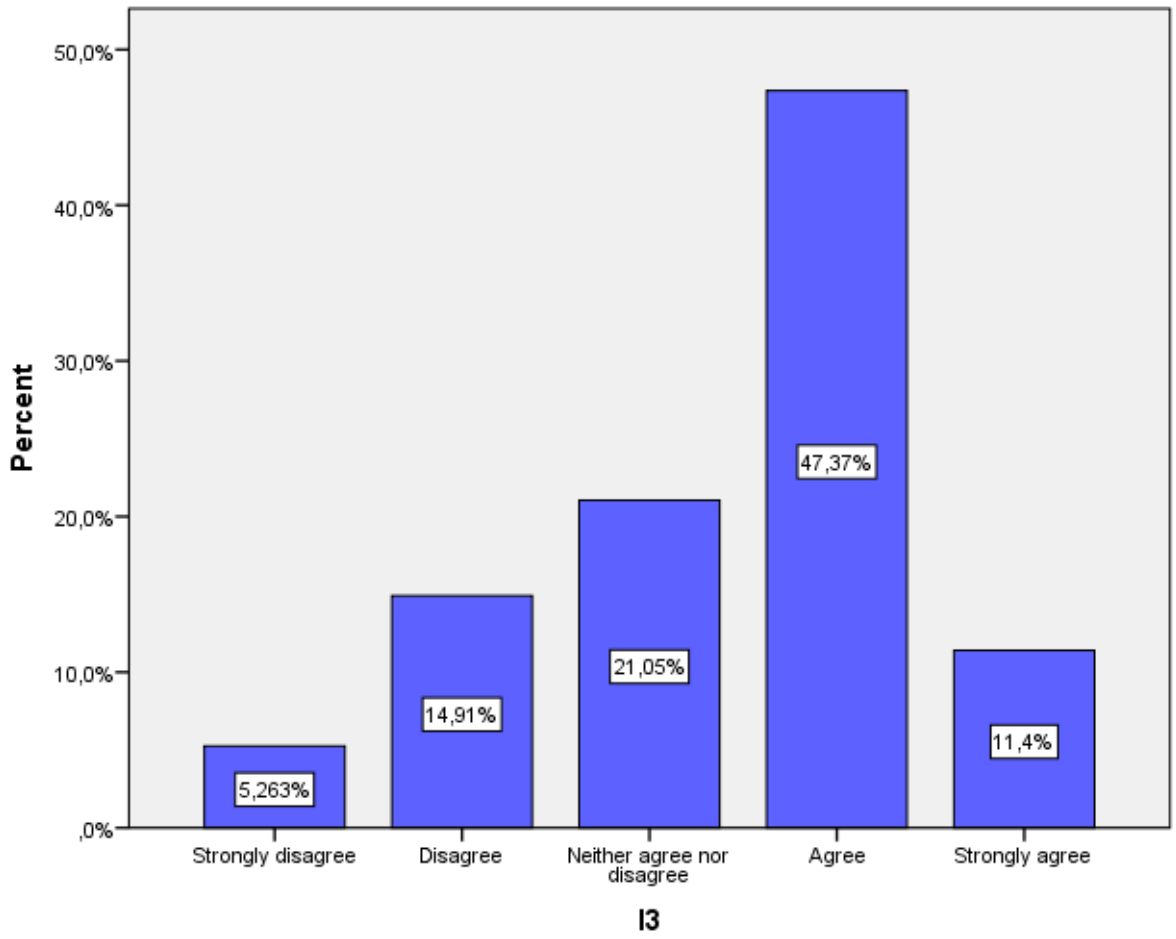


Figure 23: Distribution of the answers to the question on logistics

Source: Author, based on survey data.

4. Technologies and Equipment Used in Wheat Production and Processing

The research results showed that 61% of the Central Anatolia Region sector stakeholders agreed/strongly agreed with the statement that existing technology and equipment used in the production of wheat and wheat processing in the Central Anatolia Region are sufficient. While 23% of the participants stated that existing technology and equipment is not sufficient, 16% of respondents answered neither positively nor negatively (Figure 24).

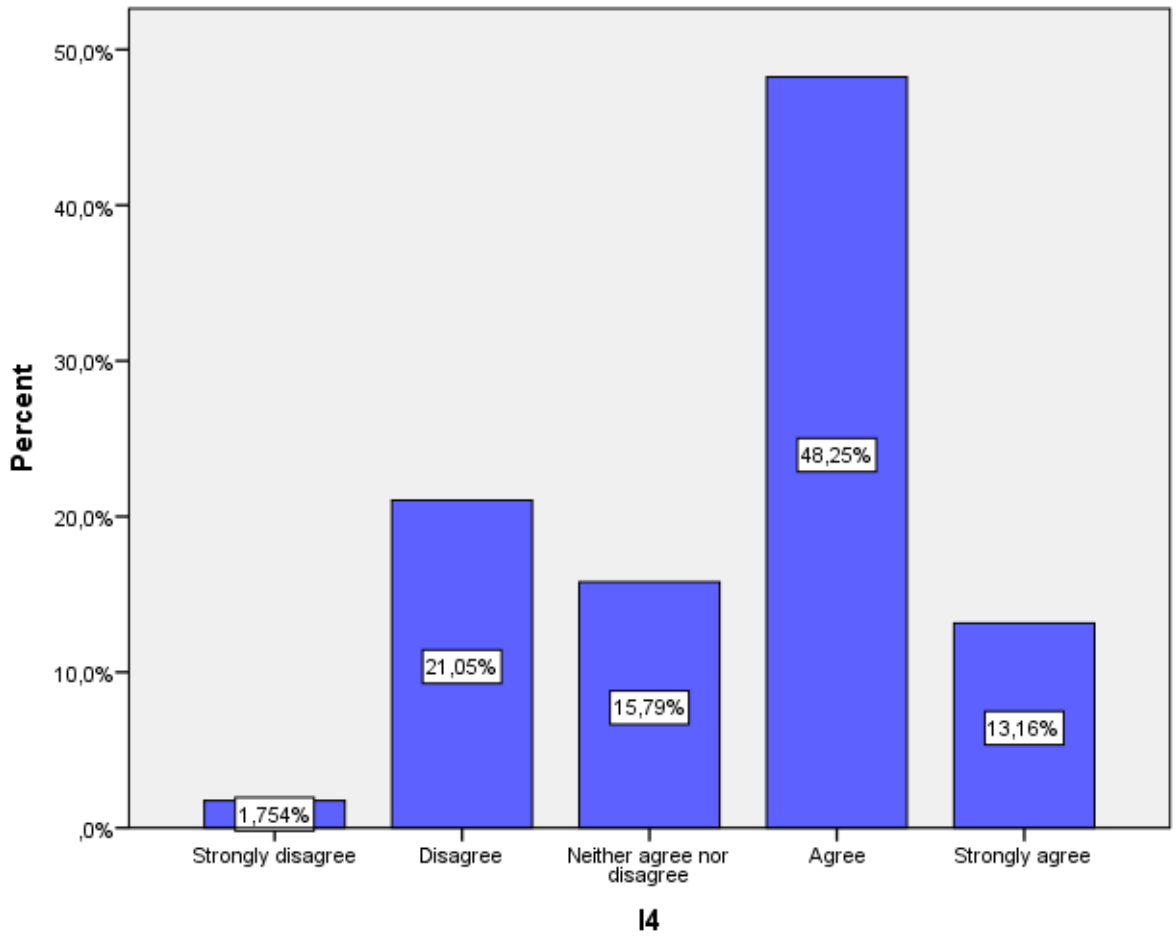


Figure 24: Distribution of the answers to the question on technology

Source: Author, based on survey data.

Agricultural mechanization, which varies according to the development levels of countries, may also differ depending on the regions of a country. One of the most commonly used tools in agriculture is the tractor. For this reason, the most important measure of the agricultural mechanization level of an area is the tractor power (kW/ha) per planting area. According to data from the 2001-2004 period, the mechanisation level of the Central Anatolia Region was the highest among all regions in terms of quantity of equipment per tractor (equipment/tractor) and the 5th among all regions in terms of tractor power per planting area (KOCTURK & AVCIOGLU, 2007).

A more recent study revealed that the level of agricultural mechanization in the region increased during the 2005-2014 period[24]. Comparing 2005 and 2014, the mechanization indicators were as follows, respectively: tractor power per planted area 1.76 and 2.18 kW/ha, average tractor power 39.32 and 40.38 kW, number of tractors per 1000 ha area were 44.66 and 53.90 (SAGLAM & KUS, 2016).

5. Impact of Seasonality and Land Structure

Besides many factors ranging from inputs to accessing necessary financing, factors that are difficult to control such as weather conditions and land structure also have an impact on agricultural production. Sector stakeholders were asked whether production and price fluctuations in the wheat market were largely based on difficult-to-control factors such as weather conditions and land structure. Approximately 61% of respondents stated that seasonal fluctuations in production and prices were largely due to factors like weather conditions and land structure, while around a quarter of the participants stated that they did not agree with the said statement (Figure 25).

Just as climate has an effect of on production in agriculture, agricultural production also significantly affects on climate in the long term. Therefore, it can be said that there is a cyclical relationship between agricultural production and climate. From this point of view, an environmentally friendly approach stands out in reducing the negative effects of environmental factors on agricultural production. Climate change poses a great threat to crop production, with several negative effects such as as high temperature, drought and a decrease in rainfall. Since approximately 75% of the agricultural land in Turkey is dry farmed, rainfall is of great importance for crop production.

[24] The study included Aksaray, Kırşehir, Kayseri, Niğde, Sivas, Yozgat, Nevşehir, and Kırıkkale provinces.

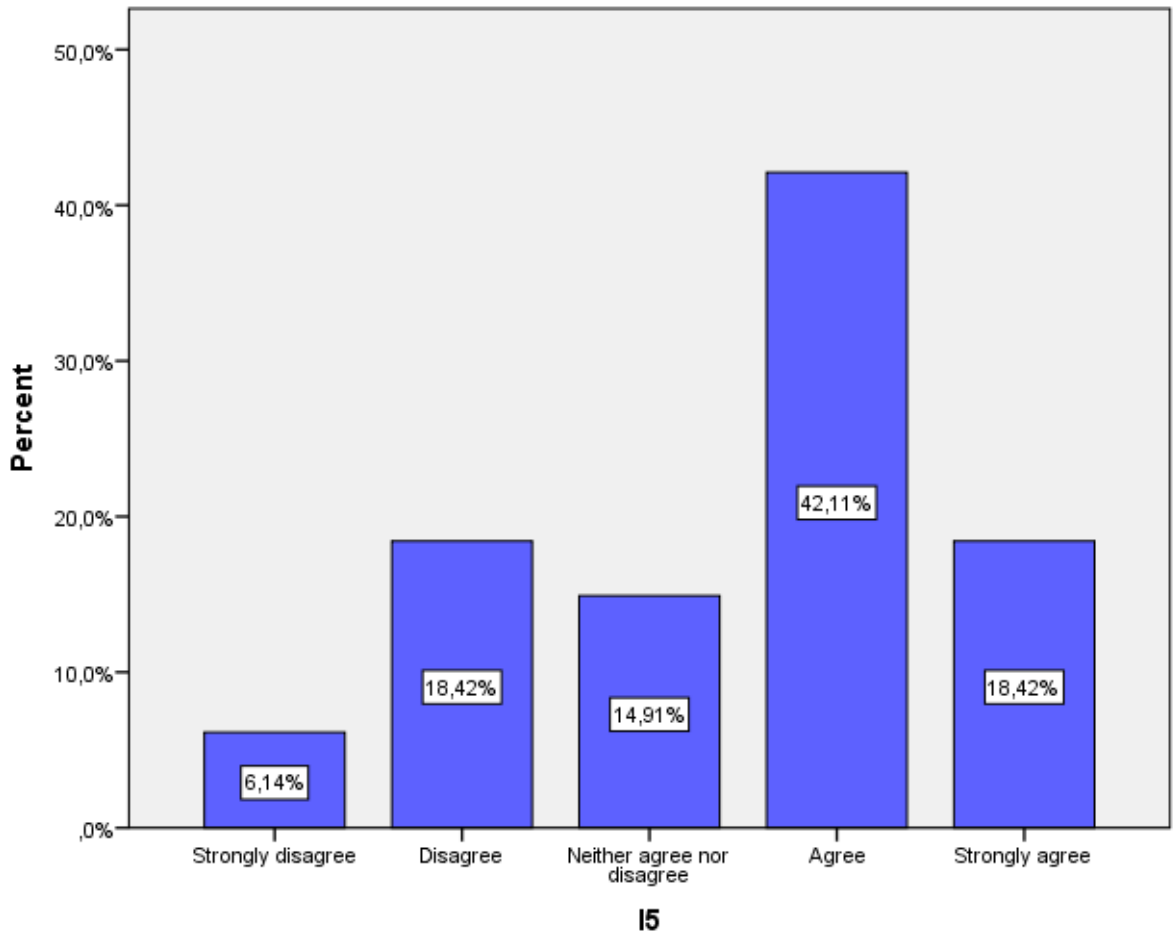


Figure 25: Distribution of the answers to the question on seasonality

Source: Author, based on survey data.

Different regions of Turkey are expected to be affected by climate change in different ways. Due to climate change, the highest temperature increase forecasts for 2050 are expected in the Central Anatolia Region, with a 4.1°C increase in July and August. As a result of the estimated change in temperature and rainfall, it is predicted that the average yields of wheat, barley, corn, sunflower and cotton, which constitute approximately 85% of the cultivated agricultural areas in the country, will decrease by 7.6%, 7.6%, 10.1%, 6.3% and 3.8%, respectively. It is also predicted that the cultivation area and yield changes due to climate change will affect foreign trade, wheat exports will decrease, and price of wheat will increase by 6.3% (Ministry of Development, 2018). Considering all these, it is crucial that the policies to be developed for agriculture should be long-term, sustainable and prioritize the environment.

Financing:

1. Access to Financing

Financing is one of the main elements of agricultural development, as well as sustainability in agriculture. The financing needs of each actor in the agricultural value chain are different:

- Lack of finance may prevent farmers' access to the elements necessary for production, such as seeds, labour or equipment
- For traders, lack of financing can prevent them from paying cash to buy the crop, resulting in the producer selling their product to another buyer
- Small-scale processors face difficulties in expanding their operations when they have financing problems
- Wholesalers may act as a bank for other actors in the chain, providing cash to trustworthy traders to buy crops on their behalf or providing products on credit to retailers (so that the retailer pays after selling the goods). Therefore, in the value chain, wholesalers generally need more capital than traders (KIT & IIRR, 2010).

Since any constraint that may arise in financing will prevent the effective functioning of the value chain, wheat industry stakeholders operating in different fields were asked whether it is easy to access financing resources in the sector. While 29% of the establishments participating in the survey stated that access to financing resources is not easy in the sector, approximately the same proportion of participants replied as neither agree nor disagree. On the other hand, 35% of participants agreed with the statement that access to financial resources is easy, and around 7% of them answered as "strongly agree" (Figure 26).

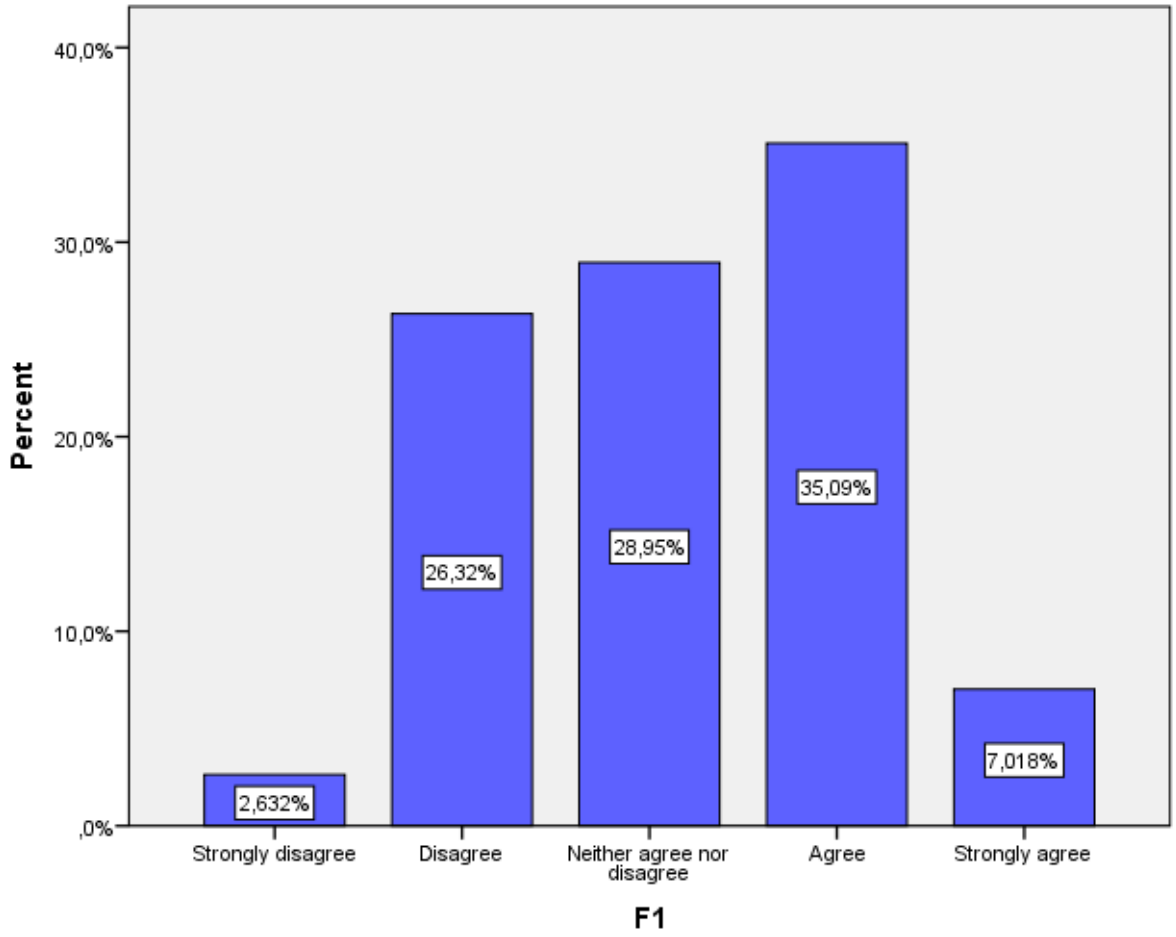


Figure 26: Distribution of the answers to the question on access to financing

Source: Author, based on survey data.

2. State Support

During the last decade, state support for the wheat market in Turkey has followed an increasing trend (see Table 10 in section 3.5.5.). Around 44% of the sector stakeholders participating in the survey stated that state support for the wheat sector is insufficient. On the other hand, while 26% of the answers stated that state support was sufficient, 5% of the participants strongly agreed to the said statement (Figure 27).

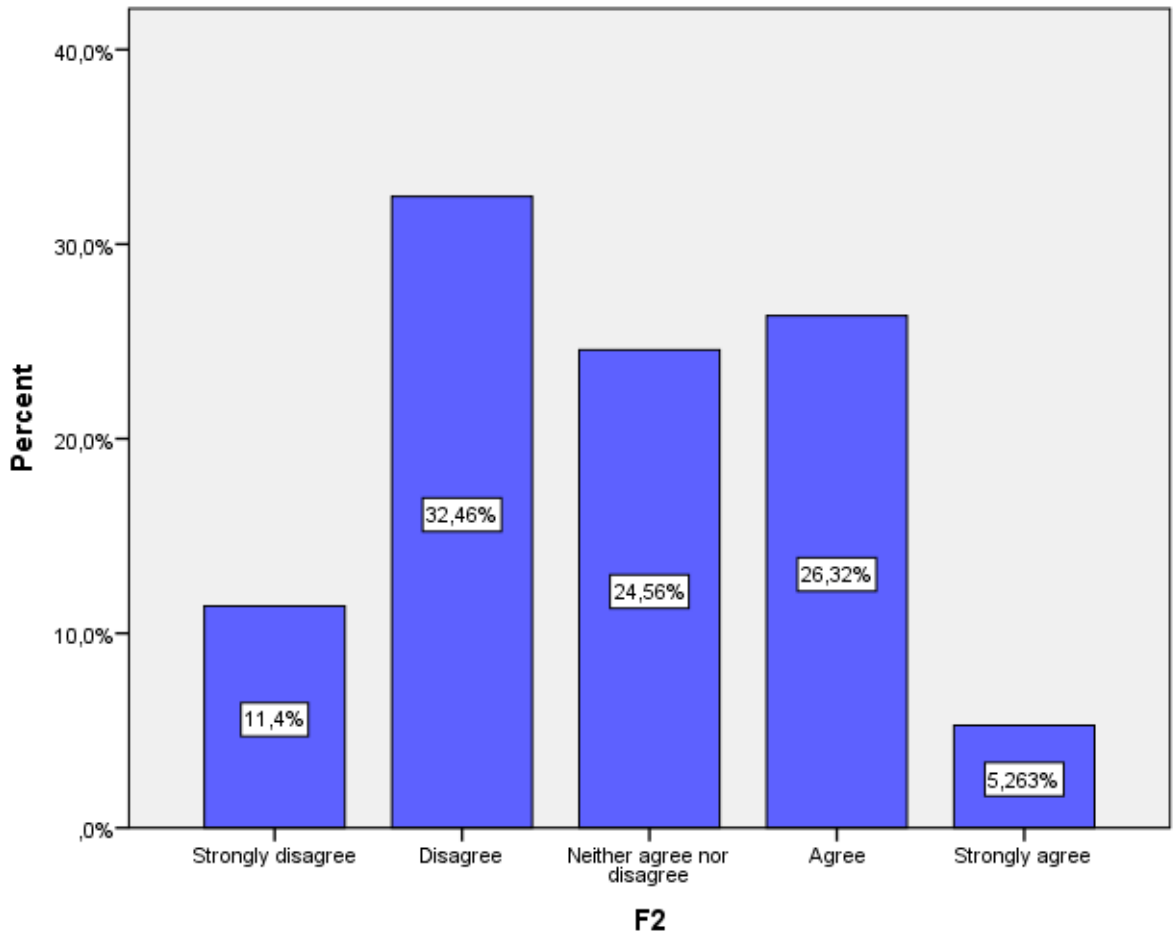


Figure 27: Distribution of the answers to the question on state support

Source: Author, based on survey data.

Comparing agricultural support[25] in the leading countries of the grain industry (USA, Russian Federation and EU-28), it can be observed that Turkey has the highest total support estimate to agriculture, which was 1.7% of GDP in 2016-2018 period while the OECD average was 0.6 in the same period. In the United States, total support to agriculture was around 0.5% of GDP in 2016-18, while in the European Union total support to agriculture as a share of GDP has declined significantly over time (0.7% in 2016-2018 period), as well as the share of the agricultural sector in the economy. In the Russian Federation, which has an important share in Turkey's wheat import, total support to agriculture was 0.8% of GDP in 2016-18 (OECD, 2019).

[25] Total Support Estimate (TSE).

3. Basin-based Support System

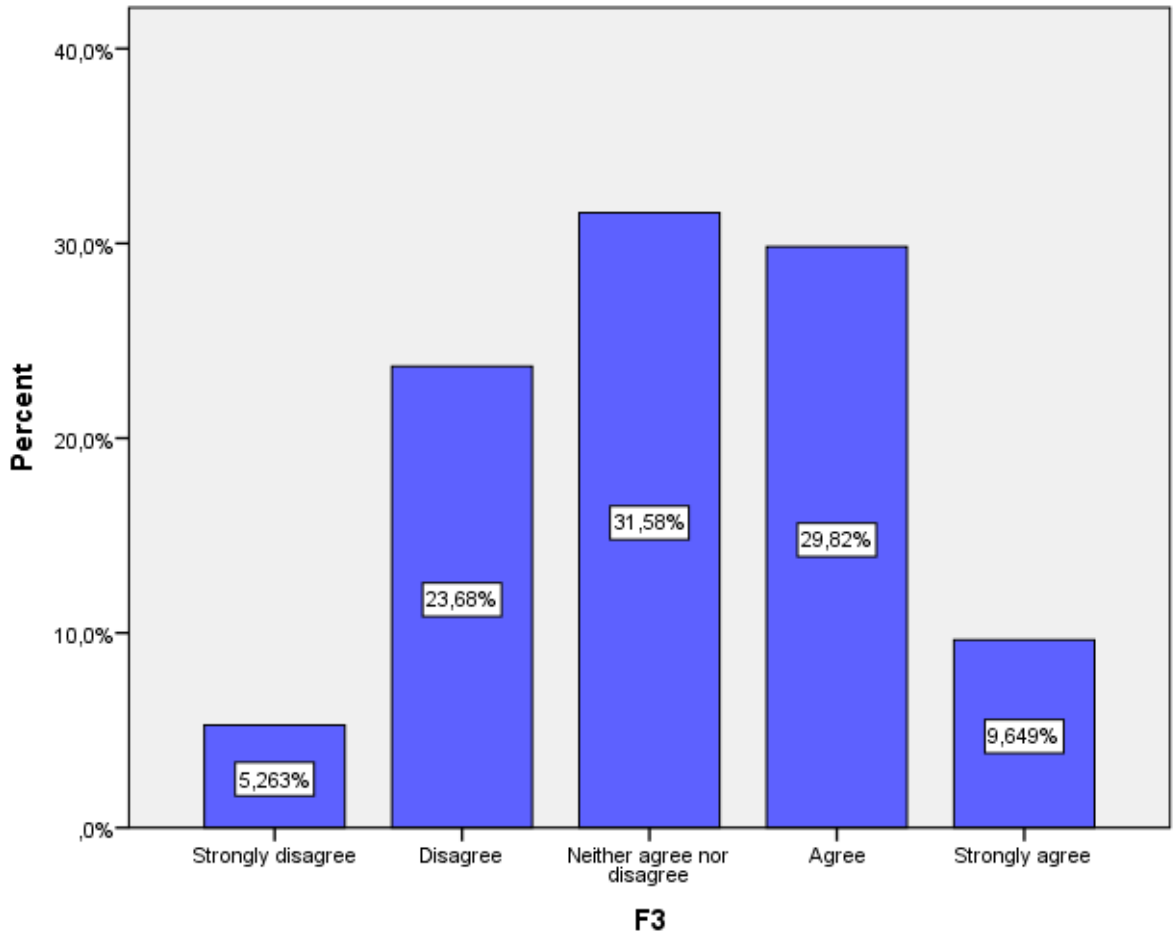


Figure 28: Distribution of the answers to the question on basin based support

Source: Author, based on survey data.

As mentioned in detail in the previous sections (see Chapter 3.4.2.) 21 different products including wheat are supported on a basin basis in Turkey. In the basin-based support model, wheat production is supported in all 13 provinces in the Central Anatolia Region. Considering that this system has been implemented since 2017 and covers all the provinces in the region for wheat, sector stakeholders were asked if the basin-based support system contributed positively to the wheat market in the Central Anatolia Region. Approximately 39% of the participating sector stakeholders agreed with the statement, while a total of 29% disagreed or strongly disagreed. On the other hand, 32% of participants neither agreed nor disagreed to the statement (Figure 28).

4. Licensed Warehousing and Finance

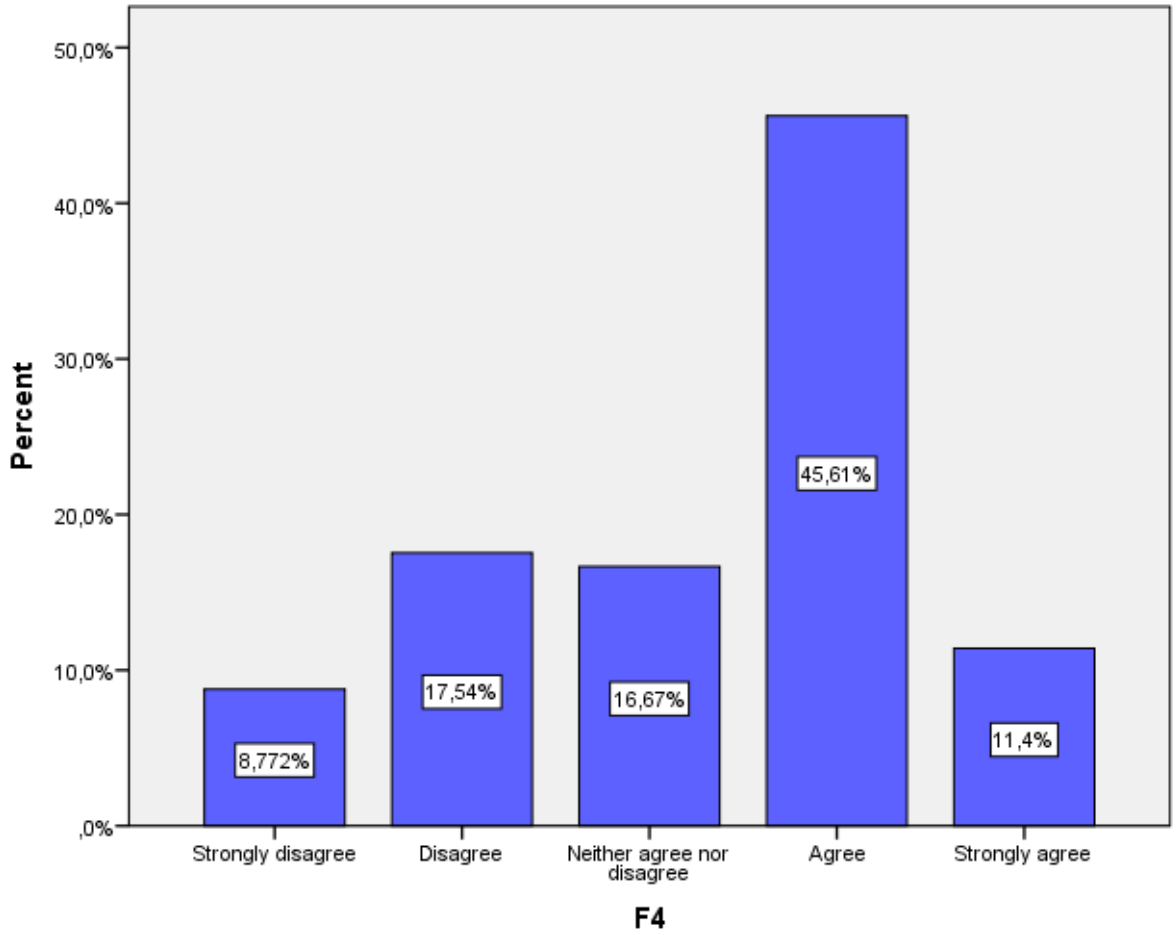


Figure 29: Distribution of the answers to the question on licensed warehousing and finance

Source: Author, based on survey data.

Warehouse receipts obtained by the producers by delivering their product to licensed warehouses can be exchanged in commodity exhanges, endorsed or used as collateral in loan transactions (KAYA, 2017). For this reason, the producers were asked whether licensed warehousing services are an effective alternative in financing wheat production. As can be seen from the Figure 29, 57% of the participants agreed/strongly agreed that licensed warehousing services are an effective alternative in financing wheat production. Around 26% of participants disagreed/strongly disagreed while 17% of them neither agreed nor disagreed.

5. Futures Exchange

Konya, Polatlı and Eskişehir commodity exchanges are among the most prominent commodity exchanges operating in the Central Anatolia Region where wheat is traded. The survey participants were asked whether developments in the futures exchanges had a positive effect on the income of wheat sector stakeholders. While 10% of the respondents "strongly agreed" to the statement that developments in futures exchanges have a positive effect on the incomes of the sector stakeholders, 39% "agreed" to the statement. On the other hand, 25% of the sector stakeholders responded as disagreed/strongly disagreed to the said statement, 26% responded neither agreed nor disagreed (Figure 30).

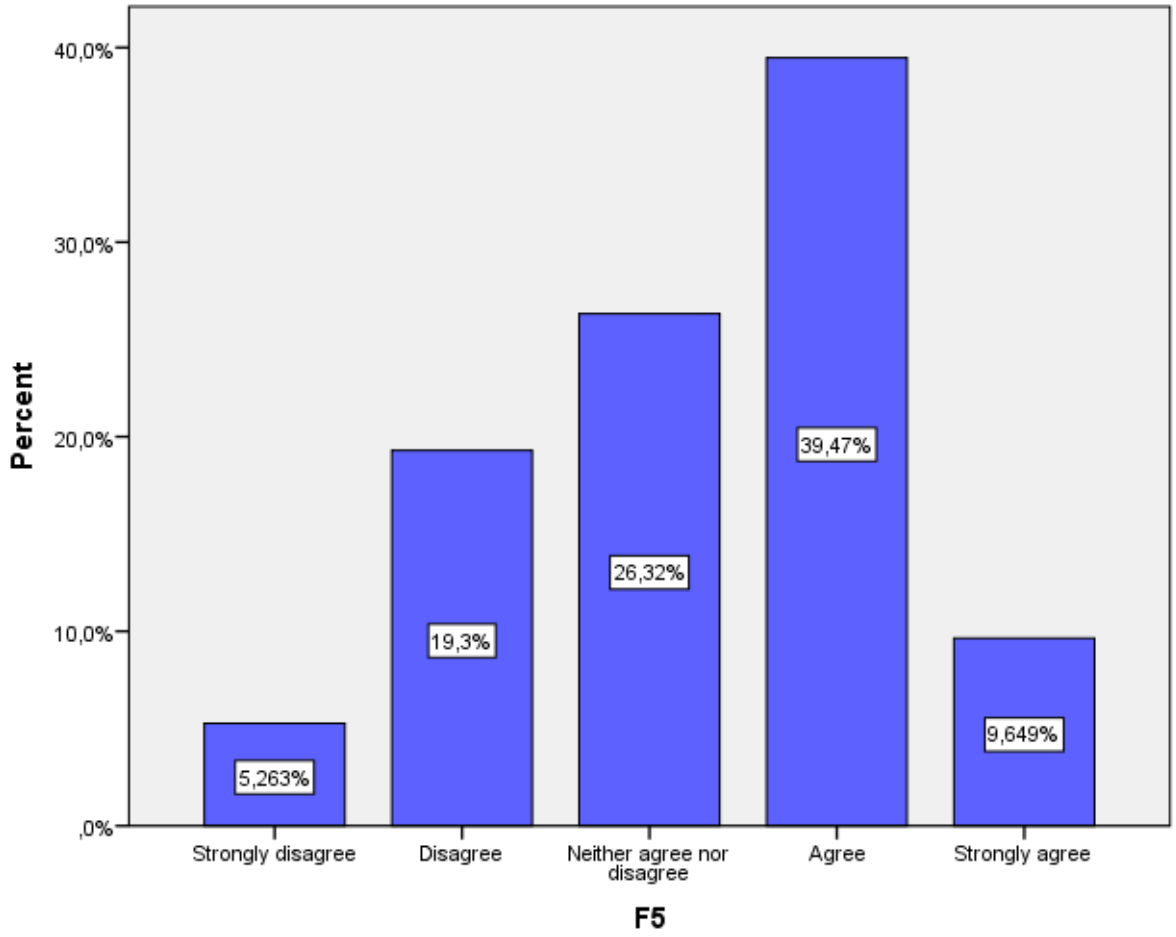


Figure 30: Distribution of the answers to the question on futures exchanges

Source: Author, based on survey data.

6. CONCLUSIONS AND RECOMMENDATIONS

This chapter of the study presents a summary of the research, conclusions and recommendations based on the obtained results from analyses. The chapter highlights findings that were determined in line with the questions in the study. The main purpose of this study is to analyze the wheat value chain in Turkey in detail, and to reveal the major bottlenecks in the value chain and also to examine where the development opportunities exist, in line with the research results. As examined in detail in the previous chapters, the analysis was carried out in three stages to find answers to the following through different methods selected in accordance with each stage:

- To examine the Turkish wheat sector in detail within the framework of the value chain approach
- To reveal the position of the Turkish wheat sector among major wheat producer/exporter countries in the context of comparative advantage
- To analyze the policy impact on the Turkish wheat sector
- To assess the outcomes of possible different market conditions by generating various scenarios
- To obtain the insights of wheat sector stakeholders on the main areas (financing, infrastructure and technology, marketing and communication) in the sector by conducting a case study in the region that ranks first in wheat production.

6.1. Summary of Findings

Preliminary results of this research showed that there have been significant changes in the Turkish wheat value chain in the last decade. The most striking of these changes are the increase in flour exports, a rising trend in wheat imports, a decrease in wheat cultivation areas and the fact that wheat yield is still below the world average. Having a significant place in wheat production and processed wheat product exports in the world, Turkey has strong potential in terms of the development of the wheat value chain. Therefore, by analyzing the current situation in detail, it is possible to establish a more effective and sustainable wheat value chain with policies tailored towards the sector. In order to reveal the current situation in the sector in more detail, a three-stage analysis was conducted. These analyses were selected to conduct a detailed study from the general to the specific, in other words from the international level to the country level and then to the regional level. While the international level here denotes the comparison of the countries, the

analysis at the country level is the analysis of sector data in a way that reflects the country in general. Finally, analysis at the regional level involves choosing a region that best reflects the sector and collecting primary data from that region. In the first stage, the competitiveness of the Turkish wheat industry was examined within the frame of the "Revealed Comparative Advantage" approach. According to the results of the analysis, the RCA index of the Turkish wheat sector (wheat and wheat flour) calculated for 2018 was 2.57. This coefficient shows that the sector has a comparative advantage. Later in the analysis, the RCA indices of the major wheat producer/exporter countries were calculated in order to make a comparison. As a result, the country with the highest RCA value by far is the Russian Federation (7.93 for 2018), followed by Turkey (2.57), USA (1.41), and EU-28 (0.80). The RCA index values calculated for these countries showed the same order for the period 2009-2018. The fact that the sector has a certain degree of comparative advantage can be explained by Turkey's high flour exports. When only wheat is taken into account and wheat flour export figures are not included, Turkey's RCA index is the lowest compared to the countries mentioned.

In the second stage of the wheat value chain analysis, the sector was examined more closely. At this stage of the analysis, the Policy Analysis Matrix methodology was applied, and in addition to assessing the profitability of wheat production in Turkey, diverting effects of existing policies on the sector were also examined. As a result of the analysis, it was determined that wheat production in Turkey was profitable, but input prices were higher than world prices and government supports had a significant share. In the next step called "Sensitivity Analysis", various scenarios for the wheat market were produced and the possible consequences of these scenarios were examined. Three different types of scenarios were examined within the scope of sensitivity analysis: (i) single input price changes, (ii) multi-input price changes and (iii) changes in fertilizer use and wheat yield. In the first scenario, the possible impact of changes in fertilizer prices was analyzed. The results showed that a 30% increase in fertilizer prices caused a 13% increase in tradable input costs and 8% fall in profit. On the other hand, a 30% decrease in fertilizer prices had the opposite impact and caused the NPCI value to fall to below 1, to 0.92, implying that the private prices of fertilisers would be lower than their social prices in this scenario. The second scenario examined the effects of multi-input price changes. Results of a 25% increase in tradable input prices (fertilizer, wheat seed and pesticide) caused a 9% increase in overall costs and a 15% fall in profits. In this scenario, the NPCI value rose to 1.31, indicating that market prices would be 31% higher than world prices. In the case of a 25% decrease in input prices, the NPCI value would drop to 0.79, which means market prices of tradable inputs would

be lower. In the last scenario, changes in fertilizer use and wheat yield were analyzed. A 30% increase in fertilizer use and 20% increase in yield resulted in approximately a 12% surge in tradable input costs and 11% increase in private revenues. In this scenario, profit would increase 24% and the DRC value would change from 0.68 to 0.55, indicating a higher comparative advantage than the base scenario.

A case study was conducted in the third and final stage of the wheat value chain research. For the case study the Central Anatolia Region was chosen as it has the highest wheat production among the seven geographical regions of Turkey, and also has a significant share in the processed wheat products industry. A total of 114 sector stakeholders from different categories participated in this study in order to determine the insights of the wheat value chain stakeholders on the sector, and consequently the challenges in the sector. The survey questions were designed to obtain opinions of the sector stakeholders about the market under three sub-groups: (i) Infrastructure and technology, (ii) Marketing and communication and (iii) Financing. Each question category consisted of five relevant questions and the answers to the survey questions were designed according to a five-scale Likert-style, from ‘strongly disagree’ to ‘strongly agree’. As a result of a statistical analysis of the data collected by the survey method, it was found that the Central Anatolia Region wheat sector stakeholders gave the most positive answers to the questions in the "Infrastructure and technology" category, followed by "Marketing and communication" and "Financing" with mean values of 17.63, 16.52 and 15.76, respectively. The noteworthy points in the answers given to the questions regarding the opinions of the sector stakeholders are as follows:

- More than half of the industry stakeholders (57%) stated that the wheat grown in the region is suitable for the industry's needs. The Central Anatolia Region plays an important role not only in wheat production, but also in the production of processed wheat products. In the wheat industry, wheat quality needs of each sub-sector differ. For example, to the survey question of whether the quality of the wheat grown in the Central Anatolia Region is suitable for the sector's needs, “Seed” and “Feed” groups gave a relatively more positive opinion than the “Processed wheat products” group.
- When asked whether it is easy to access information such as price, production expectations and legal regulations in the sector, 73.6% of the participants stated that access to information in the sector is easy. On the other hand, the rate of those who find the events and platforms where the sector stakeholders come together insufficient was 53.5%.

- Another noteworthy result of the survey is that 82% of the participants expressed an affirmative opinion when asked whether the use of certified seeds positively affects wheat quality and yield. Therefore, it can be said that the sector has high awareness and positive opinions about certified seeds.
- More than half of the stakeholders answered positively to the questions about the adequacy of logistics, infrastructure, technology and storage in the region.
- While the question about whether access to finance is easy or not in the sector was answered positively with a rate of 42%, and 44% of the survey participants stated that subsidies are insufficient. On the other hand, the rate of those who think that the basin-based support model contributes to the sector is approximately 39%.

6.2. Testing of Hypotheses

Hypothesis One: Policies aimed towards the Turkish wheat sector should prioritize the low-value segment in order to increase competitiveness.

A country's comparative advantage in a sector is of great importance in terms of the development and sustainability of that sector. Therefore, one of the main objectives of this study is to examine the position of the Turkish wheat sector among major wheat producer/exporter countries in the context of comparative advantage and ask the research question if the Turkish wheat sector has a comparative advantage compared to other major producer/exporter countries. To answer this research question, Balassa's "Revealed Comparative Advantage" methodology was applied to the Turkish wheat sector and to the USA, Russia, and the EU. According to the analysis results, the Turkish wheat sector has a decent comparative advantage when wheat and wheat flour are taken into account together. However, when only wheat is taken into account, it is revealed that the sector does not have a comparative advantage. When the major wheat producing and exporting countries are compared, it is observed that Russia has a very high comparative advantage in the wheat sector in both cases.

In order to ensure the sustainability of the sector and to alleviate the vulnerability of the downstream parts of the value chain due to import dependency, policies aimed towards the Turkish wheat sector should prioritize the low-value segment in order to achieve stronger competitiveness. The comparative advantage analysis results support the hypothesis, therefore the hypothesis one is accepted.

Hypothesis Two: Financial-related problems in the Turkish wheat value chain are more likely to be severe when compared to infrastructure and marketing-related problems.

Constraints occurring in value chains may differ according to the structure of the chain as well as the conditions and development level of the country in which it is located. In order to identify potential areas of improvement in the value chain, it is first necessary to determine which area has the most problems. Therefore, another major research objective of this study is to analyze the insights of wheat sector stakeholders on the main areas in the sector (financing, infrastructure and technology, marketing and communication), within the scope of a case study to identify potential areas of improvement in the value chain.

Quantitative survey results revealed that the wheat sector stakeholders have the least positive opinions in the Financing category, while the most positive opinions were given in the Infrastructure and technology categories. The results of the quantitative survey analysis support the hypothesis; therefore the hypothesis two is accepted.

Hypothesis Three: Constraints faced by the Turkish wheat value chain stakeholders differ based on their location.

The third hypothesis examined whether there is any significant difference in the opinions of wheat sector stakeholders between the provinces in which they operate. Results of the statistical analysis showed that, for the M (Marketing and communication question category) total variable, there is a significant difference among provinces ($p<0.05$). Therefore, among three question categories, only the "M total" hypothesis three is accepted, and the "I total" (Infrastructure and technology) and "F total" (Finances) variables hypothesis three is rejected.

Hypothesis Four: Constraints faced by the Turkish wheat value chain stakeholders differ based on their activity areas.

The fourth hypothesis investigated whether there is any significant difference in the opinions of wheat sector stakeholders between the activity areas of the establishments. According to $p<0.06$ the "M total" variable has a significant difference among activity areas. Therefore, the hypothesis four is accepted only for the "M total" variable. An LSD test was conducted to obtain more detailed results. Results of the test showed that the "Seed" and "Feed" groups had a higher mean than the "Grain trade/transport" group. In other words, survey respondents from the "Seed" and "Feed" groups gave more positive opinions on the "Marketing and communication" questions. In addition to this, the "Grand total" variable showed a significant difference among activity areas,

according to $p<0.10$. This result is mostly based on the fact that the "Seed" group had a higher mean than the "Grain trade/transport" group.

6.3. Recommendations

According to the results of this research, in order to achieve a more competitive and sustainable wheat value chain in Turkey, the policies mainly need to focus on reducing the cost of wheat production, increasing wheat yield, financing, and integrating small-scale industry stakeholders into the wheat value chain.

- Increasing smallholder engagement with the value chain is essential for effective and sustainable rural development. In order to integrate the producers into the value chain in the wheat industry, which is characterized by small and medium-sized producers, their bargaining power needs to be strengthened. Besides, they must be aware of the quality needs in middle and downstream segments of the chain and produce according to the quality needs. Integration of disadvantaged stakeholders to the value chain can be achieved through collaborations aimed at both increasing added value and participation in the chain. Therefore, it is beneficial to adopt an inclusive approach, involving all value chain stakeholders in policies developed to increase the competitiveness of the wheat sector.
- Financing of agriculture is very important due to the seasonal nature of agricultural production and the corresponding fluctuating incomes of sector stakeholders. As the research results indicated, financing is one of the main challenges that stakeholders encounter in the wheat value chain. The share of agricultural supports as a portion of GDP is relatively low in developed countries. Therefore, although the results of this research showed that more than one third of wheat sector stakeholders found the government support insufficient, it will be more sustainable to solve the financing problems by expanding and encouraging the use of alternative financing instruments in the agricultural sector besides government subsidies and bank loans. The licensed warehousing system, which offers an alternative for financing in the wheat market, has gained momentum in Turkey. For instance, the TMEX (Turkish Mercantile Exchange) - where electronic warehouse receipts issued by licensed warehouse enterprises can be traded- was established in 2018. Therefore, informing sector stakeholders more effectively about the latest developments and opportunities, as well as promoting alternative financing sources in the wheat value chain, should be prioritized.

- Enhancing platforms and events where stakeholders come together in the value chain is beneficial for strengthening market linkages. It is one of the noteworthy outputs of this research that the results of the survey revealed that platforms and events where stakeholders of the sector come together were considered insufficient.
- Increase in wheat production volume can be achieved by expanding the cultivation area or by increasing the yield. Since there is a certain limit of cultivation areas, the focus should be on increasing the wheat yield in order to enhance wheat supply and reduce the import dependency of the processed wheat products industry in particular. However, efficiency and production increase may not be sufficient, therefore, enhancing product quality in line with the needs of sector stakeholders is important for the self-sufficiency and competitiveness of the sector.
- In addition to the issues mentioned above, improving post-harvest processes and decreasing waste along the chain also plays a significant role in the better functioning of the food value chain. A sustainable way to use limited resources effectively is to reduce food waste and loss. One of the most important challenges in the process of preventing food waste and loss is measuring the amount of waste along the value chain. Therefore, it would be beneficial to channel regulations in this direction, and then developing policies by taking both international and regional good practices as an example.

7. NEW SCIENTIFIC RESULTS

7.1. New Scientific Achievements/Observations

As a result of the “Revealed Comparative Advantage” analysis, “Policy Analysis Matrix” and the case study based on the Central Anatolia Region wheat value chain stakeholders’ opinions about the sector; the following novel outcomes were explored:

1) Based on the results of the "Revealed Comparative Advantage" analysis, it can be established that the Turkish wheat sector is not competitive in the low-value segment. The RCA analysis revealed that, while the sector has a comparative advantage when flour exports are taken into account, it is not competitive when only wheat is taken into account.
2) Input prices and productivity are two important points to be considered for the production stage of the wheat value chain. The PAM analysis revealed the profitability of wheat production as well as the distorting effects of subsidies. In addition, according to the results of the analysis, wheat production activity is more costly for Turkish farmers compared to foreign wheat producers, as the input prices used in wheat production in Turkey are higher than world prices. Based on the results of the sensitivity analysis, it was found that, even though increasing fertilizer use notably raises the cost of production, overall profit would be higher than the basic scenario due to the greater yield.
3) According to the results of the quantitative survey conducted on the opinions of the sector stakeholders, it can be established that the most challenging constraints in the Turkish wheat value chain are related to financing. It was seen that the subgroup of questions answered least positively was the "Financing" group.
4) The case study results showed that the least challenging constraints in the Turkish wheat value chain are related to infrastructure. It was found that the subgroup of questions answered most positively was the "Infrastructure and Technology" group.
5) It is important that the policies to be developed for the wheat value chain are inclusive of each sector stakeholder and respond to their needs. For instance, among the opinions of sector stakeholders, a remarkable difference was observed between *stakeholders* in the question category of "Marketing and communication".
6) In the context of sustainability, it is crucial that the policies to be developed for value chains also take into account spatial differences and focus on regional needs and potentials rather than one-size-fits-all approaches. According to the opinions of sector stakeholders, a

significant difference was observed between *provinces* in the question category of "Marketing and communication".

7.2. Future Research Areas

- Comparison of wheat sector by region in terms of marketing and communication, financing, and infrastructure and technology. Identifying regional differences and similarities and revealing their main causes.
- A detailed examination of the significant differences in the views among provinces in the field of “Marketing and Communication” (as revealed in this study) in the context of the cause-effect relationship.
- A detailed examination of the significant differences in the views among activity areas in the field of “Marketing and Communication” (as revealed in this study) in the context of the cause-effect relationship.
- Applicability of methods focusing on climate change and environment in value chain development. What are the best practices against climate change and environmental risks?

8. SUMMARY

As an important nutritional source and a widely produced and traded crop around the world, wheat is an agricultural product of strategic importance. Although domestic consumption is usually below Turkey's annual wheat production volume, some amount of wheat is imported mostly for the processed wheat products industry, which has a considerable export volume. Wheat import data for the period 2009-2018 shows that Turkey's wheat imports have increased significantly especially in the last five years. In addition, according to wheat cultivation area data for the same period, cultivation area showed a decreasing trend. On the other side, population of the country increased during this period. Since wheat is an agricultural product with strategic importance, the significance of policies for the wheat sector is increasing, especially in the context of food security. Recent studies highlight different aspects of the food systems that play an important role in ensuring food security. It is understood that food security cannot be achieved solely focusing on food production. The value chain approach, which considers the entire sector rather than simply the production stage, provides a holistic perspective in this context.

The aim of this research is to analyze the latest situation regarding the wheat value chain in Turkey in detail and to identify the bottlenecks in the value chain, to guide policies, and to contribute to the literature in this field. For this purpose, a three-stage analysis methodology was applied. First, it was examined whether the wheat sector in Turkey has a revealed comparative advantage, and then a comparative analysis was made with the major producer/exporter countries. In the second stage, the profitability of wheat production and the distorting effects of policies on the sector were examined with the Policy Analysis Matrix method. Possible results of different scenarios for the market were also examined with Sensitivity Analysis within the framework of the PAM approach. At the last stage of the analysis, a case study was conducted to identify the problems faced by wheat value chain stakeholders. The Central Anatolia Region, which ranks first in wheat production in the country, was chosen for the case study. In addition to demographic questions, the wheat sector stakeholders were asked questions under three different categories: "Marketing and communication", "Financing" and "Infrastructure and technology" and the results obtained were statistically analyzed.

Outputs of the Revealed Comparative Advantage analysis showed that the RCA value of the Turkish wheat sector was above 1 when export data for wheat and wheat flour were taken into account together and it was below 1 when only export data of wheat was taken into account.

Comparison of major wheat producer/exporter countries indicated that the Russian Federation by far had the highest RCA value. As a result of the Policy Analysis Matrix method applied to examine the wheat sector more closely, it was observed that the producers receive a certain amount of profit from wheat production activity, and state supports consitute a considerable share in it. The analysis also revealed that the input prices were higher than social prices, indicating a higher cost of production. With the sensitivity analysis, potential positive effects of the possible increase in yield were observed. Finally, the results of the survey conducted to identify the difficulties faced by industry stakeholders in the wheat value chain showed that, on average, industry stakeholders responded more positively to the questions in the "Infrastructure and technology" category, while the least positive answers were given to the questions in the "Financing" category.

In this research, four hypotheses were tested using the appropriate methodology for each of them. The first hypothesis suggested that the policies aimed towards the Turkish wheat sector should prioritize the low-value segment in order to increase competitiveness. The RCA analysis results showed that the Turkish wheat sector has a certain level of comparative advantage when wheat and wheat flour are taken into account together. However, when only wheat is taken into account, the sector has no comparative advantage. Therefore, hypothesis one is accepted as the RCA analysis results support the statement. The formulation of the second hypothesis is based on the constraints experienced in the wheat value chain. The hypothesis suggests that financial-related problems in the Turkish wheat value chain are more likely to be severe when compared to infrastructure and marketing-related problems. The case study results showed that value chain stakeholders gave the least positive opinions to the questions asked in the "Financing" category. The "Marketing and communication" and "Infrastructure and technology" categories follow the "Financing" category, respectively. As a result, based on the quantitative survey results, hypothesis two is accepted. The third hypothesis of the research suggests that constraints faced by the Turkish wheat value chain stakeholders differ based on their location. Results of the statistical analysis indicate that, for the “Marketing and communication” question category, there was a significant difference between cities. Thus, for the “Marketing and communication” category, hypothesis three is accepted, and for the “Infrastructure and technology” and “Finances” categories, hypothesis three is rejected. Finally, the fourth hypothesis of the study suggests that constraints faced by the Turkish wheat value chain stakeholders differ based on their activity areas. Similarly, it was observed that there is a significant difference between activity areas for the “Marketing and communication” category. Therefore, for the “Marketing

and communication" category, hypothesis four is accepted, and for the "Infrastructure and technology" and "Finances" categories, hypothesis four is rejected.

Comprehensive value chain analysis revealed that in order for the wheat value chain to function more effectively in Turkey, policies should be aimed at reducing production costs and increasing yields, as well as expanding alternative financing methods, considering spatial differences and differences among stakeholders, and better integrating small-scale producers into the chain.

9. APPENDICES

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A2: Supplementary Data for Chapter 5.1.

Table A2.1. Wheat exports of Turkey (US Dollar thousand)

Years	Export	Wheat export	Wheat flour export	Wheat+Wheat flour Total
2009	102 142 613	60 692	581 039	641 731
2010	113 883 219	200 848	596 282	797 130
2011	134 906 869	2 580	891 744	894 324
2012	152 461 737	34 248	840 817	875 065
2013	151 802 637	79 317	946 605	1 025 922
2014	157 610 158	35 356	931 232	966 588
2015	143 844 066	32 394	978 608	1 011 002
2016	142 606 247	11 439	1 078 489	1 089 928
2017	156 992 940	14 828	1 052 581	1 067 409
2018	167 923 862	23 906	1 006 290	1 030 196

Source: (International Trade Centre, 2020)

Table A2.2. Wheat exports of Russian Federation (US Dollar thousand)

Years	Export	Wheat export	Wheat flour export	Wheat+Wheat flour Total
2009	301 796 059	2 753 003	121 495	2 874 498
2010	397 067 521	2 069 017	35 698	2 104 715
2011	516 992 618	3 671 175	214 178	3 885 353
2012	524 766 421	4 523 964	65 174	4 589 138
2013	527 265 919	3 482 680	57 222	3 539 902
2014	497 833 529	5 423 131	47 288	5 470 419
2015	333 501 801	3 893 150	82 488	3 975 638
2016	285 491 052	4 215 803	71 073	4 286 876
2017	357 083 135	5 791 013	64 383	5 855 396
2018	449 347 157	8 432 493	69 085	8 501 578

Source: (International Trade Centre, 2020)

Table A2.3. Wheat exports of European Union-28 (US Dollar thousand)

Years	Export	Wheat export	Wheat flour export	Wheat+Wheat flour Total
2009	4 512 359 407	10 352 645	1 200 430	11 553 075
2010	5 079 164 099	11 310 224	1 119 271	12 429 495
2011	5 940 942 336	13 971 612	1 514 371	15 485 983
2012	5 685 013 441	13 046 940	1 452 999	14 499 939
2013	5 995 678 119	15 590 680	1 645 284	17 235 964
2014	6 030 026 919	15 730 359	1 461 097	17 191 456
2015	5 257 571 152	13 118 183	1 225 911	14 344 094
2016	5 240 804 587	12 327 937	1 186 658	13 514 595
2017	5 732 807 735	10 861 369	1 245 085	12 106 454
2018	6 317 292 369	10 818 533	1 279 983	12 098 516

Source: (International Trade Centre, 2020)

Table A2.4. Wheat exports of USA (US Dollar thousand)

Years	Export	Wheat export	Wheat flour export	Wheat+Wheat flour Total
2009	1 056 712 100	5 380 044	132 282	5 512 326
2010	1 278 099 187	6 775 480	139 881	6 915 361
2011	1 481 682 200	11 148 795	153 859	11 302 654
2012	1 544 932 000	8 188 708	144 294	8 333 002
2013	1 577 587 300	10 524 734	133 219	10 657 953
2014	1 619 742 900	7 780 927	126 493	7 907 420
2015	1 503 101 490	5 635 088	148 108	5 783 196
2016	1 451 459 684	5 382 844	161 335	5 544 179
2017	1 546 462 344	6 093 373	135 785	6 229 158
2018	1 665 992 032	5 458 267	131 530	5 589 797

Source: (International Trade Centre, 2020)

Table A2.5. Wheat exports - World (US Dollar thousand)

Years	Export	Wheat export	Wheat flour export	Wheat+Wheat flour Total
2009	12 345 154 948	32 172 520	3 898 970	36 071 490
2010	15 094 521 830	32 928 153	3 933 421	36 861 574
2011	18 103 516 982	47 491 330	5 547 004	53 038 334
2012	18 396 609 430	48 882 996	5 229 828	54 112 824
2013	18 875 061 792	49 095 219	5 429 719	54 524 938
2014	18 846 917 455	47 807 962	5 138 026	52 945 988
2015	16 415 641 494	38 731 276	4 881 560	43 612 836
2016	15 917 841 059	36 508 850	4 762 391	41 271 241
2017	17 561 036 930	39 046 819	4 827 717	43 874 536
2018	19 310 111 006	41 173 301	4 906 770	46 080 071

Source: (International Trade Centre, 2020)

A3: Calculation of Reference Prices

Table A3.1. Reference price of wheat

Adjustment of Price of Wheat to Farm-gate Level	
CIF Marmara ($/Ton)*	210
Exchange rate (TL/$)	4.8294
Exchange rate premium (%)	0.109
Equilibrium exchange rate (TL/$)	5.3558
CIF Marmara in domestic currency (TL/Ton)	1,124.72
Weight conversion factor (Kg/Ton)	1,000
CIF Marmara in domestic currency (TL/Kg)	1.1247
Other expenses** (TL/Kg)	0.1071
Import parity value at farm gate (TL/Kg)	1.2318

*CIF Marmara price of imported Russian wheat.
**Transport, handling and distribution.
Source: Author's calculations, based on Chapter 4.2.2.

Table A3.2. Reference price of wheat seed

Export Parity Price of Seed Wheat to Farm-gate Level	
FOB Border Price ($/Ton)	331
Exchange rate (TL/$)	4.8294
Exchange rate premium (%)	0.109
Equilibrium exchange rate (TL/$)	5.3558
FOB in domestic currency (TL/Ton)	1,772.77
Weight conversion factor (Kg/Ton)	1,000
CIF Marmara in domestic currency (TL/Kg)	1.7728
Other expenses* (TL/Kg)	0.1071
Import parity value at farm gate (TL/Kg)	1.6657

*Transport, handling and distribution.
Source: Author's calculations, based on Chapter 4.2.2.

Table A3.3. Reference price of pesticide

Import Parity Price of Pesticide to Farm-gate Level	
CIF Border Price ($/Ton)	7,736
Exchange rate (TL/$)	4.8294
Exchange rate premium (%)	0.109
Equilibrium exchange rate (TL/$)	5.3558
Price in domestic currency (TL/Ton)	41,432.5
Weight conversion factor (Kg/Ton)	1,000
Price in domestic currency (TL/Kg)	41.4325
Other expenses* (TL/Kg)	0.1071
Import parity value at farm gate (TL/Kg)	41.5396

*Transport, handling and distribution.
Source: Author's calculations, based on Chapter 4.2.2.

Table A3.4. Reference price of fertiliser (DAP)

Import Parity Price of DAP to Farm-gate Level	
CIF Border Price ($/Ton)	437
Exchange rate (TL/$)	4.8294
Exchange rate premium (%)	0.109
Equilibrium exchange rate (TL/$)	5.3558
Price in domestic currency (TL/Ton)	2,340.5
Weight conversion factor (Kg/Ton)	1,000
Price in domestic currency (TL/Kg)	2.3405
Other expenses* (TL/Kg)	0.1071
Import parity value at farm gate (TL/Kg)	2.4476

*Transport, handling and distribution.
Source: Author's calculations, based on Chapter 4.2.2.

Table A3.5. Reference price of fertiliser (A.S.)

Import Parity Price of A.S. to Farm-gate Level	
CIF Border Price ($/Ton)	147
Exchange rate (TL/$)	4.8294
Exchange rate premium (%)	0.109
Equilibrium exchange rate (TL/$)	5.3558
Price in domestic currency (TL/Ton)	787.3
Weight conversion factor (Kg/Ton)	1,000
Price in domestic currency (TL/Kg)	0.7873
Other expenses* (TL/Kg)	0.1071
Import parity value at farm gate (TL/Kg)	0.8944

*Transport, handling and distribution.
Source: Author's calculations, based on Chapter 4.2.2.

A4: PAM Sensitivity Analysis Tables

Scenario 1: Single input price changes

Table A4.1. Increase in fertiliser prices by 30%

Wheat	Revenues	Tradable Inputs				Domestic Factors				Total Costs	Profits
		Fertilizer	Pesticide	Seed	Total	Labor	Capital	Land	Total		
Private Prices	A	B				C					D
	450.0	50.7	11.0	42.3	103.9	12.7	102.0	59.0	191.5	295.5	154.6
Social Prices	E	F				G					H
	337.5	37.9	8.3	41.6	87.8	8.1	114.2	29.1	168.7	256.6	80.9
Divergences	I	J				K					L
	112.5	12.8	2.7	0.6	16.1	4.6	-12.2	29.9	22.8	38.9	73.6

Source: Author's calculations, based on Chapter 5.2.

Table A4.2. Decrease in fertiliser prices by 30%

Wheat	Revenues	Tradable Inputs				Domestic Factors				Total Costs	Profits
		Fertilizer	Pesticide	Seed	Total	Labor	Capital	Land	Total		
Private Prices	A	B				C					D
	450.0	27.3	11.0	42.3	80.5	12.7	102.0	59.0	189.6	270.2	179.9
Social Prices	E	F				G					H
	337.5	37.9	8.3	41.6	87.8	8.1	114.2	29.1	168.7	256.6	80.9
Divergences	I	J				K					L
	112.5	-10.6	2.7	0.6	-7.3	4.6	-12.2	29.9	20.9	13.6	98.9

Source: Author's calculations, based on Chapter 5.2.

Scenario 2: Multi-input price changes

Table A4.3. Increase in fertiliser, pesticide and wheat seed prices by 25%

Wheat	Revenues	Tradable Inputs				Domestic Factors				Total Costs	Profits
		Fertilizer	Pesticide	Seed	Total	Labor	Capital	Land	Total		
Private Prices	A	B				C					D
	450.0	48.7	13.8	52.8	115.3	12.7	102.0	59.0	192.5	307.8	142.3
Social Prices	E	F				G					H
	337.5	37.9	8.3	41.6	87.8	8.1	114.2	29.1	168.7	256.6	80.9
Divergences	I	J				K					L
	112.5	10.9	5.4	11.2	27.5	4.6	-12.2	29.9	23.7	51.2	61.3

Source: Author's calculations, based on Chapter 5.2.

Table A4.4. Decrease in fertiliser, pesticide and wheat seed prices by 25%

Wheat	Revenues	Tradable Inputs				Domestic Factors				Total Costs	Profits
		Fertilizer	Pesticide	Seed	Total	Labor	Capital	Land	Total		
Private Prices	A	B				C					D
	450.0	29.2	8.3	31.7	69.2	12.7	102.0	59.0	188.7	257.9	192.1
Social Prices	E	F				G					H
	337.5	37.9	8.3	41.6	87.8	8.1	114.2	29.1	168.7	256.6	80.9
Divergences	I	J				K					L
	112.5	-8.6	-0.1	-10.0	-18.7	4.6	-12.2	29.9	20.0	1.3	111.2

Source: Author's calculations, based on Chapter 5.2.

Scenario 3: Changes in fertiliser use and wheat yield

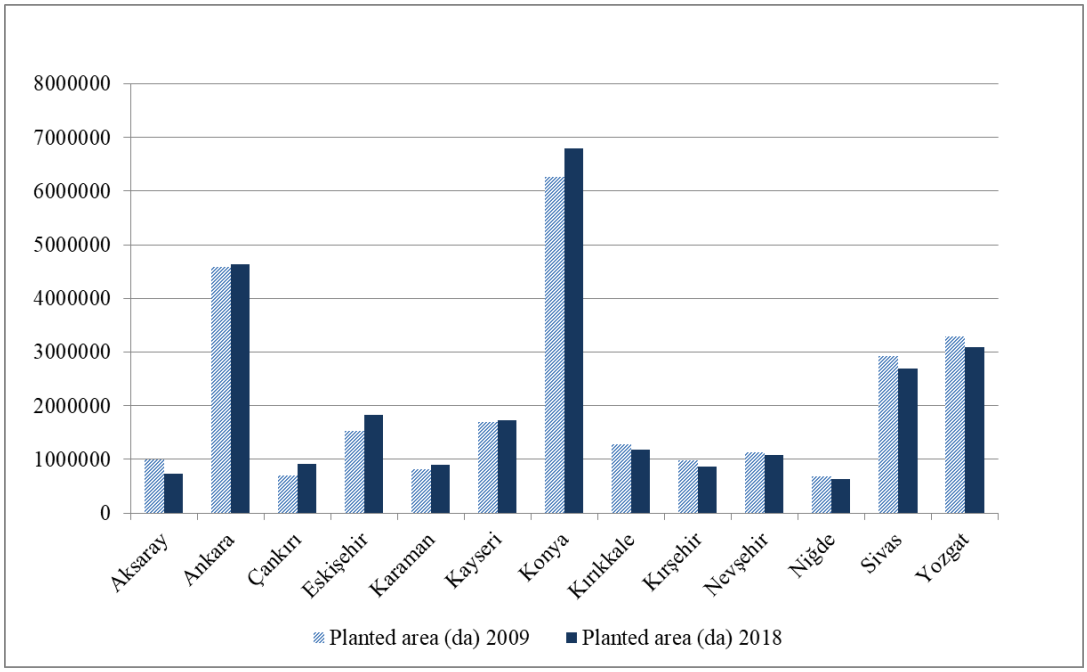
Table A4.5. Increase in fertiliser use (+30%) and yield (+20%)

Wheat	**Revenues**	**Tradable Inputs**				**Domestic Factors**				**Total Costs**	**Profits**
		Fertilizer	Pesticide	Seed	Total	Labor	Capital	Land	Total		
Private Prices	A	B				C					D
	502.6	50.7	11.0	42.3	103.9	12.7	102.0	59.0	191.5	295.5	207.2
Social Prices	E	F				G					H
	405.0	49.3	8.3	41.6	99.2	8.1	114.2	29.1	169.7	268.9	136.1
Divergences	I	J				K					L
	97.6	1.4	2.7	0.6	4.7	4.6	-12.2	29.9	21.9	26.6	71.0

Source: Author's calculations, based on Chapter 5.2.

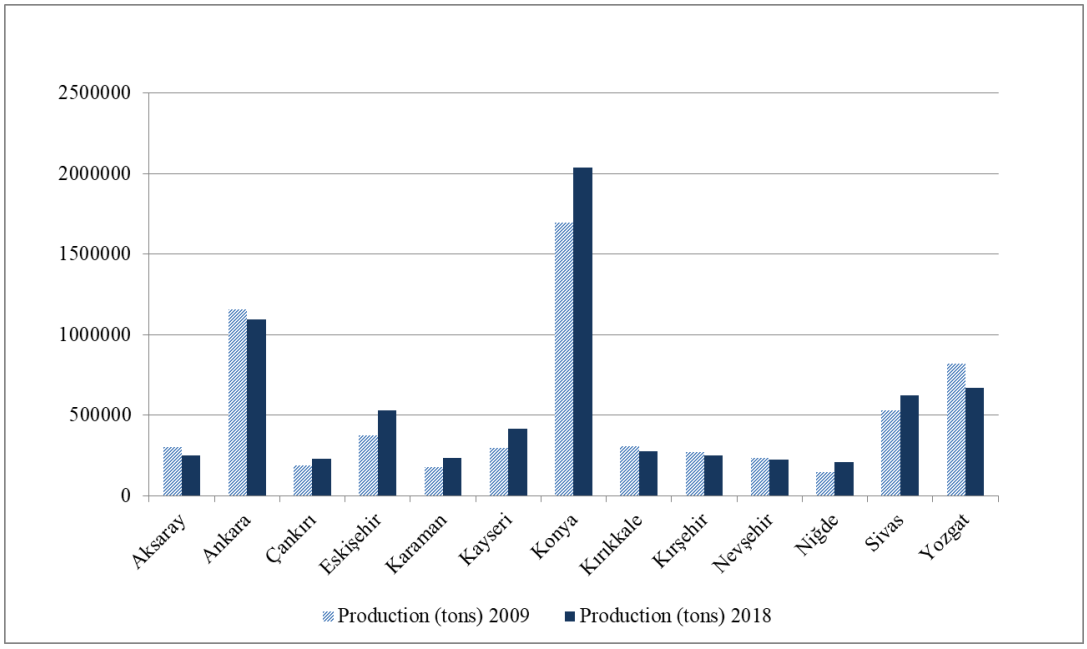
A5: The Central Anatolia Region Wheat Sector Statistics

Table A5.1. Wheat planted area comparison by province between 2009 and 2018



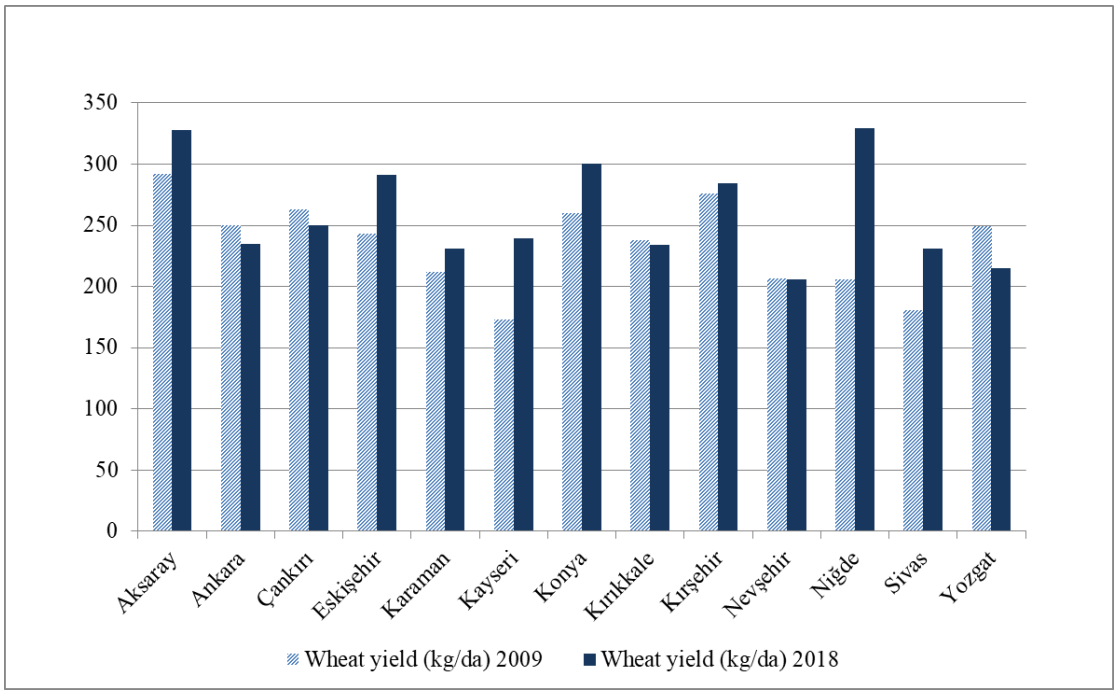
Source: (TUIK, 2020a)

Table A5.2. Wheat production comparison by province between 2009 and 2018



Source: (TUIK, 2020a)

Table A5.3. Wheat yield comparison by province between 2009 and 2018



Source: (TUIK, 2020a)

A6: Supplementary Data for Chapter 5.3.

Table A6.1. Mean and st. dev. values of the total answers according to establishment size

		N	*Mean*	*Std. Dev.*
M total	More than 250	9	17,22	2,39
	Between 50 and 250	23	16,87	3,72
	Less than 50	82	16,34	3,58
	Total	114	16,52	3,52
I total	More than 250	9	18,44	1,94
	Between 50 and 250	23	18,48	3,34
	Less than 50	82	17,30	3,85
	Total	114	17,63	3,66
F total	More than 250	9	16,11	2,89
	Between 50 and 250	23	16,09	3,16
	Less than 50	82	15,63	3,59
	Total	114	15,76	3,44
Grand Total	More than 250	9	51,78	4,94
	Between 50 and 250	23	51,43	8,32
	Less than 50	82	49,28	9,62
	Total	114	49,91	9,09

Source: Author`s calculations based on survey data.

A7: Research Questionnaire

Sample questionnaire for the Central Anatolia Region Wheat Value Chain Stakeholders` Opinions[26]

Dear participant,

I am conducting research for my doctoral thesis on challenges encountered in the wheat value chain and their solutions. As a stakeholder in the sector, your views are of great value to my study. The information you declare in this survey research is anonymous and will only be used for academic purposes and will not be shared with third parties. Answering the questions takes about 6-7 minutes. Thank you for your time and valuable comments.

Dear participant, when answering the survey questions, it is important that you specify "what is", not "what you think should happen", in order to achieve the correct results. Please answer all questions without skipping any questions.

(Nazlı Ceylan – Hungarian University of Agriculture and Life Sciences)

I. *Demographic questions about the establishments:*

Field the establishment operates in

- Flour production/trade
- Feed production/trade
- Pasta production/trade
- Biscuit production/trade
- Bulgur production trade
- Seed production
- Grain transport
- Non-governmental organization
- Grain buying/selling
- Other

Size of the establishment

- Less than 50 employees
- Between 50-250 employees
- More than 250 employees

[26] Translated version from Turkish to English.

Structure of the establishment

- Private
- State
- Social
- Mixed

Province

District

II. *The answers to the questions for this section are: 1- Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Absolutely agree*

1) The wheat produced in the Central Anatolia Region is of a quality suitable for the needs of the sector.
2) It is easy to access information about current developments in the wheat market (price, production expectations, legal regulations, etc.).
3) Events and platforms where wheat sector stakeholders come together are sufficient.
4) Participation of small-scale producers in the wheat value chain is sufficient in the Central Anatolia Region.
5) Increasing the use of certified seeds positively affects the quality and yield of wheat.
6) Grain storage/preservation facilities are sufficient in the Central Anatolia Region.
7) The licensed warehousing system is beneficial for the development of the wheat sector.
8) The logistics infrastructure used for the supply of wheat produced in the Central Anatolia Region is sufficient.
9) Current Technologies and equipment used in wheat production and processing in the Central Anatolia Region are sufficient.
10) Seasonal production and price fluctuations in the wheat sector are largely based on difficult to control factors such as weather conditions and land structure.
11) Access to financing resources is sufficiently easy in the sector.
12) State support for the wheat sector is sufficient.
13) The contribution of the basin-based support model to the wheat market in the Central Anatolia Region is positive.
14) Licensed warehousing services are an effective alternative in financing wheat production.
15) Developments in futures exchanges have a positive effect on the increase in the income and welfare level of wheat sector stakeholders.

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