AGRICULTURAL RESEARCH IN NOWADAYS

Editors

Assoc. Prof. Dr. Nermin BAHŞİ

Prof. Dr. Dilek BOSTAN BUDAK

Agricultural Sciences

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PREFACE

Agriculture is one of the irreplaceable sector in the world, which has an important place in human nutrition as well as its contribution to the national economy. In recent years, Covid 19 pandemic had a negative effects in all areas of social life in all over the world. The precautions taken due to the pandemic led to a decrease or even halt in production in many sectors. As in other sectors, it caused serious problems in product supply in agriculture sector. Ensuring food security has become one of the most important issue for all countries during this time. Many countries had restrictions on exports so that their own country people do not face problems in supplying agricultural and food products. In fact, the pandemic process, once again, has showed the importance of agriculture and food sector. During this time, there have been various changes not only in production process but also in the preferences and lifestyles of individuals. Market shelves have been empty in many products, due to the slowdown and stopping of production, people have stored to stocpilling at home due to the concern of not being able to find food products. The disruptions in supply and the increase in demand were reflected to prices. Spending more time at home, loosing jobs, reduction or loss of income have also changed the consumption patterns of people. The whole process has once agained showed the importance of agriculture, food and food safecty for national economies and societies.

This book aims to cover all aspects of the agriculture and food sector. For this reason, researches from different scientific fields in agriculture were included. We hope that this book, which consists of 15 chapters that have written by expert researchers in their fields, will provide different perspectives to its readers. We would like to thank all the authors who contributed to the publication of this book, the referees and the Livre De Lyon Publishing House.

Assoc. Prof. Nermin Bahşi

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CONTENT

CHAPTER I

INNOVATION AND DIGITALIZATION IN AGRICULTURE

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1. Introduction

Agriculture is a sector that meets the food needs of people and its importance increasing day by day. In addition to its contribution to nutrition, it also contributes to the national and world economy. Increasing competition conditions and changing markets have an impact on agricultural foreign trade in the world. Today, it is necessary to increase the competition conditions and meet the food needs of the increasing population.

According to the United Nations population estimates, the world population for 2021 was estimated as 7.9 billion people (TUIK, 2022). However, it is not possible to increase food production at the same rate with the increasing population. For this reason, food supply security is in danger. In addition, effects of climate change has been felt more and more in recent years. Reasons such as misuse of agricultural lands, erosion, floods and raids are an important element of pressure on production. It is important to increase the amount of production in terms of ensuring food safety under this condition. This is the most important issue in all over the world politics. To deal with this issue, the use of new technology for sustainable and sufficient food draws attention.

Sustainable agriculture is an approach that includes the protection of soil and water resources and integrated agricultural control management. Sustainable agricultural activity is aimed to reduce all kinds of erosion, environmental pollution caused by human beings in nature, excessive water use and destruction of pastures and grassland (Günaydın, 2005). The sustainability of life is directly connected to sustainability in agriculture (Bahsi, 2020). However, there are concerns about sustainability all over the world. Sustainability has an important place in economic development. In this context, it is necessary to determine the weaknesses and strengths of countries by establishing a substitution relationship between sustainability and new technology (Yeni, 2014). It defines the developing technology innovations to achieve the Sustainable Development goals. In the World Economic Forum report, attention was drawn to the effects on sustainability, inclusiveness, productivity and health in food systems (Anonymous, 2019).

Today, agricultural markets are rapidly globalizing. Increasing integration of agro-industrial chains, increasing agricultural trade volume, changing trade policies, volatile food prices, increasing agri-energy sector linkage are causing the redefinition of agriculture as the basic element of economic growth in developing countries (Braun, 2008).

In recent years, an intense competitive environment has emerged with globalization. Enterprises need to gain competitive advantage in order to continue their economic activities. The most important way to gain competitive advantage is to have innovations. Businesses provide significant gains thanks to innovation. Competitive advantage is achieved by reductions in production costs (Akıncı, 2011).

Today, innovation is the leading actor in the increase of economic growth, welfare and living standards (Yılmaz and İncekaş, 2018). It is one of the most important sources of this change and transformation in the agricultural sector. Global developments in the agricultural sector and the role of innovation should be evaluated in developed and developing countries. This situation provides important information in the process of determining the policies that shape the future of the sector. Developed industrial countries do not put agriculture in the second place. On the contrary, these countries carry the agricultural sector to a strategic position with their scientific research and development studies, production, processing, marketing, system and organizational innovations. The use of new technology in agriculture increases the production of products with high added value (Uyan, 2018).

With the developing technology, the concept of Industry 4.0 has started to be mentioned in recent years. Industry 4.0 is a concept introduced in Germany in 2011. In the 21st century, there has been a rapid change and development in technology, especially in information technologies. Experts are investigating how to use this rapid change in the industrial sector. In this context, they put forward studies on the use of information processing technologies (ICT) in the industrial production structure. Artificial intelligence is the main actor in this structure. The reflection of the change process in the agricultural sector is called Agriculture 4.0. Agriculture 4.0 provides the opportunity to carry out sustainable agricultural activities in optimum conditions. In this agricultural approach style, which is expressed as smart agricultural technologies, technology is intensive. Countries using these technologies have the opportunity to control all kinds of agricultural activities. These systems increase the chance of being fast in decision-making processes and using the information for the desired purpose (Saygılı et al., 2018). The value of trials on innovation adoption decisions comes from improving skills (for example, in the agronomic management of a crop) as well as reducing uncertainty about the long-term profitability of the innovation (Ghadim and Pannell, 1999). In addition, digitalization has started to become widespread in the marketing of agricultural products in the world and in Turkey. While the farmers could reach the final consumer directly, digital channels provide a marketing advantage to the agricultural sector (Kara, 2018).

The aim of this study is to emphasize the significance of digitalization in agricultural production and evaluate its use in agriculture from production to consumption.

2. Use of Technology in Agriculture

Agriculture is the sector where technology has started to transform the most. The agricultural sector is known as labor-intensive but actually it is capital-intensive. However, it is evolving into a knowledge-intensive industry. Creating value added with agricultural technologies is as important as being a regional base and supply center in agriculture. Agriculture is a major entrepreneurial sector. In recent years, agriculture has become the application area of advanced technology. There is an idea that the world population will reach 10 billion by 2050 and that global food production will be doubled. Agricultural activities have started to be followed not only by the farmers but also by the society. Agriculture has now become the “agriculture-food” sector. Similar to other sectors, it crosses national borders. In addition, with the support of its corporate network, it has gained the appearance of supplying goods and products to the world market (Anonymous, 2022).

In recent years, more space has been devoted to innovative agriculture, agriculture 4.0 and precision agriculture practices in agriculture reports. This change also affects farmers, manufacturers, marketers, retailers, consumers, and governments that interfere with the flow of goods and products. According to the "Smart Agriculture Market Research" conducted in 2017, the value of the world smart agriculture market increased from 13.7 billion dollars in 2015. This value shows that smart agriculture practices will be the factor that will affect the agricultural sector till 2030. Between 2017 and 2022, the global market share of agricultural technologies and smart agriculture applications is expected to increase from $9.58 billion to $23.14 billion. In the "Agriculture 4.0: The Future of Agriculture" Report of the European Agricultural Machinery Association, it is stated that there are 4500 manufacturers with an annual turnover of €26 billion, producing 450 different agricultural machinery in Europe, and 135 000 people are employed in this sector. The relationship between agriculture and technology has increased significantly in recent times. Within the scope of smart agriculture, there are machine-to-machine communication, drone applications, autonomous tractors, sensors, cloud technology and augmented reality applications. It is predicted that internet applications used in agriculture will reach a volume of $30 billion on a global scale by 2023. In Smart Agriculture and Agricultural Technologies, within the scope of Agriculture 4.0, the Ministry of Agriculture and Forestry has allocated a resource of ₺900 million for these applications in Turkey. It is planned to double this support in the coming period. With the creation of a database and encouraging young people to agriculture, the share of agriculture in development will increase in the coming period. With the development of new applications such as nanotechnology, precision agriculture and contract agriculture, it is expected that the agricultural ecosystem will be renewed and its productivity will increase. Thus, it is expected that the agricultural ecosystem, which will reach the customer through inputs, cultivation, productization and distribution, will be renewed (Anonymous, 2022).

As in all areas, marketing in the virtual environment on the basis of agricultural products draws attention. Agricultural product sellers carry out their marketing activities through the use of websites, social media and mobile applications. With the use of new technology in agriculture, new markets are formed. It also supports the variety of products in the markets. However, rapid technological developments are changing the concept of communication all over again. These forms of communication are the internet, which is also called a virtual environment and is a communication channel. Communication media are becoming increasingly digital and enriched via the internet. In other words, instead of one-way information transfer in communication media, interactive communication media are becoming dominant. A communication strategy cannot be determined without considering especially interactive communication on the internet and social media consisting of friend groups. A great deal of cost is incurred by the intermediaries in the delivery of agricultural products to consumers. For this reason, marketing agricultural products to consumers through new communication media attracts the attention of practitioners and researchers (Kara, 2018).

When the effect of the virtual environments used on marketing is examined, it has been determined that electronic commerce sites are not very sufficient in terms of performance in Web sites. However, it has been understood that the sites are sufficient in terms of security, SEO (search engine optimization) and mobile compatibility. One of the important findings in the marketing of agricultural products in new communication environments is the use of social media. The Internet has ceased to be a one-way channel where enterprises offer their products to consumers, and has become interactive and versatile. Consumers are both suppliers and consumers, unlike the traditional client-server model. Big enterprises often provide centralization and standardization of information in their information system networks. In social media networks, information is created by consumers and is closely related to consumer trends. Marketing of agricultural products in new communication channels provides a great advantage with the development of communication forms (Kara, 2018).

3. Some Factors Affecting Adoption of Innovations and Technology in Agriculture

An object, practice or idea that is perceived as new by the applied group or individuals is called innovation. An idea is an innovation if it seems new to the individual (Tatlıdil, 1997). The rate of adoption of innovations differs within the social system (Rogers, 1995). The reasons for the different adoption rates could be explained by the characteristics of the innovations. These are the advantage, suitability, complexity, trialability and observability of the innovation (Aydın et al., 2018).

There are different inputs and methods that could be considered as innovations in the functioning of agricultural activities. Seed, tool-machine, method, fertilizer, medicine could be considered as an innovation in terms of farmers.

Many factors affect the adoption of innovations in agriculture. In the research, the approach to the use of new technology changes by the age, gender, education level, income and experience of the individuals. Rogers (1983) classifies the factors affecting adoption of innovations as personal variables, socioeconomic characteristics (such as age, education, social status, credit use, farm size) and communication behaviors. Besley and Case (1993) considered empirical approaches to technology adoption as examples of dynamic choice and learning from the behavior of others. Öztürk (2010) found that operating land, production area and number of parcels were efficient in determining the level of innovation. Negatu and Parikh (1999) it was stated that variables such as individuals' farm size, farm income and soil type have an important role. Weir and Knight (2000) and Türkyılmaz et al. (2003) examined the role of education in the adoption and diffusion of agricultural innovations. It has been determined that educated farmers are more effective in adopting and disseminating innovations than less educated farmers. Türkyılmaz et al. (2003) and Karaturhan et al. (2005) determined that the social participation levels of farm owners and the ability of empathy have a significant effect on being aware of and adopting innovations.

Boz et al. (2011) were stated that the breeds of animals raised, income level, age of the operators are effective in adopting the innovations and in the investment decision making process. Boz (2014) found that adaptation level is affected by the membership of the cooperative, the investments made in the farm, the size of the farm, having a developed cultural race, income level, reading the newspaper, using the internet, contacts with the publishing personnel and veterinarians, and socio-economic variables. Sow (2016) was stated that there is a relationship between farm characteristics and innovation practices. In addition, company size, equipment investment, employee training, age of the firm and the type of product it produces, and the amount of product put forward are the other factors that have an effect on decision. Ajak and Demiryurek (2017) were determined that farmer's age, experience, knowledge, family size, family workforce, number of workers in the farm, agricultural gross income of farms, livestock production income, width of agricultural lands, production area, product yields, access to agricultural information resources, market and marketing experience and innovation systems have been instrumental in the adoption of innovations. Noga et al. (2017) found that the adoption of innovations includes institutional relations, availability and/or supply of deterrent innovation inputs, contact of farmers with extension agencies, and government support for extension services. Yener (2017) found that the education of the farmer, income level, follow-up of innovations, level of influence from other farmers, labor costs and the milk cooling tank, feed mixer and milking unit machinery and equipment they use in agricultural production are effective in the spread out and adoption of innovations in enterprises. Dhraief et al. (2018) argued that in terms of economic and socio-demographic factors, farmer education level, the size of cattle herds and non-farm income are effective in the adoption of innovations. Ntshangase et al. (2018), farmers' perceptions of no-till conservation agriculture and the factors affecting the adoption of no-tillage conservation agriculture in the study area were stated to be effective in terms of high crop yield, extension visits, age, education, and the increase in farmers' positive perceptions. Bahşi and Kurt (2019) declared that income level, high prices of product, increase demand, guarantee and easiness in marketing, technical training and support and effective information have an effect in adoption of organic agriculture by farmers. Weyori et al. (2018) found that social network capital has a critical role in the adoption of advanced farm technology. Abegunde et al. (2020) identified the factors affecting the level of adoption of innovative Climate-Smart Technology (CAP) practices by small-scale farmers. These are education level, farm income, farming experience, size of farmland, contact with agricultural extension, media exposure, agricultural production activity, membership in an agricultural association or group, and perception of the effect of climate change. Kaya and Bostan Budak (2022) determined that the irrigation method preferred by the farmers were affected by their education level, family size, education on irrigation systems, bookkeeping habits, annual income, newspaper preferences, crop yield, cultivation area, land presence, loan usage, crop cultivation intention, reveals that there is an important relationship between variables such as environmental awareness.

4. Internet Use and Literacy in Turkey

According to the results of the household information technologies usage survey, it was determined that 94.1% of them had the opportunity to access the internet at home in 2022. This rate was 90.7% of households in 2020 and 92.0% in 2021.

While internet use was 79% in the 16-74 age group in 2020, it rose to 82.6% in 2021 and to 85% in 2022. It is found out that 76.5% of the 16-74 age group use the internet regularly (almost every day or at least once a week) during the first three months of 2020. These ratios increased to 80.5% and 81.7%, in 2021 and 2022, respectively. (TUIK, 2022). Internet use also differs by gender.

As seen in Table 1, men use the internet (86.9%) more than women (78,69%) on a regular basis.

Table 1. Average internet usage frequency of individuals (%)

Frequency of use	Female	Male	Total
Regular internet use	78.6	86.9	82.7
Several times a day	64.9	73.3	69.1
Once a day or almost every day	10.9	11.0	10.9
At least once a week (but not every day)	2.9	2.6	2.7
Less than once a week	0.7	0.7	0.7

Reference: TUIK, 2022

In recent years, individuals have been carrying out their official business through their websites. They have started to buy goods and services and place orders over the internet. In addition, subscriptions, internet use for learning activities and social media use have increased in the world and Turkey.

The change and development of the literacy rate of individuals in Turkey over the years is given in Table 2. The literacy rate of individuals differs by gender. It is seen that the literacy rate of women increased by about 5% between 2010-2021. It is understood that the significance given to education in Turkey has increased with the increase in the literacy rate of women (Table 2).

Table 2. Change in literacy rate in years (%)

Years	Female		Male	
	Literate	Non Literate	Literate	Non Literate
2010	90.13	9.87	97.79	2.21
2015	93.72	6.28	98.71	1.29
2016	94.1	5.9	98.88	1.12
2017	94.47	5.53	99.0	1.0
2018	94.83	5.17	99.1	0.9
2019	95.26	4.74	99.22	0.78
2020	95.54	4.46	99.29	0.71
2021	95.75	4.25	99.28	0.72

Reference: TUIK, 2022

5. Conclusion ve Recommendations

The agricultural sector is a strategic sector that has gained importance with globalization, especially in developing countries, due to its impact on poverty reduction, food security, input supply to industry, foreign Exchange and economic growth. According to the agricultural indicators of Turkey, it can be said that Turkey cannot adequately evaluate its agricultural potential. In the agricultural sector, it is necessary to rise the added value, income, production, quality and reduce the costs. To increase agricultural potential, innovation has an important role in Turkey. It contributes to the reduction of the foreign trade deficit and food inflation. It also supports the supply of quality, affordable and stable inputs to the agriculture-based industry. It reduces the production costs of small agricultural enterprises, which is an important problem for Turkey, and supports the marketing conditions.

Technology has been changing rapidly in recent years. Production methods and technologies are constantly developing in agriculture. Innovative approaches in the stages of production are offered to the use of farmers. In particular, innovations have spread in a wide perspective depending on the developments in information and communication technologies, biotechnology and nanotechnology. In terms of agricultural development, the level of technology can be a good indicator of development. Generally, agricultural farms prefer to continue the current conditions. It is not easy for the farmers to accept the innovations by spreading them over time.

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CHAPTER II

CLIMATE SMART AGRICULTURE APPROACH IN AGRICULTURAL ECONOMICS

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1. Introduction

It is widely known that climate change as a result of human development and economic growth affected agricultural systems and food security to meet the need of food demand. Increased food demand result with increased food production that causes more greenhouse gas emissions (GHG) consecutively contribute to climate change (Li et al., 2022). Darting a quick glance nearly all publications which are concerning the future of agriculture in the world, a repeated scenario comes in view. Enourmous increase in population brings out climate change and this projection comes with the results of global food security challenges (Taylor, 2018). It appears unavoidable climate change affect negatively people in the future, as it was in the past. Moreover, extreme weather events can arise social issues such as migrations and health problems(Gultekin et al., 2016).

In the report "The Future of Food and Agriculture: Alternative Pathways to 2050" Food and Agriculture Organization (FAO) stated that food and agricultural systems are troubled by trends that could risk the future sustainability of them. Population and income growth result with the demand for food and cause changes in people's nutritional preferences. Constant poverty, inequality and unemployment restrict access to food and that obstruct the success of food security and nutrition goals. On the other hand climate change affecting yields and people who live in rural areas. As long as food and agricultural systems abide on their current path,, there is a future for humankind resulted with food insecurity and unsustainable economic growth the evidence shows (FAO, 2018). "Human caused climate change" entails repeated and intense extreme events resulted with losses and damages to environment and all environmental components broadly. Unquestionably some attempts and efforts have helped to reduce the effects. Beyond sectors and geographic positions the most vulnerable people and systems are noticed to be affected in a way that is not in accordance with equality and justice (IPCC WG II, 2022). In 2022, Intergovernmental Panel on Climate Change (IPCC) released its' last report and stated that beyond 2040 considering the current level of global warming climate change will lead to countless risks to natural systems and needless to say to humans. IPCC also declared that the impacts and hazards of climate change develop into a complex form which resulted in management challenges. Farming systems deals with pressures in twofold. One is to reduce greenhouse gas (GHG) emissions to help the mitigation of climate change and other is adaptation of climate change considering food security (He et al., 2022). It is very known that there is a need for considerable investment for the actions that encompasses adaptation and mitigation of climate change. These actions toward a climate smart food system that climate change influences food security (Wheeler & von Braun, 2013). It is crucial to adress climate change for safeguarding food provisioning from agricultural systems (Brandt et al., 2017). Effects of climate change in agriculture sector varies. Dry spells, droughts, floods, erratic rainfall, cropping schedule changes and rising temperatures (Bryan et al., 2013; Musafiri et al., 2022; Ochieng et al., 2017).

In 2010 at the Hague Conference on Agriculture, Food Security and Climate Change, Climate Smart Agriculture (CSA) defined and presented by FAO. CSA integrates the three dimensions of sustainable development which are economic, social and environmental dimensions. Furthermore CSA consists of three main pillars such as: 1. sustainably increasing agricultural productivity and incomes; 2. adapting and building resilience to climate change; 3. reducing and/or removing greenhouse gas emissions, where possible. Agriculture and food systems should experience powerful transformations with regard to meet the challenges of food security and clime change. Rising the efficient use of resources is crucial not only for food security but also mitigation of the climate change on the long term. With respect to resilience it has also great importance to be prepared for uncertainty and change. Efficiency and resilience have to be considered together from three perspectives such as environmental, economic and social. Moreover Climate Smart Agriculture should be defined as a new approach. It should not be define as a new system not new practices. CSA should be seen as a guide to adress the changes which should be considered as a result of the food security and climate change (FAO, 2013). CSA is an innovative approach and CSA may accomplish the development goals of fragile populations who are highly dependent on agriculture. Furthermore this goal achivement task will depend on effective management of the pillars of CSA such as mitigation, adaptation and productivity. The concept of CSA is already embedded in many practices, tools which have helped farmers to produce food while they are facing with the effects of climate change (Partey et al., 2018).

The purpose of this study is to present a narrative review regarding the practices of Climate Smart Agriculture. At first the study briefly reviews the concept of CSA not only viewpoint of FAO that firstly described an introduced, but also for other researchers. It then offers a more in depth consideration of the research literature pertaining to the studies that encompasses CSA practices all over the world. The study is structured as follows. The following section provides brief background about the concept of CSA. Section 3 presents studies which are using CSA practices as a research method. Finally Section 4 concludes the study with statements.

2. The Concept of Climate Smart Agriculture and Its Practices

2.1. Climate Smart Agriculture Concept and Twisted Challenges

In 2010 World Bank released "World Development Report 2010: development and climate change" report and "climate -smart term was firstly used (Taylor, 2018). The term was used to outline policies which enhance development, reduce vulnerability and finance a low- carbon growth path. In addition to this concept climate smart world encompassing actions that need collaboration, urgency and makes difference from past habits(World Bank, 2009). As World Bank defined climate smart world concept very briefly it consists "acting now, together and different". But it was the FAO that defined the concept of CSA in a structured and formal form in 2010 at the Conference on Agriculture, Food Security and Climate Change at the Hague (Taylor, 2018). A few years after the concept of CSA was launched, FAO published the first edition of the Climate -Smart Agriculture Sourcebook in 2013. In 2017, second edition of the book released. According to FAO, CSA sourcebook is being transformed into a "living" digital source to be able to guide policy makers, programme managers, experts, extension agents and academics better. The first edition of the sourcebook was containing 18 modules. After the revision five new modules were added to new digital version (FAO, 2022).

Agriculture and food sectors need to deal with three challenges twisted together. These are: increasing agricultural productivity in a sustainable way to meet global demand; adapting to climate change; contributing to climate change mitigation (FAO, 2013; FAO, 2010; Beddington et al., 2012a; Beddington et al., 2012b; Foresight, 2011; HLPE, 2012). In other words we can name three intertwined challenges including sustainability, food security and climate change (FAO, 2022). We should understand the concept of sustainability consisting three dimensions: economic, environmental and social. With this point of view a sustainable farming system should be profit making (economic), should establish favorable relationships among community around (social) and finally should contribute for the sake of the land and other natural resources (environment). Sustainable agriculture development is designed to improve productivity, manage and preserve soil fertility and enhance the efficiency of resource management. Moreover sustainable agricultural development contributes to growth of equity and social well being. The key to success of these numerous objectives is the adoption of an approach consisting systems, that means considering food system as a "whole." Food security is another important issue to combat. There is four dimensions of food security: food availability, access to food both economic and physical, food utilization, stability (vulnerability and shocks). Climate change affects food availability as a result of adverse effects on crop and animal productivity. Declining productivity of agricultural products causes producers suffer from lower yields. Lower yields increase prices and that resulted with poor -both urban and rural- have to spend much higher shares of their budget on food. Food utilization can be defined as food quality in terms of nutrition and food safety. The last but not least dimension is climate related shocks such as drought or flood (FAO, 2022).

2.2. The need for Climate Smart Agriculture and Implementation Process

As noted in the previous section climate smart agirculture has three principal goals. While implementing CSA practices it can be understood that in every location should meet afore-mentioned goals. On the contrary CSA approach pursues trade – off elimination and encourage collaboration by taking these goals into consideration. It is essential to understand that CSA approach aims to collaborate with agricultural producers, policy makers and researchers who make decisions at the all levels about all kind of strategies. Climate Smart Agriculture is not a class of practices that can be applied generally rather an approach that can be customized regarding the local needs.

As mentioned before CSA builds its approach on sustainability. To achieve this main goal CSA use principles sustainable land and water management and evaluates the use of resources and energy in food and agriculture systems. For the countries where their growth nearly dependent on agriculture, this main goal is very crucial. We can name this countries as developing countries. Apart from such efforts CSA also help to reduce greenhouse gas emissions (GHG) or increasing carbon sequestration. Research organizations and extension services should involve in the policy making to help to spread information on climate change and its social and economics impacts. FAO introduced five action points for implementing climate smart agriculture apprach (FAO, 2022). Action points would be a beneficial guide to countries that decide to implement the approach. Countries may differ but main points remain same. Hence the key points are general but very helpful to initiate the process.

Five action points are:

I. Expand the evidence base

II. Support enabling policy frameworks

III. Strengthening national and local institutions

IV. Enhancing financing options

V. Implementing practices in the field

Figure 1 shows the schematic representation of three pillars of CSA and action points FAO developed.

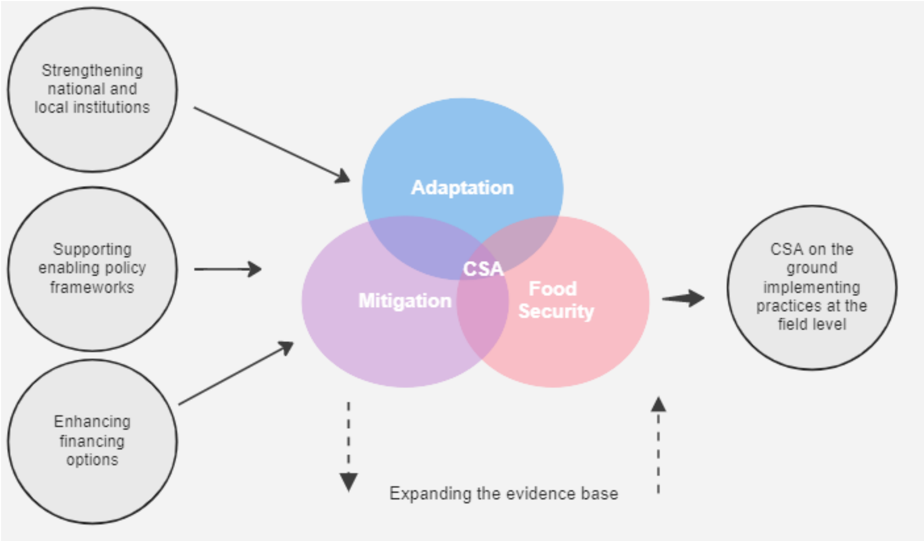

Figure 1: Three Pillars of CSA and Action Points

Figure adapted from (FAO, 2022)

In impelementing CSA approach the initial step is to establish a powerful evidence base, which means to build a framework considering to increase productivity and incomes and how to mitigate. This step needs both analytical work and a collaboration with stakeholders who can give advice. Moreover this step also include social and economic aspects of the implementation. In the second step, empowering policy frameworks are fundamental to safeguard the previous step. For the new policies it is very crucial to aim to fill the policy gaps and make contributions to country oriented approach which include understanding and eliminating socio economic and gender differentiated barriers or improving the motivation of the adoption of practices. Cross sectoral dialogues, which play an important role in implementing the practices create the third step. This form of dialogues can consist workshops, presentations or disscussion sessions which sectoral members involved. In the fourth step is an another crucial step for implementing climate smart agriculture. Merging climate change subjects to agricultural sector budget and planning helps to address the effects of climate change succesfully. The very first step " expanding the evidence base" for climate smart agriculture can provide information to complete this step. Finally, agricultural producers are the experts of their own environment. They have knowledge about their local ecosystem and climatic patterns. Hence effort for implementation could not be successful if the local experts not taken into account. Manager of local institutions should be engaged with local producers to discover the suitable climate smart agriculture options.

3. Literature Review

This section provides a brief information about the climate smart agriculture literature. Noting that is important as this study is a non-systematic review study. Studies selected regarding the criteria such as year (between years 2020 and 2022), indexed journal (SCI or SCI-E), methods employed (empirical studies) finally research field (only agricultural economics). The articles reviewed in the paper were sourced only Science Direct database. The aim of this section is to understand how climate smart agriculture has been studied in the relevant literature. There are various studies in the literature but in this study the main motivation is to present the outcomes of current research studies.

3.1. Selected Studies

Amadu et al. (2020a), studied in southern Malawi. As widely known in the literature, Sub -Saharan Africa threatens by climate induced shocks and various effects of climate change. In their study they analyzed maize yield effects on agroforestry within a large CSA project. Agroforestry is widely promoted farm level CSA practice and agroforestry is a key component of many CSA programs. (Amadu, Miller, et al., 2020a). As a result of their study Amadu et al., (2020a) founded a positive and statistically significant yield effect of CSA program participation and the intensity of agroforestry fertilizer trees. The results also showed that engaging agroforestry into CSA projects could increase agricultural yields among smallholder farmers. Another study of Amadu et al. (2020b), they developed a typology of farm- level CSA practices to facilitate anaylses of CSA adoption. Their study field was southern Malawi again. As a result of their study they founded positive and statistically significant effects of program participation on adoption of CSA practices. Generally strongest effects found on resoruce intensive CSA categories. Therefore CSA funding increased the adoption probability of more resource intensive CSA categories (Amadu, et al., 2020b).

Martey et al. (2020) conducted their study in Ghana. They identify the relevant factors influencing the adoption of row planting and drought tolerant (improved) seed. Drought tolerant seed and row planting tools are component of CSA. Moreover they employed Multinomial Endogenous Switching Regression (MESR) model to measure the effect of drought tolerant seed and row planting on yield. Finally, they demonstrate the effectiveness of row planting to increase climate change resilience. As a result they found that drought tolerant maize varieties and row planting icreases yield in Ghana (Martey et al., 2020).

Amadu et al. (2020c) founded that among CSA adopters in Malawi maize yield increased in a drought year. Their study results demonstrate thay policies and funding systems supporting CSA can have important positive impacts on food security. Low income producers who are facing with climate uncertainty can boost their crop yields with the help of CSA practices (Amadu, et al., 2020c).

Another study analyzed the effects of drought tolerant crops is Ogada et al. (2020). In the study they found that drought tolerant crops improved household income and asset accumulation in Nyando basin, Kenya. The data in the study comes from a project that assess the impacts of CSA technologies and practices by introducing Climate Smart Villages (CSVs). CSVs are villages where located in differenet agro- ecological zones but facing with climate risks and vulnerabilities. In this group of villages every village has various activities such as water smart, carbon smart crop smart etc. These findings also show that the adoption of modified crops improves household asset accumulation by increasing income (Ogada et al., 2020).

Zakaria et al. (2020), reported that climate smart agriculture has been promoted as a means of climate change adaptation among Ghanian farmers. In the study Zakaria et al. (2020), determined the role of farmer participation in training programmes for the adoption of climate smart agriculture practices. Finally they stated that participation in training is endogenous and it is positively influenced by farmers' access to extension services(Zakaria et al., 2020).

Additional study supports the findings of previous study is Muench et al. (2021). One of the finding of the study is that farmers who attend training freuquently used a wider range of adaptation strategies (Muench et al., 2021). In their study they applied CSA framework to comprehend the degree of climate change adaptation among the smallholders tea farmers in Nepal. Muench et al. (2021), added that common adaptation strategies are crop diversification, soil conservation, agroforestry and the usage of cultivars which are less sensitive to climate change.

Intensive soil tillage can cause to increase negative environmental impact due to GHG emission. Climate smart agriculture is concerned with increased adaptive capacity and the reduction of GHG emissions. Minimum or zero tillage methods are also considered as part of the solution that can contribute CSA objectives (Rahman et al., 2021). According to Rahman et al. (2021), soil organic carbon accumulation rate of converstation tillage (minimum and zero tillage) exceeded conventional tillage. Furthermore minimum tillage method had the lowest carbon and water footprint among other methods.

In their study Ngoma et al. (2021), assessed if climate smart agriculture reduces the cropland expansion in Zambia. One of the result of their study is that they did not find statistically significant associations between adopting CSA and cropland expansion (Ngoma et al., 2021).

Pangapanga – Phiri and Muntgatana (2021), examined drivers of CSA practices' adoption and their influence on the technical efficiency of maize production under extreme drought episodes. One of the finding of this study is that drought episodes substantively increasing the adoption of organic manure by 76 % and soil and water conversation by 29 %(Pangapanga-Phiri & Mungatana, 2021).

Considering afore-mentioned studies they are all conducted in low income countries as their economies are heavily dependent on agriculture sector. Nevertheless Ibrahim and Johansson (2021) conducted their study in Sweden. They are also stated that there are not many studies that have explored farmers adaptation capacity to climate change especially in Nordic countries. Finally they found that agriculture activities are believed not to impact the climate and environment, farm scale adaptation interrventions are perceived less effective than regional ones and many farmers are skeptical to climate change (Ibrahim & Johansson, 2021).

Scognamillo and Sitko (2021) assessed the interactions between Malawi's largest public work programme and climate smart agriculture practices. They reported that sustainability of adoption soil water conservation can be built with the combination of public works participation. In addition to this integration of social protection support with the promotion of Climate smart agriculture will help to advance the CSA agenda (Scognamillo & Sitko, 2021).

Kangogo et al. (2021) disscussed if farmer entrepreneurship plays role in influencing the adoption decision in smallholders. In their study they reported that there is need for targeted entrepreneurship training programs to influence smallholder's adoption decisions. Also focusing on the intensity of resources that need to adopt CSA practices provide more insights on the adoption decisions (Kangogo et al., 2021).

Previously mentinoed about soil and water conversation technologies which are components of CSA practices are discussed in Mairura et al. (2021) study. They found that there is a link between using of soil and water conversation technologies and perception of climate variability (Mairura et al., 2021).

Akter et al. (2022) measured income and yield effects of climate smart agriculture adoption. Their study conducted in flood prone areas of Bangladesh. They stated that if non adopting household are soil salinity concious and adopt CSA practices their yield would increase by 7.55 %. They declared that CSA is an essential way to safeguard food security and diminish rural poverty in a changing climate conditions (Akter et al., 2022).

Another study conducted in Climate Smart Villages (CSVs) is Thant et al. (2022) study. They stated that application of a CSA strategy are central to safeguarding the food system's productivity to deliver the wanted outcomes such as food security, decreasing malnutrition and empowering fragile groups (Thant et al., 2022).

An additional study about farmers entrepreneurship is conducted in Kenya. Andati et al. (2022) reported that based on PCA analysis, their study considered siz categories of CSA practices and found that farmers' entrepreneurial orientation had mixed influence on CSA adoption. They added that there is a positive influence on crop management but there is negative influence on water harvesting technologies (Andati et al., 2022).

According to Mashi et al. (2022) promoting to use of CSA technologies by farmers there is the need to properly understand the key variables that determine the extent to which farmers are aware of the technologies as CSA technologies and practices are important for promoting sustainable crop yield increases and to address the challenges of climate change (Mashi et al., 2022).

4. Concluding Remarks

Climate change and its impact on environment is not a challenge for limited countries in the world rather it effects all types of economies. It should be understood that the major barrier on the sustainable food production and sustainable environment is climate change. It is widely known that jeopardized agricultural production brings consequences for livelihoods and food security. There are various efforts to eliminate the impacts of climate change on human and environment. In this study climate smart agriculture evaluated following the findings of the study I herewith discuss key points.

First, literature review demonstrates various studies focused on low income economies like sub Saharan African countries. These countries are facing with serious impacts of climate change. Aside this fact it is also widely known that climate change is not a problem of specific countries, its negative effects surrounds all over the world. Furthermore this is a result of Sustainable Development Goals of United Nations are focusing especially on vulnerable ones. In the mentioned studies it can be seen these researches are outcome of various projects funded by international institutions. Rare studies focused on developed countries regarding the adoption of CSA practices.

Secondly, as previously mentioned CSA practices needs collaboration with all levels of stakeholders. To accomplish this there should be a target that stakeholders focus. Large scale such as climate smart villages (CSVs) could be a beneficial example of this integration and collaboration.

Finally, training programmes are very important to adopt the practices. As various researches support this finding the success of adoption connected with training programmes.

Selected studies and a brief introduction to CSA is presented here. For future research it is recommended to compare studies country and scope base. That will give insights to researchers about the succession of CSA adoption studies.

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CHAPTER III

THE ROLE OF WOMEN ENTREPRENEURS IN AGRICULTURAL PRODUCTION*

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1. Introduction

The dictionary equivalent of entrepreneur as a term is stated to be (entrepreneurs) who put forward capital and venture in areas such as agriculture, trade, and industry. According to the Dictionary of Economic Terms of the Turkish Language Association, an entrepreneur is defined as "a person who brings together labor, capital and natural resources and initiates the production process, designs, organizes and takes all risks upon himself". According to the Maltese thinker De Bono: What defines an entrepreneur is the desire to make something happen. It is no different from the desire of a writer or painter. To reveal or develop something that did not exist before is its greatest goal (Titiz, 1998). As an entrepreneurial concept, it is defined as people who obtain the factors of reproduction by producing economic goods and services and marketing them, repeating these transactions regularly, having a profit purpose and undertaking all the risks that may arise at the end of the

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enterprise (Tosunoğlu, 2003). Likewise, entrepreneurship requires minimizing them with risk management or directing them to other areas (Özden et al. 2008). According to Schumpeter, there are four different behavioral indicators of a successful entrepreneurship. The first one is to offer a new good or service to the market, the second is the development of a better method of production, the third is the capture of a demand gap that has not been noticed yet by others, and the last is the establishment of a new company in an industrial field (Ercan and Gökdeniz, 2009).

The transition period from hunting and gathering to sedentary agriculture has greatly increased the rate of economic and social development of people and increased entrepreneurial activities (Kutlu, 2006). The industrial revolution that arose in England led to the formation of a brand new economic order and the increase of wealth. This new period has contributed to the reshaping of entrepreneurship and to make entrepreneurs more effective. Within this socio-economic and cultural transformation, the concept of entrepreneurship has also changed and the entrepreneur who breaks away from waste and retention has been replaced by an entrepreneur who thinks more calmly, knowledge-based and has an innovative understanding (Ercan & Gökdeniz, 2009). This change in the quality of the entrepreneurial individual has also increased the economic value of the entrepreneur and therefore its importance in society. As a natural result of this development, entrepreneurship began to seen as a factor of production (Aytaç, 2006).

Joseph Schumpeter formulated the fundamentals of the theory of economic entrepreneurship. In Schumpeter's views, entrepreneurship is an invention, or more commonly, an unimplemented technological opportunity, to create a new commercial product, or to innovate the mode of production to produce an existing product in a new form. In Schumpeter's definition, entrepreneurship involves innovation, so the title entrepreneur is not a permanent status. According to this definition, entrepreneurs are those who use opportunities and innovate. Therefore, entrepreneurs do not have to be just those who start new companies. Therefore, any employee in the firm can also become an entrepreneur by innovating. In this sense, entrepreneurship is a kind of management that requires the protection of opportunities other than the resources that are still at hand. Entrepreneurs identify opportunities, combine the necessary resources, implement a practical plan of action, and achieve the results in a specific time and flexibly (Schumpeter, 1974).

Entrepreneurship; to have the ability to sense the opportunities offered by the atmosphere in which we live, to make some plans from those intuition, to transform these plans into projects, to facilitate human life with projects. Entrepreneur; are people who produce goods or services by seize opportunities with an innovative business idea or an existing business idea, bringing resources together and taking risks. The entrepreneur candidate has a business idea that contains innovation by seize the opportunities or the potential of an existing business idea and makes the necessary researches about the initiative and investigates how to access the necessary financial resources and is in the process of established a business.The entrepreneur candidate should be called an entrepreneur if he completes all his studies and establishes his business.

The concept of 'big producer' emerged in the Middle Ages and in the 17th century it was described as a 'risk-taker' and included the concept of risk. In the 18th century, the characteristics of risk taking and owning capital were considered as a separate issue. In other words, it has started to be defined under the name of 'the person who takes risks different from the capital owner'. In the 19th century, the profit belonging to capital was separated from the profit obtained from the enterprise, and in the 20th century, the concept of entrepreneur began to take its general form and began to be defined as 'innovative, organizer and moderately risk-taker'. Entrepreneurial activities, which started with the industrial revolution, have become a period in which various policies have been put forward and important changes have been made worldwide in the second half of the 1970s. Some economists who belong New Classical Schools demanded the liberalization of markets, market disruption, the abolition of interventions in markets for various purposes and the liberalization of markets to make their own movements, and an end to state intervention and participation. The adopt of these New Classical Policies and the reduction of the place of the state in the economy in all countries and the abolition of direct intervention in the markets and privatizations enabled the spread of liberalization in foreign trade. Turkey joined this new classical trend with the implementation of the stability policy of January 24, 1980. All these developments have increased the importance of entrepreneurship, which came to the agenda with the industrial revolution, and accelerated its formation (Şahin, 2002).

Entrepreneurship is increasingly recognized as an important driver of economic development, productivity and employment, and is recognized as a key element of economic mobility. Turning ideas into economic opportunities and putting them into practice is the defining element of entrepreneurship. In the early ages of history, women were engaged in soil and men were more engaged in animal husbandry (Özçelik, 2005).

2. Development of Women Entrepreneurship in the World and in Turkey

Looking at historical developments, the term entrepreneurship was used to describe the person who managed large production projects in the Middle Ages. In today's age, the entrepreneur defines himself as the person who manages the project by evaluating the capital given to him by the state without taking any risk in large production projects (Kosgeb, 2018). To understand the development process of entrepreneurship in the world, first of all, the stages of economic endeavors should be examined. Since the lifestyle, economic pursuits and economic thoughts of the society differ in each age, it is seen that entrepreneurship is defined from different aspects in every period. Economic developments in the 20th century have caused entrepreneurship to differ in every era. All kinds of activities such as hunting, farming, animal husbandry and trade, which people do to continue their lives and meet their needs, are indicators that the history of entrepreneurship dates back to the early ages.

If one thinks that women have been pushed into the background since ancient times, it can be said that this situation perhaps forms the basis of social patterns and patriarchal structure. Since this patriarchal structure and social patterns indicate the place of women in society as mothers and wives first, men's entrepreneurial activities have become more evident with this revolution as they existed before the industrial revolution. Women, on the other hand, could only take part in entrepreneurial activities as 'workers' or 'wage earners'. Due to these problems faced by women in their working lives, it has been brought to the agenda of the UN since the 1950s and an intensive work has been started to increase women's participation in economic activities all over the world (Şahin, 2006).

Entrepreneurship reduces the problem of unemployment, increases resource and human productivity, and increases the income level and well-being of society. For this reason, special importance is attached to the issue of encouraging entrepreneurship in developed and developing countries. In the European Union member countries, there are many support programs in order to develop small agricultural enterprises, improve their competitiveness and encourage entrepreneurship (Çakıcı, 2003). In Turkey, it can be said that entrepreneurship culture has recently been developing on an individual and corporate scale, has started to spread and has been encouraged in various ways.

When the history of entrepreneurship in Turkey is examined, it is seen that it dates back to the period of the Anatolian Seljuks. During the time of the Seljuk Empire, an industrial site was established for artisans to perform their crafts and took the name of 'Ahilik Teşkilatı'. During the Ottoman Empire, farming, civil service and military service were preferred as professions and during the Ottoman period, the people started to do trade with foreigners. However, trade was heavily under the control of foreigners in provinces such as Bursa, Edirne and Istanbul. In 1908, with the II. Constitutional Monarchy, there was a revival in the fields of trade and industry. An 'industrial census' was conducted in 1915 on the need for industrialization. This census covered only commercial organizations in Istanbul, Bursa, Bandırma, İzmir, İzmit, Uşak and Manisa benefiting from the Encouragement Industry Law enacted after the declaration of the II. Constitutional Monarchy. In this census, which does not include handicrafts and home crafts, the existing industry was divided into various groups (Kutlu, 2006). With the opening of the industrial school, the people were encouraged to establish enterprises and the necessary supports were given together with the chambers of industry established later. In addition, entrepreneurship could not develop sufficiently before the Republic due to the privileges granted to the British, the fact that the state did not give enough incentives and the ineffectiveness of the incentives given, the fact that the people traded mostly with foreigners and the effects of the war (Şekerler, 2006).

Entrepreneurial activities in Turkey took place with the 1st Economic Congress held in Izmir under the leadership of Atatürk. Atatürk stated in the congress that economic prosperity in Turkey would be achieved through entrepreneurship. With the 24 January Stability Policy, entrepreneurship gained momentum with the transition to a free market economy and increasing foreign exchange revenues from exports and other sources, adopting the open growth model, that is, to ensure integration with the world by reducing the state's interventions in the economy (İyicil, 2006). This shows that entrepreneurship is an important force in economic development.

Liberalization trends in Turkey started in the 1950s. Add to focusing on agriculture, there has also been an increase in infrastructure investments. Increasing weight of the private sector in the industry to 70% is another development seen in this period. The 1960s were the years of transition to a planned economy. In this period, two Five-Year Development Plans were prepared and put into practice. Although the effects of the statism principle continued, the emphasis was placed on the private sector in the planned period and private sector investments increased. Since the 1980s, entrepreneurship has gained momentum in parallel with the policies of opening up in the economy and the acceptance of openness in growth. The market economy provided an opportunity to open up to the world and there has been an important developments in Turkey's economic integration with world markets. As can be seen, the concept of production and trade, which are almost the same age as the existence of human beings, gained great momentum with the developments in the industry that emerged in the 1800s and although they have existed in Turkey for years, they have come to the forefront with the realization of their importance in recent years and have gained the quality of being an indispensable cornerstone of today's economies. It is seen that this whole process contributes to the concepts of entrepreneurship and therefore entrepreneurs take their current form (İyicil, 2006).

The phenomenon of entrepreneurship, which has shown a significant development since the 1980s, has started to be of interest to women as well as men. In today's world, where women have started to enter the business life more and their share in the total workforce has increased, the rapid developments in science and technology and the advances in economic and social development have changed the place of women in society over time and made them an indispensable part of business life (İplik, 2012).

Women's entrepreneurship in Turkey took place on the agenda of society and women for the first time with the symposium 'Supporting Non-Traditional Business Lines for the Economic Independence of Women' organized by the Istanbul Municipality Women's Library and Information Center Foundation together with the Consulate General of the Netherlands in October 1992 (Anonymous, 2000). Due to the impact of entrepreneurship on economic growth and development, its' importance has been better recognized in recent years, efforts have been made to spread it.

A visionary woman who owns her own business and produces and sells services or goods that employ a worker alone or alongside her, who can benefit from credit resources, who can adapt to new conditions, who has experience in her field and who is a feature that should be present in all entrepreneurs is an 'Entrepreneurial Woman' (Şahin, 2006). Women's entrepreneurship is important at least men's entrepreneurship because they can contribute to the economic development of countries. The population of Turkey is 83,154,997 as of the end of 2019. Of this population, 41,721,136 are males and 41,433,861 are females. In other words, males constitute 50.2% of the total population and females 49.8%

(TÜİK, 2020). Supporting the activities that will ensure the economic freedom of women, who constitute such an important part of the population, especially the entrepreneurial activity that will provide both income and employment for many people, undoubtedly, it has a place in the economy of the country.

2.1. Characteristics of Entrepreneurs and Entrepreneur Candidates

In many studies, the characteristics of entrepreneurs and entrepreneur candidates have been evaluated from different angles, except for some basic headings. There is no such thing a successful profile of businessman or businesswoman. However, in order to be a successful, he must have a significant part of the following personal qualities.

• **Risk-taker:** Entrepreneurs and entrepreneur candidates are those who can take risks economically and intelligently without knowing the exact result. Being able to take risks is associated with creativity and being innovative, and it is necessary to realize thoughts. Same time, being able to take risks is associated with self-confidence. The more confidence an entrepreneur has in his own ability, the more he trusts in the results of the decisions he makes, never taking unnecessary risks. Having control of their emotions, they accept risk only when the gains are equal to or greater than the risk involved (Tan & Pazarcık, 1984).

• **Innovative and Sensible Opportunities:** One of the important aspects of an entrepreneur to benefit by making a difference or evaluating the potential of an existing business idea on the condition that they bring a brand new product or service that is unknown. The entrepreneur is the one who observes the environment very well, interprets them with his intuition and brings together the resources to produce products or services that he thinks will be needed in the long run or that he creatively imagines.

• **Leader:** A skill that is based on concrete foundations that everyone can learn from, helping to guide institutions and groups of people in a way that can bring profit or lead to goals. Leadership is one of the qualities that entrepreneurs should have.

Leaders according to Walter (1997),

- They encourage harmony and unity in team spirit.
- They exhibit energy, passion, and enthusiasm.
- Looking to the future with hope and optimism, they continue with determination against all setbacks.
- They set goals and standards with a long-term perspective.

- They have infinite confidence in themselves and their employees.

- They keep the morale and motivation of the employees high.

- Distributes authority and responsibility and supports initiative (Tan and Pazarcık, 1984).

• **Planned Employee Has the Spirit of a Researcher:** The entrepreneur candidate should start the business establishment process after doing all the necessary research regarding the business idea and being ready. Things to do in this process;

- Evaluation of the Potential of the Business Idea.

- Preparation of Feasibility Report.

- Preparation of Business Plan.

- Preparation of Marketing Plan.

• **Have the Ability to Communicate:** One of the key features that contribute to the success of entrepreneurs is personal relationships. One of the most significant reasons that make an entrepreneur successful or unsuccessful is public relations and human relations. If he wants to ensure maximum benefit and continuity of cooperation, he should be able to communicate well with his customers and gain their trust with what he produces. The entrepreneur must also be able to communicate well with his own employees. Keeping the motivation of his employees high, can increase work efficiency to the higher levels.

2.2. Basic Skills of Entrepreneur Candidates

Along with personal characteristics, there are some basic skills that he will need to manage his own business. If one or more of these skills are missing during the entrepreneur candidate initiative, in some cases he may receive help from special consultants' persons and organizations. But for every skill one must have at least one basic grasp (Anonymous, 2000). These basic skills are:

• **Marketing and Sales:** It is the most basic source of benefiting by delivering the goods or services produced by the entrepreneur to the target audience.

Anonymous (2000) has the following elements in Marketing:

- To plan the right goods or services,

- To make a price determination by calculating the costs for the good or service and making a profit estimate,

- Deciding where and how sales transactions will take place,

- To introduce the good or service to customers.

In the sales process, there are the following elements:

- To determine the potential customer network,
- To introduce your goods or services to the customer with a good presentation technique,
- Finalize a sales transaction,
- Delivering or performing goods or services,
- To collect the price of the good or service,
- To provide the necessary service completely after sales.

• **Management:** Basically carry out all the work that occurs within the enterprise and control the formations. Management in business life includes the following activities:

- To determine the resources necessary to implement a certain work,
- To collect these resources and use them effectively,
- To monitor how resources are used,
- To investigate the possibilities of using them more efficiently; For example, reducing the waste rate or increasing production,
- To be able to establish a structure that can be monitored systematically by using time in the best way; For example, a computer software that can monitor all processes from the entry of raw material to the output of the product.

• **Communication:** It is necessary to be in constant contact with different people in business life. These; employees, customers, suppliers, banks, public institutions, accountants, competitors, etc. In addition;

- To collect thoughts and ideas by having the ability to speak and write clearly and to decide what the desired message will be,
- Deciding what will be the best means of communication to convey the message. For example, television advertisement to the customer, official letter to the public institution, telephone fax with suppliers, etc.,
- To check that the message is received and understood.

• **Decision Making:** The basis of all these skills is the ability to make decisions. When there are sudden decision-making situations related to the business or business idea of the entrepreneur or entrepreneur candidate, he/she should have the ability to make quick decisions by thinking fast.

Sub-skills used when making decisions are:

- Using information appropriately and correctly,
- Evaluating the probabilities correctly and making predictions,
- Evaluating the useful and useless aspects of decisions,

- Not ignore the results of different options,
- Make good use of time.

2.3. Women's Entrepreneurship and Its' Importance

After the 1970s, it has been seen that women have made a great leap forward in the world and in Turkey. In other words, women have increased their effectiveness and importance in business life. However, it was not until the 1980s that women gained experience in business life and proved that they could reach high levels. After the 1990s, women were able to compete in higher positions and men head-to-head (Liman, 1993). In less developed countries, fewer women are involved in business life as entrepreneurs. The first women's movements emerged in the United States due to the struggle for the abolition of slavery, which was a source of economic power. It is known that it emerged in European countries after the 1980s. Especially the United States, England and France have been the countries that have struggled intensively to win the rights of women (Aklar, 1993).

Although women have contributed to family life and the economy alongside men throughout an entire era, it was possible for them to start working at affordable wages with the industrial revolution. At the end of this revolution, women left the field and met with working life, and the importance of women as production actors, who started to be employed in every field especially because of their cheap labor, increased day by day (Demiralay & Kaya, 2009).

Generally speaking, in recent years, women have become independent and self-confident about entering the business life compared to the past and have started to gain more place in business life. In this sense, although they are not yet sufficient, they began to be effective in management and establishing partnerships (Gürol, 2000).

As in the concept of entrepreneur, different authors assign different meanings to the concept of women entrepreneur. According to the definitions related to women entrepreneurs, women entrepreneurs;

- A person who has one or more workplaces established in her own name in her home or in a place outside the home and who works with other persons she employs or establishes a partnership as the owner of the business,
- She performs functions such as production, marketing, distribution, sale of goods and services,
- Decides on the organization of the work process, the planning of the production of goods and services, the operation, closure or development of the workplace,

- It is the woman who is effective in transforming her earnings into investment (Yıldız, 2007). Since entrepreneurship means courageously combining the factors of production and risking profit or loss, women who practice their profession (such as doctors, lawyers, pharmacists) are not accepted as entrepreneurs (Çelik & Özdevecioğlu, 2001). The fact that women take a more active and effective role in economic life is of more importance for the development and realization of our country. Lately, the importance of women's entrepreneurship is increasing day by day due to the increasing demand of women for entrepreneurship and their contribution to economic development (Liman, 1993).

2.4. Characteristics of Women Entrepreneurs

In the research conducted by Kutanis & Hancı (2004) on the profiles of entrepreneurial women, entrepreneurial women have reached the conclusion that entrepreneurial women are self-confident, have strong hunches, are patient and resilient, can take on risks, have strong persuasion ability and use initiative. In the same research, it has been pointed out that being an entrepreneurial woman gives women more independence rights in working life than other forms of work, planning short and long periods for women's work. It has been determined that it provides a significant gains such as using resources efficiently and transferring the experiences gained in the business to efficient channels. We can examine the most prominent characteristics of women that benefit women in terms of being entrepreneurs and achieving success in four items:

Self-confidence: Self-confidence means that people feel good as a result of developing good feelings that are unique to their own selves. Self-confidence is vital for an enterprising woman. Women who are not at peace with themselves cannot fight against strong competitors. Therefore, 'self-confidence' in entrepreneurship is the key to success (İraz, 2005).

Motivation: it can be described as the energy that activates the resources of the individual in the direction of a goal. Today, the contribution of motivation to the success of entrepreneurs, who are among the important actors of sustainable economic development, cannot be denied. For women entrepreneurs to realize this mission they have; it obliges them to have a sustainable innovation. In order to realize sustainable innovation, creativity should be considered as a basic dynamic and obstacles should be removed (İraz, 2005).

Risk: Risk is the possibility of not achieving results within the targeted time, failure or loss. Risks are sometimes unpredictable and therefore associated with uncertainty. There are negative effects in achieving results. A successful entrepreneur is required to have the ability to take risks. Today, the ability to take risks is mentioned as the basic condition of being a successful entrepreneur. That is, a successful entrepreneur is someone who can take reasonable and appropriate risks (Tekin, 2004).

Emotional Intelligence: In a general sense, the definition of emotional intelligence can be defined as being able to observe and regulate what oneself and others feel and using feelings in a way that guides thought and action. A successful entrepreneur is someone who can use his emotional intelligence and does not mix his emotions into business life. It should only be possible to build bridges over one's own feelings to the feelings of others. Only in this way, it can be possible to establish a relationship beyond the same type of thinking, the appropriate views, similar tastes, or similar levels of intelligence (Sartorius, 2008).

2.5. Types of Women Entrepreneurs

Traditional Female Entrepreneur Type: In other words, it can also be defined as a classic woman. These types of women entrepreneurs have high levels of entrepreneurial ideals. In these entrepreneurs who act in accordance with gender roles, the family role is also essential. Traditional women entrepreneurs, whose main motivation is to make money, keep their businesses in balance with their family roles. Women entrepreneurs who are of the traditional entrepreneurial type can often be said to have a guesthouse, secretariat, care agency, restaurant, food factory and hair salon (Kutanis & Hancı, 2004).

Familial (Domestic) Female Entrepreneur Type: Familial women entrepreneurs also pay great attention to women's duties among their relatives. Since his family comes first, his entrepreneurial ideals are lower than the traditional type. The main motive that leads such women who continue their activities in the fields of entrepreneurship that their families see fit and that suit their families is to be entrepreneurial is the desire for self-development and to support their families. For this reason, family is at the center of her life (Top, 2006).

Innovative Women Entrepreneur Type: Women entrepreneurs who keep their entrepreneurial ideals much higher than traditional gender roles and who put the growth of their business among their priority goals. They are usually highly educated, economically fond of their independence and could use technology very well (Kutanis & Hancı, 2004).

Established (Feminist) Women Entrepreneur Type: Women entrepreneurs who fall into this type think that they are equal to men in all areas. For this reason, they think that they should be in the same place with men in entrepreneurship as in every field. If they are married, the work is carried out jointly, equally and cooperatively between the spouses. Feminist women entrepreneurs show little commitment to both entrepreneurial ideals and traditional women's roles (Top, 2006).

2.5.1. Factors Affecting Women's Entrepreneurship

Positive Factors

The reasons why women become entrepreneurs differ depend on countries and culture. Because social culture is an important factor in the formation of entrepreneurial tendency. The individual always carries the cultural values of the society in which she lives. For example, in the USA, among the reasons for women entrepreneurs to establish a business, there are reasons such as independence and the desire to control decisions, while in Turkey it is among the main reasons for the formation of entrepreneurial spirit. Women's reasons such as meeting their family needs, entering social relations, their desire for self-realization, personal freedoms, being the boss of their own business are included (Aslan & Atabey, 2009). The level of economic development in a country is closely related to entrepreneurial tendencies. While the factors that lead women to entrepreneurship in developed countries are positive, it has been determined that there are negative factors that distance women from entrepreneurship in developing countries (Durak, 2011). Factors that drive women to entrepreneurship to start their own businesses do not depend on a factor alone but depend on the series of factors that affect each other. For example, psychological factors such as success, independence, economic necessity, economic factors that seem to be a path to financial independence, as well as many factors such as disappointment in your career, dissatisfaction with the current working conditions or creating a flexible working model can be counted (Smile, 2008). In all countries, the desire to provide income lies at the beginning of the factors that lead women to entrepreneurship. Worldwide, female workers earn less than males. This situation increases the desire of women to realize themselves and to start their own business. Since in most countries there is little respect for women's achievements and talents, their desire to realize their own dreams is very strong and they see entrepreneurship as an opportunity to build their own self-esteem. The need to achieve high success is also one of the important factors that make entrepreneurship attractive. Depending on the cultural structure of the countries, the low belief that women can achieve success gives women more ambition and encourages them to become a more successful entrepreneur.

The support received from the state, the role models who have achieved success in the immediate environment and the trust given by the family are among the factors that attract women to entrepreneurship. In addition, being a prominent member of society can make entrepreneurship an attractive possibility or career choice (Özdemir, 2010).

The main sources of motivation that encourage women to entrepreneurship are as follows (Tekin, 2005):

- To gain economic freedom,
- Realizing a business idea or dreams,
- Work independently without being under the command of someone else,
- Self-realization,
- To gain social status,
- To supply additional income to the family,
- Money, status/prestige, the desire to have power,
- Desire to be productive,
- Prioritizing male employment, in other words, personal bias.

In recent years, women's desire to use their talents and skills more and to be independent shows that they prefer to start their own businesses by using their personal savings to a large extent instead of working with wages and salaries. In this case, entrepreneurship will eliminate employment bottlenecks and to enable women to enter the working life (İyicil, 2006).

Negative Factors

Many factors are effective in women's refusal to be interested in entrepreneurship. The most important of them are stressful work environment, job dissatisfaction and work-related frustrations (Orhan & Scott, 2001). It is known that it is more difficult for women to establish their own businesses than men. While men who have the obligation to make financial gains can easily become entrepreneurs, it is seen that it is difficult for women who do not have enough education, knowledge, confidence, experience or capital to become entrepreneurs.

The problems that women experience or may experience in entrepreneurship may arise not only during the establishment of the enterprise, but also in the process of maintaining the continuity of the enterprise. These difficulties are among the reasons that discourage women from being entrepreneurs. Being an entrepreneur provides more freedom and independence for a woman in working life compared to working on someone's account, as well as providing advantages such as making and implementing plans on the entrepreneur's own business. In addition, a study shows that women face difficulties in obtaining start-up capital. Often women who do not have a property of their own face difficulties in showing collateral to the bank. Women lack the motivation and ambition necessary to start a business and it is assumed that they do the work only to earn money (İyicil, 2006). Another problem that holds women back from entrepreneurial activities can be grouped under the heading of problems arising from business and environmental conditions. Some of them are, failure to provide a holistic view and organization of women's entrepreneurship worldwide, institutional diversity and coordination challenges, and obstacles related to policy development and implementation (Ecevit, 2007).

2.5.2. Factors Supporting Success in Women's Entrepreneurship

Adapting the change of the world and increasing the welfare level of society is directly related to supporting the female entrepreneur who has a potential power and making her a producer. Creating opportunities and resources for potential women entrepreneurs, trying to develop the entrepreneurial spirit of women, preparing suitable environments for them, positive discrimination policies of governments, offering special material and moral support to women by various institutions and organizations are important decisions made to support women entrepreneurship. Throughout history, women have been able to adapt to economic activities under conditions that may vary according to the structure of the society. It can be stated that these developments have increased especially with industrialization.

Many incentive policies have been developed to increase women's participation in the economy in Turkey. For example, legal regulations, support programs, grant or loan opportunities, projects and activities that encourage entrepreneurship are realized through various factors (Soysal, 2010).

2.5.3. Organizations Supporting Women Entrepreneurs

Although the efforts to support women's entrepreneurship in Turkey are new, there are various institutions and organizations that support women's entrepreneurship. These are as follows;

- Turkish Employment Agency (İŞKUR),
- KOSGEB Business Development Center,
- Banks (Vakıfbank, Ziraat Bank, Halk Bank),
- The Union of Chambers and Commodity Exchanges of Turkey (TOBB),
- Agricultural and Rural Development Support Agency (TKDK),
- Women Entrepreneurs Association (KAGİDER),
- Directorate General for the Status of Women (KSGM),
- Multi-Purpose Community Centers (ÇATOM),
- Foundation for the Evaluation of Women's Work (KEDV),
- Contemporary Women and Youth Foundation (ÇKGV),
- Women's Center Foundation (KAMER).

As in the whole world, especially in recent years, the subject of women's entrepreneurship in Turkey has become a special field of study. To identify and find solutions about the problems, academic studies have been conducted that supported by both political powers and non-governmental organizations (Ecevit, 2007). For this purpose, some institutions and organizations carry out many activities in the name of developing women's entrepreneurship and aim to encourage women to entrepreneurship. Although there are many organizations that support women entrepreneurs in Turkey, there is not a sufficient number of effective institutional structures that continuously operate in this field.

3. Women Entrepreneurs in the Agricultural Sector: The Case of Kahramanmaraş-Elbistan

In many parts of the world and in Turkey, the role of women in working life has been increasing greatly in recent years. Women have turned to establishing their own businesses due to factors such as contributing to the family budget, economic freedom, achieving a certain goal and prestige. Accordingly, today's employment of women and the number of women who own their own business are increasing rapidly. However, as in almost every field of working life in Turkey, there is gender inequality, and this inequality is more noticeable in agricultural activities. Generally, men do heavy work and more income-generating jobs, so there is little trust in women in this regard. The active participation of women entrepreneurs in the agricultural sector, as well as in the industry and service sector, will make significant contributions to the country's economy. Atay-Avşar and Bostan Budak (2016) pointed out that rural women are quite shy about entrepreneurship. There are many reasons for this timidity. Some of them are; low income level, lack of education, traditional roles assigned to women, complex and bureaucratic procedures.

The study was conducted in Elbistan district of Kahramanmaraş province with 60 women entrepreneurs who engaged in agricultural activities. Data were obtained by face-to-face survey. In research area, 51.13% of the population were men and 48.87% was women. Although the women in the region are engaged in agricultural activities, they mostly carry out the work in their enterprises together with their husbands. This means they do not fully ensure their economic independence. The age was differ from 21 to 65 years old. The average age was 34. 35% of entrepreneurial women are younger than 30 years old, 41.6% are between the ages of 31-40 and 23.4% are older than 40. Since more than half of entrepreneurial women have graduated from primary school. Low levels of education can be seen as a deficiency. Although women engage in entrepreneurial activities, some problems arising from lack of education have prevented them from becoming better entrepreneurs. More than half of the entrepreneurial women are married and they started their agricultural entrepreneurship activities with the help of their husbands. The number of children varies between 1 to 3 and the total number of family members is between 3-5 people at most. In addition to helping their husbands after marriage, women also engaged in entrepreneurial activities with the desire to earn money, but due to lack of experience, the desired level could not be reached.

The share of agricultural production in the total family income of entrepreneurs is on average 50% and they started to establish their enterprises at a young age. Plant production is usually carried out, but there are women who deals with animal production. The presence of agricultural land among women entrepreneurs has been determined as the most important factor in making an initiative. Women started animal production with more state support. However, this support provided by the state is not enough. The land assets used by entrepreneurial women in agricultural production are mostly small-scale (0-10 decares) and this situation can be considered as a disadvantage in terms of economies of scale. Entrepreneurs should be able to find land with rent or partnership in addition to their property land in case of need. Since most of the enterprises of women entrepreneurs are small-scale, the number of people employed has been limited to 1-2 people. The use of credit among women entrepreneurs is at a very low level and this shows that more appropriate credit facilities should be provided to entrepreneurs. As a matter of fact, the financing needed by the business owners during their production activities was mostly provided from equity sources and family relatives. Women entrepreneurs are generally aware of the organizations that provide incentives and support for production, but they have not benefited from the opportunities provided by these organizations at an adequate level. Women entrepreneurs engaged in agricultural production mostly benefit from agricultural supports, which consist mostly of livestock supports and difference payments.

3.1. Problems Women Entrepreneurs Face in Working Life

Rural women are more backward than men in entrepreneurial activities due to their social value judgments. Society exerts a serious pressure on women because it sees agricultural activities as more men's work. As seen in Table 1, society's value judgments about women ranked first among entrepreneurship problems with an average score of 4.68. Entrepreneurship brings with it the necessity of supplying a certain amount of capital and raw materials. While women are engaged in entrepreneurial activities, they have problems in procuring raw materials due to financial inadequacy. As seen in table, the supply of cheap raw materials is the second important problem in entrepreneurship with 4.43. Another important consequence of leaving women in the background in rural areas is that market experience is limited. The idea that women's occupation in rural areas should be their home and family cause their market experience to be limited with 4.25 points. Accordingly, the low level of education of rural women who do not have market experience and their inability to cope with rapidly changing economic conditions are also important problems in entrepreneurial activities. Income levels are divided into three groups; I=1000-2500TL, II=2501-3500TL, III=3501TL and more.

Table 1. Problems Encountered by Women Entrepreneurs in Their Working Life

Factors	Income groups			Average	SE
	I	II	III		
Society's value judgments about women	4.77	4.78	4.59	4.68	0.948
Difficulties in obtaining cheap raw materials	4.23	4.83	4.28	4.43	0.851
Limited market experience	3.92	4.44	4.28	4.25	0.932
Low level of education	3.92	4.17	4.00	4.03	0.956
Inability to cope with rapidly changing economic conditions	3.69	4.28	3.97	4.00	0.974
Lack of management ability	3.23	3.33	3.48	3.38	1.195
Difficulty balancing work and the social environment	2.77	3.17	3.45	3.22	1.379

1: Never, 2: Rarely, 3: Sometimes, 4: Often, 5: Always, SE: Standard Error

Women face many problems in their entrepreneurial activities throughout their working lives. These problems bring failure in working life. In Table 2, the solutions about their problems are listed according to their importance. The traditional upbringing style is a great obstacle in front of the steps that women will take to produce new ideas in their entrepreneurial life. The traditional upbringing style makes the value judgments of the society felt on the rural women to the end and causes the entrepreneurial spirit of the woman exposed to this pressure to be dulled. As can be seen in the table, the abandonment of the traditional style, which dulls the entrepreneurial spirit, is of great importance with 4.92. In order to carry out the agricultural activities of women entrepreneurs in rural areas independently, the state's support to women in the supply of land and qualified personnel (4.87) is an important solution proposal for the contribution of women to their entrepreneurial lives. In addition, the state should provide finance to women entrepreneurs (4.87) and increase women's participation in various entrepreneurship trainings (4.82). An important solution proposal is to ensure that rural women are more aware of the projects carried out on women (4.82) and to spread the institutions and organizations that support women and to make them more aware of these institutions and organizations (4.85). Banks that provide capital support to women entrepreneurs to establish or grow their businesses are more common today, but they are not at the desired level. Increasing women's opportunities to benefit from banks and increasing the use of credit is an important solution proposal (4.82). It was observed that there was no statistically significant difference between different income and age groups in terms of the problems faced by women entrepreneurs in working life. In other words, the problems of women entrepreneurs do not depend on socio-economic variables but have common weight for each of them.

Table 2. Suggestions for Solutions to the Problems Women Entrepreneurs Encounter in Working Life

Factors	Income groups			Average	SE
	I	II	III		
Traditional upbringing that blunts the entrepreneurial spirit should be abandoned	4.85	4.94	4.93	4.92	0.279
The state should support women in the provision of land and qualified personnel	4.85	4.78	4.93	4.87	0.389
State support should be increased in providing finance to entrepreneur women	4.77	4.78	4.97	4.87	0.389
Institutions and organizations that support women entrepreneurs should be increased and expanded	4.69	4.78	4.97	4.85	0.444
Increasing women's participation in entrepreneurship training should be pursued	4.77	4.72	4.90	4.82	0.504
Rural women should be made more aware of the projects on women	4.69	4.67	4.97	4.82	0.596
Women entrepreneurs should be able to easily obtain loans from banks when they need it	4.69	4.72	4.93	4.82	0.537

1: Strongly disagree, 2: Disagree, 3: Neutral, 4: I agree, 5: I strongly agree.
SE: Standard Error

It was determined that the ability to develop new ideas and products (4.68) among the competence factors that should be in the female entrepreneur, which was directed to all of the women entrepreneurs who participated in the survey in the research area, was considered more sufficient among other factors. They also find themselves sufficient in factors such as maintaining stability in troubled situations (4.42) and finding solutions to existing problems accordingly (4.42). Participants consider themselves quite proficient in terms of the factor of maintaining partnership relationships (4.33) (Table 3).

Table 3. Proficiency Scale in Women's Entrepreneurship

Factors	Income groups			Average	SE
	I	II	III		
I can develop new ideas and products	4.85	4.83	4.52	4.68	0.854
I always maintain my determination in troubled situations	4.38	4.33	4.48	4.42	0.907
Find solutions to existing problems	4.31	4.17	4.62	4.42	0.850
I can maintain partnership relationships	4.31	4.11	4.48	4.33	0.933
I can provide the necessary financial resources for the business	3.62	3.83	3.97	3.85	1.071
I act quickly to follow opportunities and take advantage of them	3.54	3.61	3.83	3.70	0.962
I can get employees or my family to agree that my opinion is true	2.54	2.78	3.00	2.83	1.210

1: Strongly disagree, 2: Disagree, 3: Neutral, 4: I agree, 5: I strongly agree.

SE: Standard Error

4. Conclusion

Thanks to agricultural entrepreneurship, there has been a significant progress among women in entering business life. The main reasons for this are to desire to earn money or the opportunity to gain economic independence and the possibility of flexible working. The main problems faced by women entrepreneurs are social prejudices, difficulties in obtaining raw materials at an affordable price, lack of market experience and inability to keep up with changing economic conditions. In general, women entrepreneurs in the study area are in a good position to develop new ideas and products, to cope with difficulties, to take advantage of opportunities and to solve problems. On the other hand, there are shortcomings in maintaining partnership relations and providing the financing needs of enterprises.

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CHAPTER IV

WOMEN IN RURAL DEVELOPMENT AND THE IMPORTANCE OF AGRICULTURAL EXTENSION IN TAKING A MORE EFFECTIVE ROLE OF WOMEN IN RURAL DEVELOPMENT

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1. Introduction

Development is defined as making the necessary political, economic and social changes for individuals, societies and states to realize their true potential, and development policies consist of a wide range of intertwined areas, from wealth generation to increasing the quality of education (Ministry of Development, 2018a). For sustainability development, all segments of society should be involved in the development processes. Failure to include any segment of society in this process prevents development efforts from reaching to desired level. In the past, women were excluded from development efforts and were not seen as a target group in development efforts until the 1970s. After this period, the need for women's empowerment to support development has been emphasized. In the World Bank's 2012 Gender Equality and Development Report; it is stated that gender equality is a fundamental development goal; removing barriers to women's reach to education, economic occasion and productive inputs at the same level as men has get increasingly important with the speed-up of competitiveness and globalization; that improving the statue of women feeds into many other development outcomes, bearing those for children; and that women's becoming socially and politically active and having an equal chance with men in making decisions and shaping policies will lead to the creation of more representative power and inclusive institutions and policy choices over time (Global Compact, 2014).

Although significant improvements have been achieved on a global scale in recent years from the perspective of women's access to employment, health, education, harmonization of work and family life, and early and forced marriages, gender equality remains an important area of intervention for many countries (Ministry of Development, 2018). One of the foremost activities in the area of gender equality and women's empowerment is towards women's participation and education in the labor market. In particular, low rates of female employment are an important obstacle to eliminating gender inequality and ensuring sustainable development (Global Compact, 2014). Education is one of the foremost drivers of the economic and social development of societies. Nevertheless , it is well known that women in underdeveloped and developing countries benefit less from educational opportunities than men (Kutlar et al, 2014; Atay-Avşar & Bostan Budak, 2016). Prioritizing women's education will pave the way for women to work in better conditions. Economic empowerment due to increased education and employment levels will also contribute to the improvement of women's position in society and the family.

Women, who constitute about half of the world's population, are an important part of economic and social life. Especially in developing societies, women not only fulfill their domestic responsibilities but also work in different economic sectors to conduce to the family economy. Especially until the development of the industrial and services sectors, agriculture was one of the sectors where women were employed the most.

In undeveloped and developing countries, the agricultural sector still remains important and plays an important role in economic development. Farmers need access to information to generate income in the agricultural sector. Agricultural extension services are designed to "extend" research-based knowledge to the rural sector, increasing farmers' yields and production (Buehren et al., 2019) Agricultural extension is the most important service that provides educational programs to raise the living standards of rural people (Budak, 1999). Women in developing countries are actively engaged in agriculture and urgently need help to improve their farming practices, purchase more productive inputs, reduce their workload and improve the processing, storage and marketing activities they carry out (Berger et al., 1984). In order to change the place of women, who have more responsibilities than men in all areas of community and family life, in the employment structure of rural areas, to provide women with new skills, to participate in every stage of production and employment and to have a say in decisions, multifaceted training projects should be created by considering the characteristics of the target audience (Kutlar, 2019).

In this study, the importance of women in rural development has been evaluated, the current situation of women in education and employment has been examined, and the importance of agricultural extension activities for women to play a more effective role in rural development has been discussed.

2. Rural Development and Women

Poverty and hunger, deepening differences between rural and urban, developed and underdeveloped regions and countries, economic imbalances and injustices, rapidly polluting and depleting natural resources keep the concept of development at the top of the agenda at all levels all over the world (Gülçubuk, 2013). Development is used in the sense of the development of underdeveloped countries and refers to improvements in welfare indicators and value-added increases in society as a whole (İlter et al., 2019). Development is a long-term and structural change problem, and a transition from a more backward structure to a more advanced and more prosperous structure and stage (Kaypak, 2012). Development is a process based on mutual interaction that requires the real contribution of individuals, families, groups, communities and societies, while also enabling the development of the individual potential (Özmete, 2012). Thus, It is impossible to talk about the realization of development in a country with the development of a single segment or region. The concept of development for rural areas, which have more limited economic and social opportunities compared to cities, is handled separately.

Rural development can be defined as a functional and integrated development approach based on increasing the economic welfare and social quality of the rural community, reducing the development differences between rural and urban areas, solving the lack of socio-economic and technical infrastructure in rural areas, equitable sharing of agricultural lands and ensuring agricultural modernization, eliminating rural poverty, and cooperation of agricultural and non-agricultural sectors on the common ground of development (Özcan & Akci, 2016). The main purpose of rural development is to maintain the existence of rural areas, to reduce the differences between rural and urban areas, to improve the utilization of natural resource potential in an environmentally sensitive manner, to increase the participation and contribution of non-governmental organizations and local governments, and to ensure a sustainable rural life for improve living standards of rural community, which has limited economic and social opportunities compared to the urban population and provides most of its income from agricultural activities (Kaypak, 2012). In this context, under the heading of rural development; are discussed the topics such as increasing employment areas in rural areas and supporting activities that will generate income, developing capacity for more efficient use of agricultural lands, supporting land use planning projects and disseminating them throughout the country, improving the quality of life of rural residents through the use of modern agricultural techniques, providing employment in non-agricultural sectors such as tourism, textiles, weaving and handicrafts, and expanding non-agricultural income-generating activities in disadvantaged areas (Agah, 2013). While the rural development approach based on people and nature brings to the forefront fundamental issues such as farmer training, organization in agriculture, combating poverty, gender equality and decentralization, the Organization for Economic Cooperation and Development (OECD) bases the rural development paradigm shift developed in 2016 on eight main themes (Ministry of Development, 2018b). These themes are governance, multi-sector, infrastructure, urban-rural connectivity, inclusiveness, gender equity, demographics and sustainability.

Rural development will only gain meaning when it is supported by mobilizing all stakeholders in rural society, solving rural problems within the scope of agricultural policies, creating a strong, civil and democratic society, eliminating the problem of poverty and inequality, developing the legal system and institutional structure, and implementing laws and regulations (Kızılaslan, 2016). The economic, cultural and social development of a society depends first of all on the fact that the individuals who make up that society have equal opportunities and that such individuals benefit equally from all opportunities (Peker & Kubar, 2012). Ensuring rural development on the principle of competition, sustainability and effective use of resources is possible primarily through the efficient utilization of human resources (Antalyalı, 2016).

Sustainable rural development will be possible with the inclusion and contribution of all stakeholders in rural areas to economic and social life. However, women are considered as a disadvantaged groups of the society in development efforts because they placed in the second plan in traditional structure which is dominated by male based on customs and traditions in undeveloped and developing countries. Women, who are burdened with heavy responsibilities before completing their developmental age and who cannot receive any vocational training, are more disadvantaged than men (Esen, 2013). Generally, men's jobs are socially more remunerative. Women's work is mostly seasonal, part-time, unpaid work based on home-based labor. Accordingly, the products obtained from women's work, such as food and clothing, do not have an economic value as they are mostly consumed immediately. As a result of this, women's work renders worthless and invisible because housework and agricultural activities seem close to each other in rural areas and some of the housework is supportive of agricultural business (Kızılaslan & Yamanoğlu, 2010; Gökdemir & Ergün, 2012; Candan & Günal, 2013).

The underestimation of women's activities comes from women performing unpaid everyday tasks such as cooking, finding fuel, and collecting food for animals rather than income-generating work in developing countries and countries where owning land means being powerful. This invisible or inconspicuous contribution of women creates the image that they are dependent rather than productive in society (Özçatalbaş, 2000). In short, women's participation in the rural labor force is not accepted as real work, but is considered as compulsory work that women must fulfill in accordance with their traditional roles and duties (Kutlar, 2019).

In rural areas, women, who have heavy workloads both within the household and in agricultural activities, perform a significant part of agricultural production, although they are considered as unpaid family workers. While women have at least as much role in production as men, they have rather a smaller share in education and social life than men (Gökdemir & Ergün, 2012). To reach wanted outcomes in rural development endeavors in developing countries, women who are disadvantaged in rural areas should take part in economic life to a great extent (İpekyolu Development Agency, 2017).

Failure to effectively utilize half of the rural population cause a significant constraint in rural development and growth (Kızılaslan, 2016). Although they are intensively involved in production activities, women's position in development was not evaluated until the 1970s and they were not recognized as a target group. Boserup first brought women's place in the development to the agenda in 1970, but it was only after the 1975 United Nations Year of Women that this issue was systematically included in policy and planning (Gökdemir & Ergün, 2012; Ökten & Tüysüz, 2017). Gender sensitivity started to make itself felt in projects and planning, and in this framework, women and development were evaluated within the frame of two approaches. The first approach is the Women in Development (WID) approach, which is mostly adopted by governments and development-related organizations and considers only the position of women in production. The second approach is the Gender Balanced Development (GAD -Gender and Devolopment) approach, which was appeared as a result of the assessment of shortcomings of WID and was developed on the premise of equality and recognize for human rights for all people, and envisages meeting of practical and strategic gender needs (Gökdemir & Ergün, 2012).

It is necessary to eliminate inequalities between women and men, to ensure women's active participation in economic, social and cultural life, and to lift of barriers to their equal access to development opportunities. In order to support women's empowerment, many international development programs and country-specific programs are prepared, temporary special measures are taken and their successful implementation is encouraged. Today, leading development actors, notably the World Bank, identify women's inclusion in development as a factor that increases labor and market efficiency and thus creates smart economies (Ministry of Development, 2018a).

Turkey has become a part of many international agreements on enhancing women's social status, ensuring equivalent occasion for women and men, protecting women's human rights, and eliminating violence and abuse against women, and has made various legal arrangements to fulfill its commitments under these agreements and to achieve the desired development momentum. In addition, the topic of women were mentioned under many headings in development plans and national action plans have been prepared on women-related issues.

Turkey's first National Action Plan on Gender Equality (2008-2013) was prepared withinside the context of the EU participation framework and identified nine priority areas to improve gender equality: education, economy, poverty, decision making mechanisms, sanitary, media, environment, human rights and severity. This action plan also includes two targets for women in agriculture. The first is to make better the economic situation of rural women, including strategic actions on access to technology, increasing women's entrepreneurship and cooperative membership in agro-based enterprises, diversifying income-generating projects available to women, and including women agricultural workers in the state social security system. The other one is the protection of women (especially rural women) from adverse environmental conditions and empower them to make better their standard of living. Which includes strategic actions to protect women working in agricultural fields and greenhouses from harmful chemicals and raise their awareness to protect themselves in case of natural disasters. The National Action Plan for the Empowerment of Women in Rural Areas (2012-2016) aims to make better the situation of women in rural areas, increase the gender sensitivity of the agricultural sector, improve Turkey's international indicators and statistical data on women, and include rural women in national development efforts. In this action plan, 4 strategic areas were identified for women's empowerment activities: (1) rural areas and women (poverty, education, health); (2) the role of rural women in agricultural production and marketing (agricultural production, entrepreneurship and marketing); (3) women and natural resources (use and management of natural resources, protection of natural resources); and (4) employment and organization of rural women (agricultural employment and organization, social security). The 2016 National Action Plan on Women's Employment developed by the Turkish Employment Agency (İŞKUR) includes actions that address both agricultural employment and rural women in general. The 2013-2017 Strategic Plan of the Ministry of Health aims to improve access to health services in rural areas, with specific support for women's maternal health. In the National Action Plan on Climate Change 2011-2023, it has been stated that climate change directly and negatively affects natural resources and this has a greater impact on women as first-hand users of natural resources (water, food, etc.). It is also stated that climate change is directly linked to agriculture and it should be ensured that training and extension services related to increasing agricultural yields for women farmers in order to adapt to the effects of climate change. Morover, the plan calls for education and awareness-raising on public participation in forest protection and administration of natural resources, including women in forest villages (FAO, 2016). The Turkish Cooperatives Strategy and Action Plan (TÜKOSEP) for 2012-2016, prepared under the leadership of the Ministry of Customs and Trade, emphasizes the importance of women's employment and women's cooperatives, and calls for efforts to organize women under cooperatives to increase their entrepreneurial capabilities and ensure their participation as actors in the economy (TGNA, 2018). In addition, the Women's Empowerment Action Plan covering the period 2018-2023 was also prepared.

Today, the issue of women and development does not only mean women becoming more productive and using their labor more effectively. Women's empowerment is perceived and accepted as women's role in the production process and their attendance in the labor force, their access to modern institutions (extension, education, credit, health and social services, etc.), their ability to increase their control over their own labor and daily life, and their attendance in the development process on an equivalent basis with men (Gökdemir and Ergün, 2012; Ökten and Tüysüz, 2017). Therefore, efforts to empower women in rural areas are important both in terms of ensuring women's full attendance in the development process and in terms of revealing their potential and strengths as individuals in this process (Özmete, 2012).

Women still lag behind men in terms of social development indicators and do not receive an equal share of the development (Gökdemir & Ergün, 2012). Factors such as low educational attainment, social prejudice, and high gender inequality weaken women's roles and functions in rural development (İpekyolu Development Agency, 2017). Women, who make up half of the population, are undeniably important in rural development. In order to secure women's empowerment, problems related to women in rural areas need to be addressed. The role of women in sustainable development will be effectively demonstrated improving their characteristics such as raising their awareness and increasing their productivity by revealing their potential capacity, access to information, organization, social security, access to health services, increasing their level of education, and removing them from the situation of being economically dependent on men (Kızılaslan, 2016).

3. Current Situation of Rural Women

In terms of rural development, women's education and employment constitute the most important issues. Because with the increasing level of education and employment, women will be able to contribute more to rural development in social and economic terms. One of the first and most basic conditions for women to be empowered, to leave the situation of being dependent on men, and to have a voice in decisions about themselves and their families is to increase the level of education. With an increase in the level of education, women will have the opportunity to work and earn income under better conditions and will be able to have more voice in decisions both in family life and in production process. In this section, the current situation of rural women in Turkey in terms of population, education and employment is evaluated.

3.1. Population

In the first years of the Republic, approximately 76% of the population lived in rural areas. Men in rural areas accounted for 73.9% of the total male population, while rural women accounted for 77.5% of the total female population.

Migration due to the disadvantages of rural areas, such as insufficient educational opportunities and low income levels, has led to decline in the population living in rural areas.

However, with the Metropolitan Law No. 6360 enacted in 2012, the number of towns was reduced and some villages became neighborhoods, resulting in a rural population ratio of 8.7% in 2013, down from 22.7% in 2012. As of 2021, 93% of the population lives in urban areas and 6.8% in rural areas (Table 1). The female population living in rural areas constitutes 6.7% of the total female population in Turkey. Approximately 49% of the total population living in rural areas are women.

Table 1. Population of province/district centers and towns/villages by years and sex (%)

Years	Province and district centers			Towns and villages		
	Total	Male	Female	Total	Male	Female
2000	64,9	65,3	64,5	35,1	34,7	35,5
2010	76,3	76,4	76,1	23,7	23,6	23,9
2015	92,1	92,1	92,1	7,9	7,9	7,9
2020	93	92,9	93,1	7	7,1	6,9
2021	93,2	93,1	93,3	6,8	6,9	6,7

Kaynak: TurkStat, 2022a

3.2. Education

It is of utmost importance for women to benefit equally from educational opportunities and opportunities at all levels in order to assume an active role in social life (Yılmaz et al., 2016). There is a notable gender gap in terms of illiteracy in Turkey, with a higher illiteracy rate among women than men (FAO, 2016).

According to TurkStat data, while approximately 9% of the population aged 15 and above was illiterate in 2008, this rate decreased to 2.82% in 2021 (Table 2). Of the illiterate population, 80.12% in 2008 and 86.67% in 2021 were women. In this period, there is a significant decline in the illiteracy rate. The number of illiterate women has declined in absolute terms but has increased proportionally. This shows that the rate of illiterate men declined more than illiterate women in this period. As ssen in Table 2, women lag behind men at all levels of education. The primary motive for that is the social structure. While families ensure that boys continue their education under all circumstances, but girls can go school to a certain level. Especially in rural areas, girls who has primary school age are responsible for taking care of their younger siblings, animal productions and cleaning the house (Yılmaz et al., 2016).

Table 2. Population by attained education level and sex, Population (15 years of age and over), 2021

	(Thousand person)			(%)		
	Total	Male	Female	Total	Male	Female
Illiterate	1813671	241691	1571980	2,82	0,76	4,87
Literate without a diploma	2330414	543133	1787281	3,63	1,70	5,54
Primary school	12106638	4820270	7286368	18,85	15,08	22,59
Primary education	5132420	2899977	2232443	7,99	9,07	6,92
Lower secondary school	12182748	6701773	5480975	18,97	20,97	16,99
Upper secondary school	16697592	9448709	7248883	26,00	29,57	22,47
Universities and other higher educational institutions	11637287	6086476	5550811	18,12	19,05	17,21
Master (Including 5 or 6 Years Faculties)	1395232	756363	638869	2,17	2,37	1,98
Doctorate	233342	136568	96774	0,36	0,43	0,30
Unknown	686031	322508	363523	1,07	1,01	1,13
General Total	64215375	31957468	32257907	100,00	100,00	100,00

Source: TurkStat, 2022b.

Comparable male and female data for rural and urban dwellers are not available, but in 2008, when illiteracy rates were high, there was a marked difference between illiteracy rates among women in rural and urban areas (FAO, 2016). Especially in rural areas, women are less likely than men to be literate and to continue education after primary education (Kutlar et al., 2014).

3.3. Employment

In addition to providing women with economic freedom, working life increases their self-confidence and social prestige and improves their position within the family. Although there are no legal barriers to women's attendance in the labor force and positive discrimination is practiced on the contrary, the responsibilities in family life due to the role attributed to women by society cause women to make a choice of working or not working. Women who take part in agricultural production in rural areas, even as unpaid family labor, either do not work at all or work unregistered in unskilled jobs without social security when they moved to the city. Most women in rural areas work in agriculture. The agricultural sector is the most important component that increases women's labor force participation data in rural areas. Therefore, ensuring the sustainability of agricultural activities, especially in rural areas, plays a key role in keeping women in production and social life (TGNA, 2018).

Although women constitute the majority of the population in almost every country in the world, their presence in labor markets has lagged behind men from past to present (Kasa & Alptekin, 2015). This is undoubtedly due to the socio-economic structure and cultural characteristics of the country (Kızılaslan & Yamanoğlu, 2010).

According to data from the Turkish Statistical Institute, while the employment rate of women was around 30% in 1988, it tended to decrease in the following years, dropped to around 20% in 2004, and increased again in the following years. The labor force accession rate declined from 34% in 1988 to 23% in 2004. Both the labor force accession rate and the employment rate are still behind the 1988 data. Data on key labor force indicators in Turkey for 2021 are presented in Table 3. Basic labor force indicators show that women in Turkey participate in economic life at much lower levels than men. 67.18% of women aged 15 and above are not in the labor force. Among women not in the labor force, 45.89% are not in employment because they are busy with housework. While the labor force accession rate for men is 70.3%, this rate is only 32.8% for women. The employment rate for women is 28% and the unemployment rate is 14.7%. Some of the women who appear as unemployed in the statistics are unskilled labor force working as day laborers and temporary workers due to migration. Without any social security, women who work as baby care, knitting, embroidery, cleaning or as unpaid family workers in rural areas constitute a part of informal employment (Kasa & Alptekin, 2015). The main reason for the low labor market participation of women in Turkey are the exclusion of some women who come to the city with migration, unregistered employment, patriarchal mentality and educational inequalities. Women generally cannot make the decision to work on their own; their fathers or husbands decide whether they should work or not, or what kind of work they can do. Moreover, having to fulfill obligations such as housework and childcare after working all day at the workplace can be a deterrent for women. Women's low level of education also makes it more difficult for them to discover a job than men. In most cases, low-paid and low-skilled jobs await women who overcome all these obstacles and enter the workplace (Memiş et al.,2007).

Table 3. Main labour force indicators (15+ -age) (Thousand person) (2021)

	Population 15 years and over	Labour force	Employment	Unemployment	Not in labour force	Labour force participation rate (%)	Employment rate (%)	Unemployment rate (%)
Total	63 704	32 716	28 797	3 919	30 989	51,4	45,2	12,0
Male	31 533	22 156	19 792	2 364	9 377	70,3	62,8	10,7
Female	32 172	10 560	9 005	1 554	21 612	32,8	28,0	14,7

Source: Turkstat, 2022c

In Turkey, women's labor force accession rate differs between rural and urban areas. In rural areas, women's work is almost entirely oriented towards agricultural activities. In addition to their responsibilities as mothers and housewives, rural women also physically participate in agricultural activities to a great extent (Yılmaz et al., 2016).

The labor force accession rate of women in rural areas is higher than the country-wide labor force participation rate. The share of women working in agriculture in total employment has been on a downward trend since the 1950s due to changes in agriculture and rural-urban migration (TGNA, 2018). The labor force accession rate of women in rural areas was 50.7% in 1988 and 36.9% in 2012. The employment rate declined from 48.5% in 1988 to 35.6% in 2012. While 76.8% of women were recruited in agriculture in 1988, this rate decreased to 39.3% in 2012. Until 2004, agriculture was the sector where women were mostly employed. After this year, while female employment rates in non-agricultural sectors increased, the rate of female employment in agriculture started to decline. As of 2021, 22.7% of employed women are in agriculture (Table 4). Women working in rural areas are proportionally more than men. Men are mostly employed in non-agricultural sectors.

Table 4. The distribution of employment by agriculture and non-agriculture, 2021

	(Thousand person)			(%)	
	Total employment	Agriculture	Non agriculture	Agriculture	Non agriculture
Total	28 797	4 948	23 849	17,2	82,8
Male	19 792	2 901	16 891	14,7	85,3
Female	9 005	2 047	6 958	22,7	77,3

Source: Turkstat, 2022c

In 1988, 22.7% of employed women worked for wages or salaries, while 70.2% worked as unpaid family workers. According to data for 2021, approximately 70% of the employed population in Turkey is engaged in paid or casual jobs (Table 5). In terms of total employment, the proportion of men and women in paid or casual employment is quite close to each other. However, in terms of being an employer or working on own account, the rate of men is higher than that of women. In non-agricultural sectors, women are mostly employed as wage earners or casual workers, while in agriculture they are unpaid family workers. One of the primary causes for this is that the agricultural sector in Turkey is predominantly composed from small-scale family enterprises. While there are almost no women who are employers in the agricultural sector, the rate of self-employed women is 10.31%. In Turkey, the proportion of self-employed women is higher in agriculture than in non-agricultural sectors.

Table 5. Employed by status in employment **(2021) [15+ yaş - age]**

		Thousand person					(%)				
		Regular employee and casual employee	Employer	Own account worker	Unpaid family worker	Total	Regular employee and casual employee	Employer	Own account worker	Unpaid family worker	
Total	Total	28 797	20 137	1 318	4 647	2 695	100	69,93	4,58	16,14	9,36
	Male	19 792	13 920	1 145	3 844	883	100	70,33	5,79	19,42	4,46
	Female	9 005	6 217	174	803	1 812	100	69,04	1,93	8,92	20,12
Agriculture	Total	4 948	632	69	2 048	2 200	100	12,77	1,39	41,39	44,46
	Male	2 901	411	65	1 837	588	100	14,17	2,24	63,32	20,27
	Female	2 047	220	5	211	1 612	100	10,75	0,24	10,31	78,75
Non-Agriculture	Total	23 848	19 505	1 249	2 599	495	100	81,79	5,24	10,90	2,08
	Male	16 891	13 509	1 080	2 007	295	100	79,98	6,39	11,88	1,75
	Female	6 958	5 996	169	592	200	100	86,17	2,43	8,51	2,87

Source: Turkstat, 2022c

While women work in relatively better conditions in cities to gain economic freedom, in rural areas they have to work in jobs that strain their physical strength (Yılmaz et al., 2016). In rural areas, women have to perform daily chores such as house cleaning, cooking, washing clothes and carrying water, as well as tasks such as field, vineyard-garden work, wood carrying, bread making, animal care, which require a lot of strength and take a lot of time. Women's agricultural participation in production varies according to family's land and product structure, and as the level of mechanization in agriculture increases, they are disconnected from agricultural production and their working potential is directed towards housewifery (Öztaş, 2012).

Since the agricultural sector is seasonal and daily work due to its structure, women and men working in this sector largely work without any social security. In particular, women's lack of social security in both agricultural and non-agricultural sectors makes them dependent on men in terms of health insurance and pensions. Women's lack of property ownership is also a factor that increases the invisibility of their labor. Although there are no legal barriers to women's access to property in Turkey, it is observed that rural women are generally propertyless due to the influence of traditional society and patriarchal relations (TGNA, 2018). Self-employment generally occurs when women continue agricultural activities with their children after the death of their husbands and tends to increase steadily (Yasan Ataseven & Gülçubuk, 2012).

One of the most important factors affecting the ability of individuals to be employed under better conditions is the level of education. Especially the low level of education of women working in rural areas limits their opportunities to be employed in non-agricultural areas, especially in formal jobs that bring high income (Yasan Ataseven & Gülçubuk, 2012). It is seen in our country and in many other countries that women are employed in more qualified and high value-added jobs as their education level improvement (TGNA, 2013).

According to the Turkish Statistical Institute Labor Force Statistics (2022), the labor force accession rate of illiterate women in 1998 was 32.3%, 32.4% for those with less than high school education and 82.5% for higher education graduates. In 2012, the labor force accession rate of illiterate women was 16.7%, 25.6% for those with less than high school education and 70.9% for higher education graduates. In 2021, the labor force accession rate for illiterate women is 12.8%, 25.3% for those with less than high school education and 67.6% for higher education graduates.

While 73.4% of women employed in rural areas have less than high school education, 23.4% are illiterate (Table 6). Almost a quarter of women employed in the agricultural sector are illiterate.

Table 6. Literacy and Education Status of Those Employed in Agriculture by Gender (15+ Age)

Education Status	Female	Male	Female	Male
Illiterate	508	121	21,3	4,1
Education Below High School	1750	2394	73,4	81,9
High School and Equivalent Vocational School Education	98	307	4,1	10,5
Higher Education	28	98	1,2	3,5

Source: TGNA, 2018

4. The importance of agricultural extension for women to move a more effectual role in rural development

Education is the only condition for success in every part of the society and in every subject, and education activities should be given importance in order to improve in rural areas (Kızılaslan & Yamanoğlu, 2010). Agricultural extension moves an significant role in agricultural development and increasing the welfare of farm households (Akter et al, 2020). Agricultural extension services are designed to "extend" research-based knowledge to the rural sector, increasing farmers' yields and production, and these services aim to overcome this knowledge barrier that limits technology adoption, which can result from low expected profits and perceived high risks (Buehren et al., 2019) In developing countries, agriculture can be a way to increase economic progress and poverty reduction, but efforts to improve this sector are often insufficient due to gender inequality in the extension services provided (Echo, 2015). Extension Services need to recruit and train women professionals, develop programs for women farmers, specifically target women to provide access to Extension Services, establish linkages with rural women's groups, and encourage women farmers to participate in Extension program activities to reach development goals (Rivera and Corning, 1990).

In the past, agricultural extension services have paid little attention to reaching women farmers, and agricultural extension strategies have traditionally focused on increasing yields and production by training men, with policy makers and administrators often assuming that men are the farmers and women only play a "supportive role" as farmers' wives. Despite working in most agricultural activities, women were not considered to be trained, or the idea was that innovations in agricultural technology could only reach women through their husbands, as the idea was that innovations brought to rural areas would reach women through men (Fidan et al, 2017). Women have been virtually ignored by agricultural extension agents and are often taught home economics and other subjects unrelated to their agricultural role (Berger et al., 1984). Nowadays, it is understood that it would be plenty hard to arrive women through men, and since the idea of reaching the target group directly is accepted, training and extension activities for women farmers have been intensified (Ermetin, 2015; Fidan et al, 2017).

In many studies conducted in rural areas (Özçatalbaş, 2001; Kara et al., 2004; Şahin & Terin, 2009; Kutlar et al., 2014), it has been defined that women participate in some stages of agricultural production activities more than men, but they cannot benefit from agricultural extension services as much as men. Women, who should be the main target of rural extension services, cannot benefit from these services sufficiently due to customs and traditions, low level of education and lack of female personnel to carry out extension services (Öztaş, 2012). Therefore, out-of-school (non-formal) education is of great importance for rural women to overcome the problems they face in agricultural production (Kutlar et al., 2014). While providing education and extension services for rural women, the status of women in traditional structures should be improved and women's producer identity should be focused on in extension activities (Özçatalbaş & Akçaöz, 2010). It is tried to ensure that farmer women living in rural areas are trained with improved extension methods of agricultural production and thus, they are more participatory in sustainable agriculture and rural development for enhance agricultural production (Ermetin, 2015).

All activities realized by the Ministry of Agriculture and Forestry for women and family in rural areas are aimed at "Ensuring Equal Opportunities, Increasing Entrepreneurship and Employment". The Working Group on Women and Family in Rural Areas provides training and extension services on agricultural and social issues for rural women, carries out activities to support the establishment of cooperatives, encourages and supports women's entrepreneurship in agriculture-based businesses, carries out income-generating, activity diversification and socio-economic empowerment projects, prepares training, programs and projects for children and young people, with priority given to women, to preserve and provide the sustainability of family farming, and carries out strategy studies to solve their problems. Since 2000, the Women Farmers Agricultural Extension Project aims to empower and employ rural women by carrying out projects and programs that enhance the information and abilities of women farmers at every stage of the agricultural production process, ensure sustainable agricultural activities and increase the quality of products, encourage and support rural women entrepreneurship, provide income-generating, vocational skills, increase the diversity of activities, strengthen them socio-economically, develop a spirit of cooperation and create new employment opportunities. Since 2015, the "Women Farmers Agricultural Extension Project" has been carried out in 3 phases: Strengthening Women Entrepreneurship in Agriculture Program, Women Farmers Meet Agricultural Innovations Program and Provincial Special Projects for Women Farmers. Under the Strengthening Women Entrepreneurship in Agriculture Program, 5,292 women farmers in 81 provinces received entrepreneurship training between 2015-2019. In 2019, a total of 1,081 women in 17 provinces (Ağrı, Ankara, Ardahan, Bayburt, Erzurum, Eskişehir, Gümüşhane, Hakkari, Ordu, Rize, Siirt, Sivas, Şırnak, Trabzon, Tunceli, Van, Yozgat) received training and prepared projects within the scope of certified applied entrepreneurship trainings for employment in cooperation with İŞKUR/KOSGEB. Under the Women

Farmers Meet with Agricultural Innovations program, 5,276 women farmers received training and benefited from various activities through 81 agricultural extension projects between 2015-2018. In 2019, 518 women farmers received training through 21 different projects to disseminate agricultural innovations in 21 selected provinces. Within the scope of the Provincial Special Projects for Women Farmers program, 1,509 women farmers received training through 20 special projects between 2015-2018 and 315 women farmers were employed in workshops, enterprises and cooperatives established within the scope of project activities (Ministry of Agriculture and Forestry, 2022).

In order to enhance the information and abilities of women farmers at every stage of the agricultural production process and to ensure sustainable agricultural activities and increase the quality of products, trainings are provided in 81 provinces using various extension techniques on a wide range of agricultural subjects. In addition, trainings on various social issues (such as family resources and management, nutrition, child development and education, handicrafts) are organized in 81 provinces in order to bring the social life of women farmers and young girls to the level of modern life and to develop them socio-economically. Since 2003, 2.3 million women farmers have been trained in 203 thousand activities on various agricultural and social issues targeting rural women. In addition, more than 74 thousand women farmers have been trained in cooperatives through more than 11 thousand farmer meetings since 2004. Since 2019, 1,133 women farmers have received training on cooperatives (Ministry of Agriculture and Forestry, 2022).

5. Conclusion

Development includes all efforts to increase the welfare levels of undeveloped and developing countries and to provide them with better economic conditions. However, in order to provide sustainable development, all sections of society (rural-urban areas, women and men) need to contribute to development efforts. However, for years, women, who create half of the population and have an important role in production processes, have been ignored when planning development efforts. After the 1970s, the importance of women's inclusion in these processes was realized. In recent years, a great deal studies have been conducted around the world aimed at empowering women in the process. In Turkey, it has been recognized that women play a key role in ensuring development and various efforts are being made to ensure that women are more visible in economic and social environments.

Agriculture is one of most important sectors where one quarter of women are employed. In order to ensure rural development, women, who have an important role in agricultural production activities, even as unpaid family workers, need to be trained and employed more in order to increase their knowledge and skills, to participate more in decision-making processes and to have more voice in society and in the family. Various actions are being taken by the Ministry of Agriculture and Forestry, other agencies and non-governmental organizations to reduce gender inequality and empower women. However, despite all these studies and trainings, women are still behind men in terms of education level and employment. In order for rural women to reach the desired level, agricultural extension activities for women should continue to increase. However, while planning these trainings, the conditions of women should be taken into consideration without forgetting that they are wives, mothers and working individuals. In addition, due to the low number of women extension workers, these trainings are given by male extension workers, and their husbands often prevent women from participating in these trainings due to the social family structure. In order for the trainings to be more efficient and for more women to participate in these trainings, the number of female extension workers should be increased. Increasing the trainings on women's development and production processes will move a crucial role in ensuring rural development, as women will have more knowledge and voice in economic sectors.

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CHAPTER V

METHODS OF CALCULATION AMORTIZATION IN AGRICULTURE

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1. Introduction

Fixed assets involved in production activities in an enterprise for many years lose value due to use and obsolescence. Amortization is the calculation for determining these lost values.

The concept of amortization is broadly related to all tangible and intangible assets. In a narrow sense, it is a concept that is only related to tangible assets (Koç Yalkın, 1998).

Production resources such as tractors and equipment, animals, buildings, land improvement capital participate in production for more than one year. As a result, they lose value and wear occurs.

All fixed assets, except some fixed capital goods such as land and plot, are physically worn out over time due to their use. The primary reason for amortization separations is these physical wear. Loss of value due to technological changes, outdated goods are another reason for amortization.

Agricultural tools and machines have two types of life that depends on time or use. Time-dependent life and its amortization occur as a result of technical changes in the machines. The new models that emerge determine the degree of obsolescence of the machine. The annual loss of value caused by this obsolescence is a fixed cost. However, amortization is a contingent cost. In other words, if the annual average working hours of a tractor are exceeded, depreciation is considered as a variable cost. On the other hand, if the annual average working hours of a tractor is exceeded, depreciation is a variable cost (Erkuş et al., 1995).

Cattles are still of vital importance today. It has been used for transportation purposes as well as products such as meat, milk, wool, leather from past to present. However, small family farms are in trouble with the increase in migration from the village to the city, the increase in technology and international capital movements. The number of commercial, medium and large-scale cattle farms in the world has been increasing rapidly in recent times. These farms produce milk, meat, livestock and other products. Cattle farming in the agricultural sector is supported by the state in developed countries, especially in EU countries. In this context, significant subsidies are foreseen for these products. Even without these supports, perhaps many of them would have to stop production. Because the revenues are lagging behind the costs. For this reason, it is important to calculate the real costs of the enterprises correctly (Taştan, 2014). Turkish Accounting Standards bring more realistic and accurate regulations on amortization and valuation in agricultural enterprises (Taştan, 2013).

2. Purposes of Amortization

According to their purpose, amortization is divided into cost determination purposes and financial purposes.

i) Cost determination purposes

In theory, amortization could also be called real amortization, since it is only the process of "determining the loss in value of fixed assets for various reasons" (Peker, 1988).

In cost-determination amortization, the target is to determine the actual value losses. The real cost of the activity is found by transferring the value losses to the relevant cost accounts. The goal here is to calculate amortization as a cost factor as accurately as possible. To ensure accuracy, it must be calculated according to objective measures. Therefore, it is important to separate them over their fixed values determined with historical costs.

ii) Financial purposes

Financial amortization is carried out when it is desired to benefit financially from the amortization process.

3. Amortization Calculation Methods

Amortization calculation methods can be examined in five groups. It is possible to explain them as.

- ✓ Appraisal Method (Valuation)
- ✓ Straight Line Method (Normal Amortization Method)
- ✓ Declining Balance Method (Declining Balance Sheet Method)
- ✓ Contradictory Unit Parity Method (Decreasing Ratios Method)
- ✓ Amortization by Working Unit (Success Rate)

I. Appraisal Method (Valuation): In this method, the amortization calculation is found by taking the difference between the new year value and the year-end value.

Example: A tractor; **Value per year: ₺130 000**

Value end year: ₺95 000

Share of annual amortization = 130 000-95 000

= ₺35 000

It shows subjective characteristics. If the purchased fixtures want to be sold after one year, this method is not appropriate in practice. Because in this method, it is evaluated with its half value. It is not appropriate to use this method in places where inflation rate is high.

II. Straight Line Method (Normal Amortization Method): In this method, the amortization share for each year is equal to each other. The fixed asset is divided by the average usage period and annual amortization shares are found (Boehlje, 1984).

$$\boxed{A = D / n}$$

A= Share of annual amortization (₺)

D= Fixed asset value (₺)

n= Average life or useful life of the fixture (year)

Example: Annual amortization of a machine with a value of ₺500 000 and an average life of 10 years:

A = D / n A = 90 000 / 10

= ₺9 000

In other words, when a amortization of ₺9000 is made every year, the value of this machine will be regained at the end of the tenth year. It is different if there is a scrap value for the depreciable fixture. In this case, the scrap value to be estimated first is deducted from the cost of the fixture. Then, the annual amortization share is calculated by dividing the remaining value by its average life.

This situation could be formulated as follows:

$$\boxed{\mathbf{A = (D\text{-}Scrap\ value) / n}}$$

Example: There is a tractor that costs ₺130 000. The tractor has an average life of 10 years. At the end of this period, a scrap value of ₺30 000 is accepted.

In this case, the annual amortization of the tractor is calculated as follows:

A = (130 000-30 000) / 10
= ₺10 000

In practice, the amortization rates determined for certain fixtures are mostly used. Annual amortization of that tool or machine is calculated at the determined rate.

For example, the annual amortization share of a machine with a 10% amortization rate and a value of ₺200 000 is calculated as follows:

A = 200 000 * 0.10
= ₺20 000

It is very easy to calculate annual amortization with the Straight Line Method (Normal Amortization Method). For this reason, it is used a lot in practice.

III. Declining Balance Method (Declining Balance Sheet Method): In this method, an amortization rate is applied to the current value of the depreciated property at the beginning of each year. The resulting figure is the amortization of that year. In this method, the scrap value is not subtracted from the original cost. The accepted amortization rate is applied until it approaches the scrap value. As it approaches its scrap value, it is no longer subject to active amortization. The amortization rate used in this method is higher than the straight line method (Boehlje, 1984).

It is found by the formula:

Annual Amortization Value = Amortization rate * Undepreciated value at the beginning of the year

Example: A machine with a value of ₺1 000 000 was purchased. The average life of the machine is 10 years and its scrap value is ₺110 000. The amortization rate to be used is 20%.

The amortization over the years is as follows:

Service Years	Value (beginning of the year)*	Annual amortization*	Value (remaining at the end of the year)*
1	1.000.000	200.000 (1.000.000*20%)	800.000 (1.000.000 - 200.000)
2	800.000	160.000 (1.000.000*20%)	640.000 (800.000 - 160.000)
3	640.000	128.000 (1.000.000*20%)	512.000 (640.000 - 128.000)
4	512.000	102.400 (1.000.000*20%)	409.600 (512.000 - 102.400)
5	409.600	81.900 (1.000.000*20%)	327.600 (409.600 - 81.900)
6	327.600	64.500 (1.000.000*20%)	263.100 (327.600 - 64.500)
7	263.100	52.600 (1.000.000*20%)	209.500 (263.100 - 52.600)
8	209.500	41.900 (1.000.000*20%)	167.600 (209.500 - 41.900)0
9	167.600	33.500 (1.000.000*20%)	134.000 (167.600 - 33.500)
10	134.000	26.800 (1.000.000*20%)	107.200 (134.000 - 26.800)

* Values are given in Turkish Lira (₺).

As can be seen from the table, the undepreciated value balance is ₺107200 at the end of the 10th year. This value is close to the estimated scrap value (₺110000). In this method, larger quantities of amortization are calculated in the first years. Amortization is calculated in decreasing quantity towards the end of the machine's life.

IV. Contradictory Unit Parity Method (Decreasing Ratios Method):

As in the Declining Balance Method, more amortization share is reserved for the property subject to amortization for the first years in this method.

In this method, the first step is to determine the total amortization quantity. This quantity will be equal to the value of the fixture and its residual value, if any, from its scrap value. The second step is to determine at what rate the amortization will be distributed over each year. The depreciable value of the fixture is divided into units equal to the sum of the average life of the fixture as an arithmetic series. Then, the number of units in the last year is given as a precedent for the first year, and the amortization share of the first year is calculated. The amortization of the second year is determined by writing down the number of the penultimate year to the second year. Other years' amortization is calculated in the same way (Gülten, 1994).

Year	Unit	Peer	Annual amortization
1	100 000	4	40 000
2	10 000 000	3	30 000
3	10 000 000	2	20 000
4	10 000 000	1	10 000
Total 10		10	100 000

In this method, there is no depreciated interest at the end of the period (economic life). If it is desired to calculate the amortization share for any year:

$$\boxed{\mathbf{Ay = (2D\ (n\text{-}y+1))\ /\ (n\ /(n+1))}}$$

A = Share of annual amortization

Ay = Service year for which amortization share is to be calculated

D = Amortization value of the fixture

n = Average life or useful life of the fixture

In the example above, if it is desired to find the amortization share in the second year;

Ay = (2*100 000 (4-2+1)) / (4 (4+1)) = ₺30 000

The efficiency of a machine is high in the first years of purchase. For this reason, the amortization share is higher in the first years. In the first years of service, the repair and maintenance costs of the machine are low. Therefore, it is appropriate to use methods that calculate more amortization share for these years. The declining balance method is more suitable because the declining ratio method is difficult to calculate. But in practice the straight line method is more common and extremely simple.

V. Amortization by Working Unit (Success Rate): There is the area or total working time that a tractor could operate during its economic life. This is divided by the total working time and amortization share per 1 ha or 1 hour is calculated. How many hours worked in that year or how much area has been processed is multiplied by this value, and to find the amortization value for that year. If it is used less than necessary in a year, the economic life of the machine is extended. In this case, amortization is a fixed expense. If the machine is used excessively, it is considered as a variable cost (Kral, 1992).

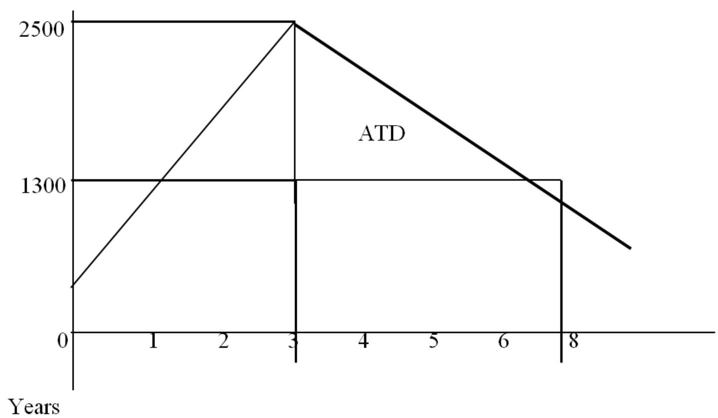
❖ Amortization Calculation for Animals

Ovine and bovine animals are depreciated because they are held for longer than one production period and have a limited productive life. In this context, it is accepted that animals with a limited lifespan will lose value (wear and loss) throughout their productive life. Therefore, live animals raised in the holding are not subject to amortization during the growing period. These assets could be depreciated only after they begin to yield (Koç Yalkın, 1998).

After the animals reach a certain adult age, they reach high efficiency. They are productive for a certain period of time, then their efficiency decreases. As the age of the animal progresses, a decrease in value occurs in the breeding value. Also, the aging animal loses its ability to give birth.

Breeding Value

(₺)



The value remaining after the breeding value (DD) of the animal is subtracted from the butchery value (KD) is the depreciable value (ATD). The amortization is then found by dividing the economic life of the animal.

The butchery value is taken as 40-55% of the breeding value (Kral, 1992).

$$\boxed{A = (DD - KD) / n}$$

In the equality;

A=Amortization

DD=Breeder value

KD=Butchery value

n=Economic life

For the example above, amortization is calculated as follows:

A = (2500-1300) / 5

= ₺240.

In other words, the annual amortization share of this animal is calculated as ₺240.

The amortization rate is as follows:

A% = (240 / 2500) *100

= 10%

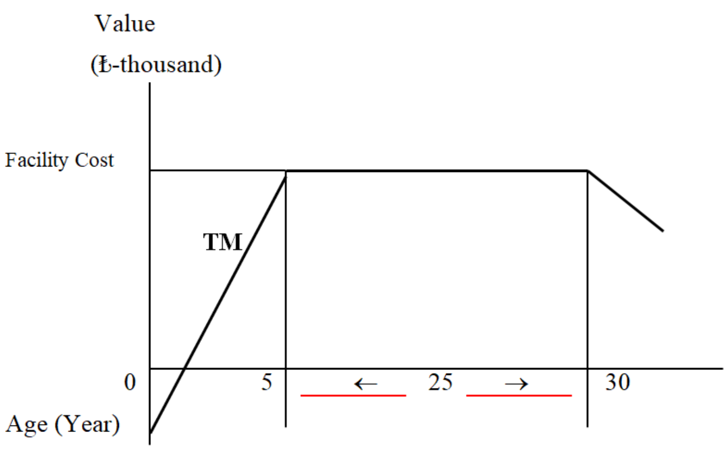
An annual amortization of approximately 10% should be set aside to compensate for the loss of value in the animal.

❖ Amortization Calculation for Orchards

The period from the establishment of orchards to the completion of their economic life is divided into two as establishment period and yield period. Annual amortization of orchards is calculated by considering the total expenses incurred during the establishment period. In other words, the cost of an orchard is the sum of the expenses incurred in the period until the year it starts yielding. Annual amortization is calculated by dividing this total cost by the economic life of the fruit (Kral, 1992).

Example: An orange orchard with a facility period of 5 years and an economic life of 25 years has a total facility cost of ₺4 000 000.

The annual amortization is calculated as follows:



Share of annual amortization;

A = TM / n

A = 4 000 000 / 25

= ₺160 000

❖ **Amortization Calculation for Buildings**

The straight line method is commonly used in this context. The residual value at the end of its economic life is deducted from the depreciable building value, and it is divided by economic life. The annual amortization share is also equal to each other (İnan, 1992).

Example: The cost of a reinforced concrete barn with an economic life of 40 years is ₺2 000 000. The residual cost of the barn at the end of the 40th year was determined as ₺400 000. Accordingly, the annual amortization share is calculated as follows:

A = (2 000 000-400 000) / 40
= ₺40 000

That is, if this barn is depreciated at ₺40 000 each year, the barn's value in year 40 is ₺400 000.

The annual amortization rate of a barn with an economic life of 40 years is calculated as follows:

%A = (40 000 / 1 600 000) *100
= 2.5%

Conclusion

Attrition, wear and tear occur by and by in fixed assets. Amortization is shown as expense share in case of aging and wear of valuable assets in the enterprises. Amortization account is frequently used in agriculture. It is relates to fixed assets of enterprises. It is used in many areas such as livestock, orchards, buildings.

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CHAPTER VI

EVALUATION OF CHANGE IN TURKEY'S CROP PATTERN AND WHEAT PRODUCTION

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1. Introduction

Agriculture is an important sector for every country. Apart from feeding the population, agriculture plays a role in contributing to the country's macro variables such as gross national product, employment, and exports. In addition, agriculture prepares the ground for the formation of agriculture-based and agriculture-dependent industries.

Agriculture has a long history and has undergone significant changes and transformations. Perhaps the most important transformation that agriculture has undergone is the shift from agricultural production for households to production for markets. Thus, agriculture started to be shaped according to the needs of the market. The products to be produced and thus the product pattern to be formed have become determined in line with the needs of the market and developments in the markets (Aydın, 2018).

When agricultural production is done for markets, the ultimate goal of farmers has been to supply more agricultural products to the market and earn more money. In order to supply more agricultural products to the product market, farmers have become much more involved in the input market. This is because increasing agricultural production, i.e. yield per unit area, depends on the use of inputs (high-yielding seeds, chemical fertilizers-medicines, machinery, tools-equipment, fuel, etc.) purchased from the input market in agricultural production (Özalp, 2014). The relationship between the prices of the inputs that farmers use to produce more and more and the prices of the products they sell after production becomes critical for farmers after a certain point: The amount of inputs a farmer buys with one kg of product he sells affects whether or not he continues agricultural production with that product. If the farmer buys fewer inputs over time with the product he produces, and since this will affect his profitability, he tends to switch from the product he produces to a more profitable product within his means. However, if this process cannot be sustained, the process of farmers becoming workers in other sectors begins (Özuğurlu, 2011).

As a result of the relationship between farmers and the markets, market needs and developments in the markets have an impact on the decision on the product to be produced, as well as the agricultural policies pursued. Because agricultural policies shape the functioning of markets. Agricultural policy is a part of the macroeconomic policy followed by the country and is affected by the changes in macroeconomic policy (Özalp and Ören, 2014). Changes in agricultural policy also change farmers' relations with markets. In other words, it determines whether farmers are positively or negatively affected by the relationship with the markets. According to this positive or negative impact, farmers decide on the product they will produce.

Especially in the 2000s, there has been a noticeable change in the crop pattern of Turkish agriculture and wheat production areas have shrunk significantly. In line with the shrinkage in wheat areas, wheat production has remained stagnant for nearly two decades and the amount of wheat imports has been increasing. In addition to these developments, the recent Covid-19 and the Ukraine-Russia war have focused attention on wheat, which is very important for food security.

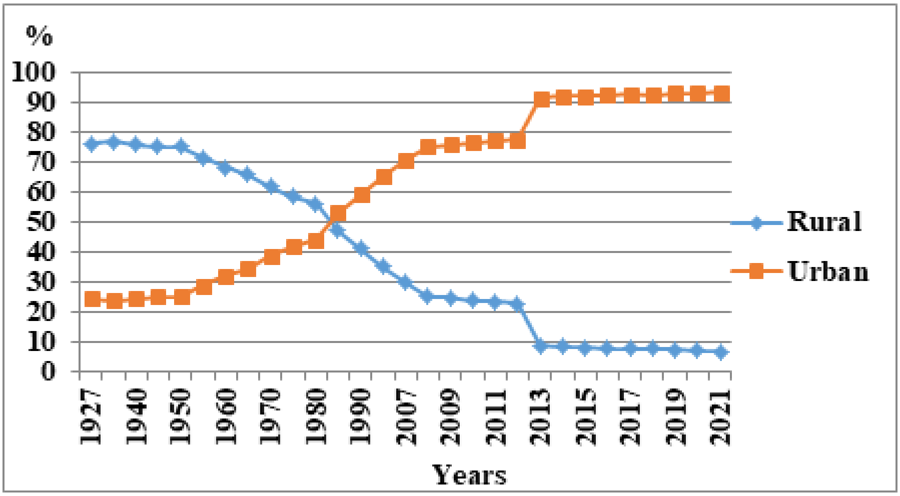
This study focuses on the changes in Turkey's crop pattern and wheat production. In this context, in order to reveal the dynamics of change, I first focused on the change in the place of agriculture in Turkey's economy and population throughout the history of the Republic of Turkey. Secondly, I briefly dwelled on the stages through which Turkey's agricultural policy has passed throughout the history of the Republic of Turkey. Thirdly, I focused on the change in Turkey's agricultural crop pattern and wheat production. Fourthly, I conducted a discussion on the change that has occurred by making connections with the previous sections. In the last section, I evaluated the changes in crop pattern and wheat production and made recommendations.

2. Agriculture in Economy and Population

The Republic of Turkey was founded as a result of the liberation struggle in Ottoman lands occupied during the First World War. The Ottoman Empire's delay in industrialization caused the Republic of Turkey to inherit an economy and population structure dominated by agriculture and rural areas.

In the early years of the Turkish Republic, in 1927, 24% of the population lived in urban areas, while 76% lived in rural areas. Namely, the peasant population was dominant at the beginning of the republic. In other words, urbanization and industrialization are at low rates. Over time, due to urbanization, industrialization, and other factors, the rural population loses its weight and the urban population comes to the fore. However, it is noteworthy that it takes many years for this change. By 2010, the ratio of the urban and rural population was reversed compared to 1927, with 76% of the population living in urban areas and 24% living in rural areas (Graphic 1). In 2013, the reason for the sudden decline in the proportion of rural population was the Law No. 6360, which was passed in 2012 and regulated the Metropolitan Municipality Status, resulting in a 15 percentage point drop in the proportion of rural population. It is not possible for the 22.7% rural population in 2012 to become 7.7% in five years, and the rural areas that have become urbanized are not truly urbanized in socio-economic and spatial terms. Therefore, the rural population still has a very important socio-economic function in Turkey (Davran et al., 2017).

Graphic 1: Distribution of Turkey's Population by Urban and Rural Areas



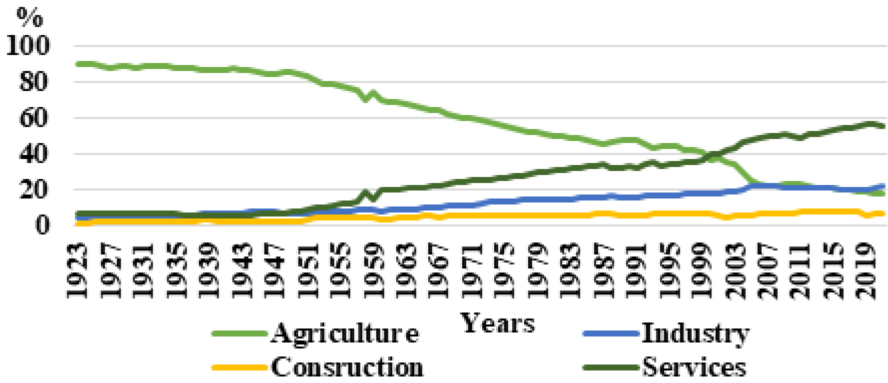
Source: TurkStat, 2014; TurkStat, 2022a

The situation in the population structure is naturally reflected in the employment structure. Again, in the first years of the republic and for many years afterwards, agriculture had a significant share in employment. With the acceleration of urbanization and capitalistization in the 1950s (Pamuk, 2022), a break in the 80-90% share of agriculture in employment began and continued over the years, reaching 17% in 2021 (Graphic 1).

When we consider the history of the Republic, an increase in industrialization started especially with the import substitution period that started in the 1960s (Pamuk, 2022). While the share of the industrial sector in employment was below 10% until 1965, it rose to 10% and above after 1965. The increase in employment in the industrial sector continued almost until 2000. However, although there was an absolute increase in employment in the industrial sector in the 2000s, it is possible to talk about a pause and fluctuation in proportional terms. In the 2000s, the share of industry in employment fluctuated between 18% and 22%; it even remained between 20% and 22% for twelve years between 2004 and 2016 (Graphic 1).

As seen in Graphic 1, industrialization and urbanization made cities more attractive, which drove the rural population towards cities in the 1950s and 1960s, and in parallel, the share of agriculture in employment gradually declined. However, it is also worth mentioning the following. Along with industrialization and urbanization, the services sector has also developed rapidly and has become the sector with the highest share in employment over time. Therefore, it would not be correct to say that the population detached from rural and agricultural areas is directly absorbed only by the industrial sector. It is possible to say that the services sector has turned into an important source of employment for the population leaving rural and agricultural areas.

Graphic 2: Distribution of Employment by Sector



Source: TurkStat, 2014; TurkStat, 2022b

3. Change in Agricultural Policy

Until the 1960s, the Republic of Turkey implemented interventionist agricultural policies and strict policies based on the National Protection Law. This was influenced by the fact that the country had just emerged from the War of Independence, the Second World War, and the peasantry being a determining factor in the country's population and economy. With the 1960s, the country entered the Planned Development Period. Agricultural policies were determined according to these Five-Year Development Plans. In the 1960s and 1970s, Turkey used import substitution policies as an economic development model. The state tried to reduce the cost of inputs used in agriculture through public institutions. In particular, the production and consumption of domestic chemical fertilizers was encouraged. Despite the January 24 (1980) decisions, the military coup of September 12 (1980) and the January 5 (1994) decisions, which opened the door to neoliberalization in the country's economic policies, the state tried to direct agricultural input and product markets by using State Economic Enterprises (SOEs) from the 1960s to the 2000s (Boratav, 2009; Demirdöğen and Olhan, 2017; Kazgan, 1999; Köymen, 2007; Önal, 2010; Özdemir, 1989; Özel, 2011; Pamuk, 1999; Yavuz, 2000). In this process, when structural measures are excluded, it is stated that product price supports, input, and credit subsidies are the most commonly used support instruments (Abay et al., 2017).

The 2000s have been a period of harsh implementation of neoliberal policies in Turkey. Therefore, liberalization in Turkey's agricultural policies accelerated in the 2000s. In this acceleration, the World Trade Organization

Agreement on Agriculture commitments, harmonization practices with the European Union Common Agricultural Policy, the International Money Fund and World Bank agreements, and the relations between Multinational Corporations and governments were decisive (Özalp and Ören, 2019).

The neoliberalization of the state, i.e. its withdrawal from input and product markets and its abandonment of the agricultural credit market to banks, left farmers vulnerable to negative developments in the markets (Keyder and Yenal, 2013). Leaving farmers defenseless paved the way for their withdrawal from agriculture after a while.

4. Change in Crop Pattern and Wheat Production

In the previous chapter, I mentioned that in the early years of the Republic of Turkey and for a long time afterwards, agriculture and rural areas were the main factors determining the structure of the economy and population.

The fact that the economy and population went through agriculture for a long time pushed the rulers of the country to turn more land into agricultural areas, to make more transportation investments in order to bring the products produced in these areas to the markets, and to further modernize agriculture in order to increase production and efficiency (Pamuk, 2022; Aydın, 2018).

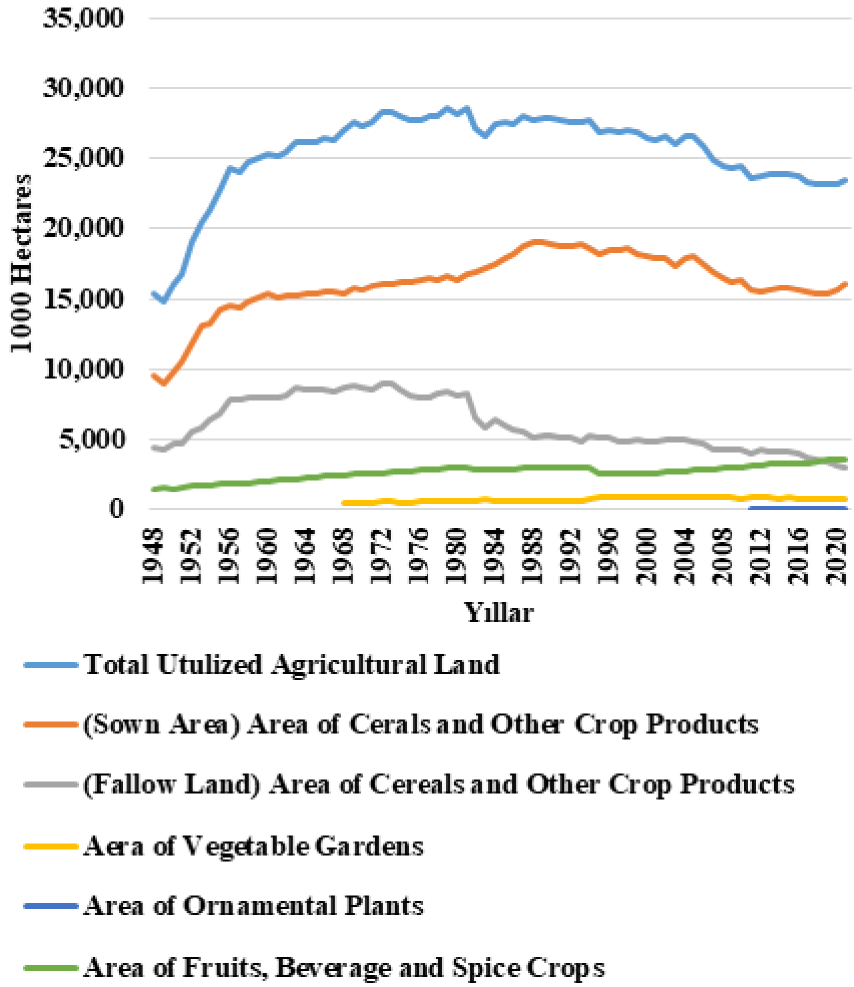
In this process, agricultural areas increased until the early 1980s. After 1981, it fell below 27 million hectares for the first time in 1995. In the 2000s, the contraction in agricultural areas accelerated and declined to approximately 23.5 million hectares (Graphic 3).

Throughout the history of the Republic of Turkey, cereals and other crop products have dominated the agricultural area. However, the decline in the cultivated area of this category of crops, which started in 1990, accelerated in the 2000s and declined to approximately the same level as in the 1970s (Graphic 3).

The area under fallow cereals and other crop products has been on a downward trend especially after 1981. However, the following should be said about this decrease. While the fallow area of cereals and other crop products decreased, the cultivated area increased until 2000. However, after 2000, both fallow area and cultivation area decreased (Graphic 3).

The areas of fruits, beverages and spice crops have expanded over the years. Especially between 2010 and 2021, it never fell below 3 million hectares and reached its highest level in the history of the republic with approximately 3.6 million hectares in 2021 (Graphic 3).

Graphic 3: Change in Agricultural Area and Crop Pattern

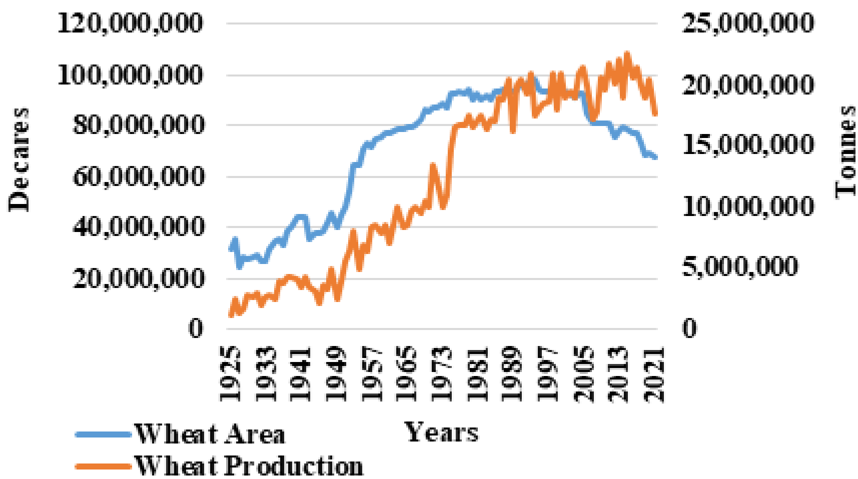


Source: TurkStat, 2014; TurkStat, 2022c

Wheat is the most important crop among cereals and other crop products. Wheat is also the most strategic crop in terms of food security. According to available data, the cultivated area of wheat has increased significantly from 1925 to 1994, albeit with decreases from time to time, and reached 98 million decares in 1994. This is the highest figure wheat has reached in the history of the republic. After 1994, a downward trend started in wheat areas and a very rapid contraction started in the 2000s. In 2021, it decreased to approximately 67 million decares, close to the level of 1953 and 1955 (Graphic 3).

According to available data, although there have been increases and decreases in wheat production since 1925, wheat production has increased compared to 1925. Wheat production crossed the 20 million mark for the first time after 1988. After 1988, there were increases and decreases in wheat production and the highest figure in the history of the republic was reached in 2016 with 22.6 million tons. In the 2000s, wheat production hovered around 20 million tons (Graphic 3; Graphic 4).

Graphic 4: Changes in Wheat Area and Production



Source: TurkStat, 2014; TurkStat, 2022c

5. Discussion

In this section, I have made a discussion on the change in crop pattern and wheat production in relation to the data I have presented in the previous sections.

Today, the majority of the country's population now lives in cities. This increases the pressure on rural areas to feed the cities. When the shrinking of agricultural land adds to this, the pressure on the countryside intensifies. To better understand this pressure, it is useful to examine the period between 1981 and 2021, when a particularly important transformation took place.

Although there was a decline in agricultural employment during the statist, import-substitution policy period until 1980, there was a definite increase in agricultural land without any serious loss. However, with the 1980s, the neoliberal policy era opened and neoliberal policies were implemented very harshly, especially in the 2000s. In this neoliberal period, both the rate of agricultural employment has fallen very rapidly and agricultural areas have decreased significantly.

Between 1981 and 2021, approximately 5 million hectares of agricultural land went out of agriculture. Approximately 3.1 million hectares, or 62%, of these 5 million hectares of agricultural land went out of agriculture between 2002 and 2021. Again, the area of wheat production abandoned between 2002 and 2021 is 2.6 million hectares. During this period, the area under fruits, beverages, and spice production increased by 917 thousand hectares. There are not as many decreases and increases in other production areas as in wheat and the fruits, beverages, and spice crops. However, there was a noticeable and significant increase in the area under cereal crops other than wheat, namely maize, paddy and triticale. These increases are 258, 69 and 94 thousand hectares respectively. The total area change of cereal crops other than wheat is -91 thousand hectares (Table 1).

Table 1: Cereal Cultivated Areas except Wheat (decare)

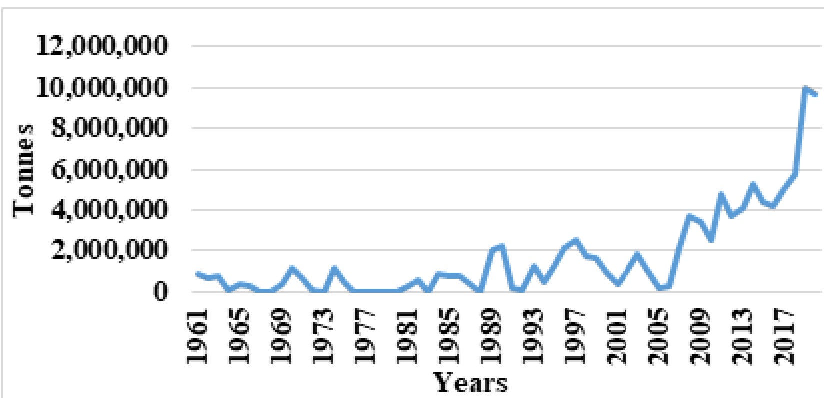
Products	2002	2021	2021-2022
Barley	36.000.000	31.691.005	-4.308.995
Maize	5.000.000	7.582.370	2.582.370
Rice	600.000	1.294.904	694.904
Rye	1.500.000	997.555	-502.445
Oats	1.550.000	1.369.490	-180.510
Spelt	77.000	23.766	-53.234
Millet	36.500	14.902	-21.598
Canary Gras	3.000	22.122	19.122
Mixed Grain	90.000	0	-90.000
Triticale	-	939.909	939.909
Sorghum	-	73	73
Bucwheat	-	9.603	9.603
TOTAL	44.856.500	43.945.699	-910.801

Source: TurkStat, 2022c

Considering the above data, the following comment can be made. It is not possible to say that there has been a serious transition to the production of other cereals in areas where wheat production has been abandoned. Moreover, the total area change in other cereals is negative. Considering that the decrease in the area under wheat production was 2.6 million hectares and the increase in the area under fruits, beverages, and spice crops was 917 thousand hectares, there may have been a considerable amount of transition to the production of these categories in the areas where wheat was produced. Considering these circumstances, it can be said that the vast majority of the approximately 3.1 million hectares of agricultural land that went out of agriculture between 2002 and 2021 may have been composed of decreasing wheat areas.

The loss of 2.6 million hectares of wheat land between 2002 and 2021, the fact that wheat production hovered around 20 million tons during this period, the increase in the population by around 16-17 million, the increase in the wheat demand of the industry, and the significant number of legal and illegal entries into the country from other countries due to the war in the nearby geography and other reasons in recent years have increased wheat imports over time and brought them to around 10 million tons today (Graphic 5). This shows that Turkey has to import half of the wheat it produces (Graphic 6).

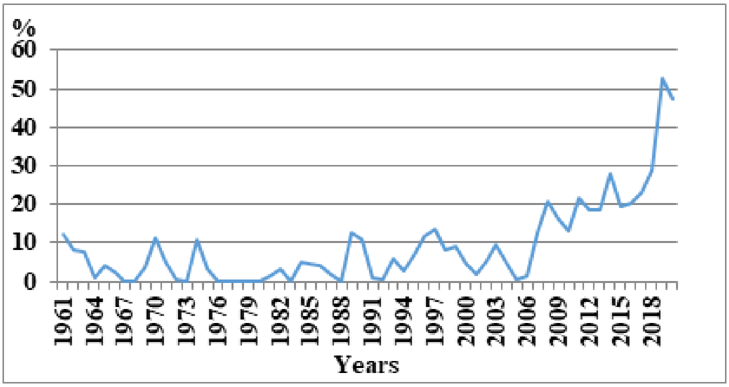
Graphic 5: Change in Wheat Imports



Source: FAO, 2022

As seen in Graph 6, the share of Turkey's wheat imports in wheat production has been on a significant upward trend, especially after 2007. There were also years when Turkey did not import wheat a all. However, from 1961 to 2008, when Turkey imported wheat, the share of imports in production was mostly below %10, with the highest level of %14 in 1997. After 2008, the share of imports in production started to climb significantly and reached 53% in 2019.

Graphic 6: Change in the Share of Wheat Imports in Wheat Production



Source: FAO, 2022; TurkStat, 2022c

The main characteristic of agricultural production is that it depends on nature and the seasons. Bad weather conditions affect production badly. In these cases, it is normal for imports to meet the need arising from low production. However, the increasing imports of wheat cannot be attributed solely and consistently to bad weather conditions.

The significant increase in the amount of imports in wheat and the criticism over this issue forced Bekir Pakdemirli, the previous Minister of Agriculture and Forestry, to make a statement on this issue at the "Turkish Grain Congress 2021". In his speech, Minister Pakdemirli said the following (TOB, 2021):

"In the last 19 years, we have exported 89 million tons of wheat and its products worth \$35 billion against 79 million tons of wheat imports worth \$22 billion, giving us a foreign trade surplus of approximately \$14 billion."

This explanation emphasizes that imported wheat is actually intended to meet the needs of the export-oriented industrial sector rather than domestic consumption. Consequently, the increase in wheat imports should not be criticized because the monetary value obtained from the processing and export of imported wheat is greater than the monetary value spent on wheat imports. While this statement may at first have the effect of allaying concerns about the increasing wheat imports and reassuring the public, a detailed reflection on the statement reveals some problems.

First, the argument that wheat imports are being made for the needs of industry rather than domestic consumption ignores the fact that between 2002 and 2021, millions of hectares of agricultural land went out of agriculture and millions of hectares of wheat production was abandoned. In other words, if Turkey had followed a policy that protected agricultural land and wheat production areas, it would not have spent billions of dollars on wheat imports and would not have needed to make industry dependent on foreign wheat imports. In Table 2, the wheat production potential of the wheat area that was abandoned between 2002 and 2021 is calculated for each year. A comparison of this calculation with Graph 5 shows that, barring bad weather conditions, Turkey would not need to import wheat in the 2000s or would import less. In other words, according to this calculation, if Turkey, which imported 79 million tons of wheat in the last 19 years, preserved its wheat production areas, it could have produced an extra 129 million tons of wheat, far outstripping its imports. Therefore, the wheat needs of the industry could have been met domestically, the foreign currency spent on imports could have stayed at home and the industry would not have been dependent on foreign wheat imports.

Table 2: Wheat Production Potential of Reduced Wheat Area Size by Years

Years	Area (decare)	Yield (kg/decare)	Production (tonnes)
2002	25.553.345	210	5.357.959
2003	25.553.345	209	5.335.314
2004	25.553.345	226	5.770.110
2005	25.553.345	232	5.939.426
2006	25.553.345	236	6.022.644
2007	25.553.345	213	5.438.413
2008	25.553.345	220	5.616.682
2009	25.553.345	254	6.498.752
2010	25.553.345	243	6.204.019
2011	25.553.345	269	6.880.718
2012	25.553.345	267	6.821.339
2013	25.553.345	284	7.249.199
2014	25.553.345	240	6.130.834
2015	25.553.345	287	7.340.967
2016	25.553.345	269	6.861.349
2017	25.553.345	280	7.163.980
2018	25.553.345	274	7.001.617
2019	25.553.345	278	7.091.592
2020	25.553.345	296	7.563.790
2021	25.553.345	262	6.694.976
TOTAL	-	-	128.983.680

Source: TurkStat, 2022c

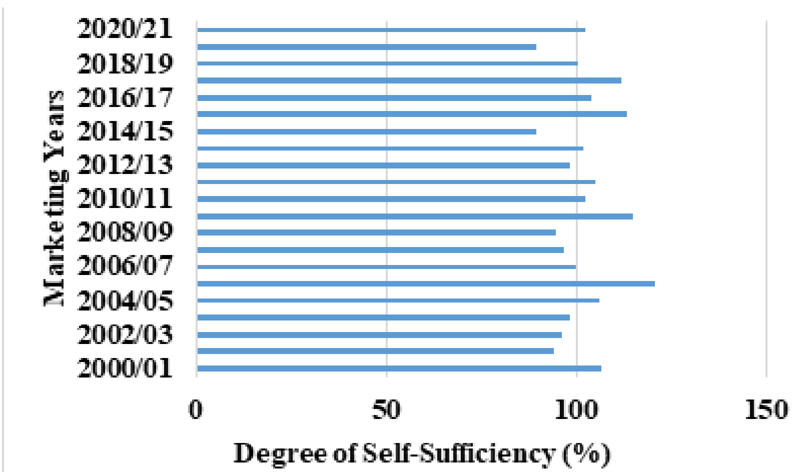
Second, during the Covid-19 period, countries' restrictions on exports of agricultural products to guarantee their own food security and the Russian-Ukrainian war, which created a grain crisis, have seriously raised the significant risks of making the industry dependent on imports. Moreover, the exchange rate shocks that Turkey has experienced in recent years have adversely affected the cost of imports

Third, while Turkey's wheat area is shrinking and wheat production remains stagnant, a growing population will further increase the demand for wheat. Over time, this will pave the way for wheat imports not only for industry but also for domestic consumption.

Fourth, in support of the third case, according to the low scenario in TurkStat's population projections, Turkey's population will be about 88 million people in 2025; according to the wheat forecast by Aydın (2022), wheat production will be about 22 million tons in 2025. In other words, from 2000 to 2025, the population will have increased by about 30% while wheat production will have increased by only about 5%. If this process continues in the coming decades, Turkey is likely to face significant food security risks.

Fifth, Turkey's self-sufficiency in wheat is quite fragile (Graphic 7). In other words, any unfavorable weather conditions or a continued decline in wheat area could cause problems for wheat self-sufficiency.

Graphic 7: Degree of Self-Sufficiency in Wheat



Source: TurkStat, 2022c

Sixth, although wheat yields have increased over the last two decades, they have not increased enough to compensate for the losses in production due to the shrinking wheat areas, which has played a role in wheat production remaining somewhat stagnant. Another reason why wheat yields have not increased as desired is that 65% of cereal areas in Turkey are still not irrigated. As it is known, irrigation has a significant contribution to the increase in yield.

6. Conclusion and Recommendations

In this study, I focused on the change in Turkey's agricultural crop pattern and wheat production. While examining this change, I tried to show the transformation that occurred throughout the history of the Republic of Turkey. However, I emphasized more on the 2000s, when a significant transformation took place in Turkish agriculture.

In Turkish agriculture, the production of cereals and wheat, which belongs to the group of cereals, has always been important. Although the cultivation areas of cereals and wheat have decreased significantly over the last 30 years, they still maintain their weight of 68% in total agricultural areas due to the shrinkage of total agricultural land. However, the share of fruits, beverages, and spice crops has increased from 11% to 15%, especially with the increase in the cultivation area of this product group and the shrinkage of total agricultural land.

Wheat imports have increased in Turkey, especially in the last 15 years or so. Although it is stated that these imports are made for the needs of the industry, it must be said that the decrease in agricultural and wheat areas, the failure to increase yields to cover this deficit, and the increase in population have triggered these imports.

It was during the neoliberal period that Turkey underwent a significant agricultural transformation and seriously lost agricultural land. Therefore, policymakers need to rethink neoliberal policies.

Turkey cannot regain the agricultural land it has lost. Therefore, it has to use what it has left much more efficiently to guarantee food security. For this purpose, it would be beneficial for Turkey to give up export-oriented fruit production for rich countries and utilize these agricultural areas for crops such as wheat and sunflower, which will guarantee food security. It should increase and accelerate R&D and especially irrigation investments to increase wheat yields.

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CHAPTER VII

THE IMPACT OF SUPPORTS IN CATTLE BREEDING ON PRODUCER'S SUCCESS*

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1. Introduction

Red meat, which occupies an important place among the nutrients consumed to sustain human life, has many benefits for human health. Red meat contain a wealthy source of vitamins of group B, such as iron and zinc. It is clear that red meat and dairy products has provide an enormous benefits for human health. Research has proven that high consumption of milk and dairy products and meat and meat products in developed countries leads to a healthier and longer lifespan (İçöz, 2004). The development of animal husbandry has provided a significant source in food production and income for households.

In healthy and balanced diet, animal products play an important role. The demand for animal products is increasing every day. In Turkey, only 36g/day animal protein has been consumed on an average person, while this amount was

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60g/day in EU countries and 70g/day in the USA. These data show that the level of consumption of animal protein in Turkey is not enough (Anonymous, 2016). In Turkey, animal products, which is an important source of food for the healthy nutrition of the growing population, is an important source of livelihood in rural areas, and also has an important role in meeting the need for raw materials in the meat processing industry (Aral, 1996; Yılmaz & Köknaroglu, 2007).

Animal husbandry, which is accepted as the locomotive of the agricultural economy in developed countries, is important in two respects. First, it creates employment with low payment and second, it converts nutritional sources into foods suitable for human health. In Turkey, animal husbandry production is not in desired level. Turkey placed in second place among the European countries and third place in the world in the total number of animals and the number of animal decreased day by day (Kutlu et al., 2003). It is understood that the measures taken in this regard and the support provided to the producers are not effective enough.

While the share of animal husbandry in agricultural production is 50% or more in developed countries, this rate is around 25-30% in Turkey (Yılmaz & Köknaroğlu, 2007; Hozman & Akçay, 2016). Animal husbandry has a very important place in agricultural production for developed countries. In Turkey, animal husbandry takes second place in agriculture. In other words, a large part of the supports is provided to crop production. In previous years, there was not enough support and work to improve animal husbandry in Turkey, but in recent years, more and various resources have been started to be provided to develop animal production (Ören & Bahadır, 2005).

While animal husbandry in Turkey went through painful processes towards the 1980s, it became difficult to support domestic producer to survive. In the past years as well as today, the authorities preferred the easiest solution to meet the increasing need for meat and turned to imports. To revive animal husbandry, which is in a bad trend in Turkey, various support policies were initiated in 2000 years. In the following years, it contributed to the development of animal husbandry by increasing the diversity of supports. Supports such as artificial insemination, milk incentive premium, calf support, production of fodder crops were included among the support types (Demir & Yavuz, 2010).

In the membership negotiations with the EU, it has been seen that studies should be carried out to harmonize the livestock sector with the level of the member countries of the union. Plans and strategies have been put forward to raise the livestock sector in Turkey to EU level (Yenilmez & Bayraç, 2005).

The decree on supporting livestock enacted with the aim of correcting and improving the deteriorating livestock in Turkey was put into practice. In order to increase livestock activities, the priorities are to encourage feed production for roughage needs and to encourage breeding with artificial seeds and pedigree records in order to increase the yield in the unit area. It is aimed to maintain and increase the livestock sector with milk support, rootstock, fattening and calf supports, which are one of the important support branches in the continuation of livestock activities (Anonim, 2014). However, when we look at the steps taken for the development of animal husbandry, it is a fact that it has not yet fully achieved the desired results (Kan & Direk, 2004). Recently, it is observed that the importance and diversity of livestock support has increased in the support provided to the agricultural sector in Turkey (Ata & Yılmaz, 2015).

Livestock, which contributes to the development of the country's economy at a high rate, can provide the most added value in the unit area with low costs. While high costs are normally needed to create a business line in the industrial sector, a new business line can be created with almost 20% of this cost in the livestock sector. Investments in animal husbandry equal to the amount of investment to be made in the industrial sector will provide employment 5 times the number of people who will work in the industrial sector. However, this opportunity has not been taken advantage of in Turkey, which is favorable for agriculture and animal husbandry, and the livestock sector has worsened instead of receiving the importance it deserves (Peşmen & Yardim, 2008).

It is a fact that Turkey is inadequate in the use of its resources. In Turkey, as there are deficiencies in terms of full use of resources, the desired point in animal husbandry has not yet been reached. Turkey is very rich in terms of natural resources and ecological conditions that suitable for animal husbandry. However, the development in animal husbandry has not been sufficiently achieved due to the inadequate and incorrect use of policies and studies that need to be established in order to use these opportunities. Naturally, the increase in costs due to rising animal feed prices has led to a decline in animal husbandry, and the increase in the price of animal products has made people less likely to consume animal products. Bahşi and Budak (2014) found that milk and dairy products (58,9%) were affected from price cut at the first place. Meat and meat products (57,1%) followed milk and dairy products.

Despite the livestock support made by the state, the number of animals has increased sufficiently, and the prices of meat and meat products have not reached normal levels. Alternative solutions are being worked on every day by the authorities and interested parties of the sector. In this context, determining the effectiveness level of the supports provided to the sector and eliminating the deficiencies and errors, if any, in the applications are among the most critical issues for development.

Animal husbandry is a very costly branch of production. Feed, electricity, water, veterinary for animal health and all other expenses such as tax, interest, insurance, and similar expenses must be covered in production period. In addition, it is quite difficult for small enterprises to make a profit. Small businesses, which 5-10 head of animal, can be far from economies of scale. Such small enterprises can survive with the family workforce and can only meet their own expenses. To be an effective entrepreneurship in cattle production, farmer has to produce its fodder and have at least 50-100 head of animal (TUİK, 2018).

2. Development of Animal Presence in the World and in Turkey

According to FAO data, there were approximately 1.525 billion head of cattle and 203 million head of buffalo in the world in 2020 (FAO, 2022). As we look from past to present, there is a steady increase in animal assets from 2000 to 2016 in the world. While there are increases in the total number of cattle in Turkey, from time to time decreases are also seen compared to the previous year. When the number of animals of the last 16 years is examined, it is seen that while the total number of cattle was 9,924,575 in 2002, this figure was 17,220,903 in 2018. While 99% (9,803,498 heads) of Turkey's total number of cattle in 2002 consisted of cattle, 1% (121,077) consisted of buffalo species. In 2018, as in 2002, cattle constitute 99% of the number of cattle. Accordingly, almost all of Turkey's cattle number consists of cattle species (Tüik, 2018). According to the changes in Turkey's cattle presence over the years, the head of the cattle presence 9803498 in 2002 was culture, the head of the 1859786 was hybrid, and the head of the 4357549 was composed of domestic cattle 3586163. In 2019, where there is an increase in the number of cattle over the years, there are 8,559,855 cultures, 7,554,625 hybrids and 1,573,659 domestic cattle assets out of a total of 17,688,139 cattle. When the proportional distribution of cattle presence is examined, it is seen that while there are increases in the number of cultured animals, there are decreases in domestic cattle.

3.3% of the Gross Product in Turkey is known from the reports of the FAO, which consists of the agricultural sector. With these data, livestock meets almost 35% of GNP. As the share of livestock in GDP varies according to countries, this rate is 49% in EU countries, this rate is 43% in the USA, but while this rate is

33% in developing countries, the share of livestock in GDP in Turkey is 36%. As of 2018, according to TURKSTAT data, the increase in the number of animals in Turkey grew by 6.9% compared to the previous year and was 17 million 221 thousand heads. In this number, almost all of them are cattle, while 178 thousand 397 heads are buffaloes. According to the data of 2018, red meat production was reported to be 1 million 118 thousand 695 tons. However, red meat production decreased by 0.7% in total compared to the previous year's rate. While there was a 63.7% decrease in goat meat production, there was a 1.7% increase in beef and a 0.8% increase in mutton. It was reported that 622,871 tons of the total meat production amount of 2018 was produced only in slaughterhouses.

2.1. Livestock Supports

In many studies, the characteristics of entrepreneurs and entrepreneur candidates have been evaluated from different angles except for some basic headings. There is no such thing as a profile of a successful businessman or businesswoman. However, in order for the chance of success to be high, it must have a significant part of the following personal qualities.

In the development of animal husbandry in Turkey, different methods have been used in the past years. Significant changes occurred in the country's support policy, especially in the post-2000 period, and in the period of 2004-2008, fodder crops, milk incentive premium, artificial insemination and calf supports constituted the most important support item (Demir & Yavuz, 2010). Livestock supports could not be achieved due to the fact that they were not continuous compared to the crop production sector in the past and there was not enough infrastructure for the implementation of support policies, and therefore the problems of animal husbandry could not be eliminated (Yavuz, 1999). The most important goal in the sector, which has been supported in various ways over the years, is to ensure that animal husbandry is a profitable sector. In order to achieve this, specialized enterprises are needed. The formation of a specialized livestock sector will also be realized by determining the appropriate production regions and setting the production planning targets in terms of the regions.

In the following years, new arrangements and amounts of support and new practices came to the agenda in the support and the share of livestock supports in total agricultural supports increased, and the share of livestock supports increased from 8% in 2004 to 22% in 2009. In the following years, the amount of support continued to increase every year and when the years 2004-2008 were taken into consideration, it was observed that the support for forage crops, milk incentives and artificial insemination continued continuously over the years and had significant shares in the support items.

Among the various supports provided to livestock enterprises, vaccination support (per animal) is 1.50 ₺, fattening male cattle support is 200 ₺, calf support is 350 ₺, animal gene resource support is 450 ₺ per animal in cattle breeding and 600 ₺ per animal in cattle breeding, 800 ₺ for protection with cattle pedigree. The supports implemented to support livestock with the production of fodder crops are shown in Table 1.

Table 1. Forage plant production supports for livestock in Turkey

Forage crops production support	**₺/decare-year**
Perennials	90
Annuals	60
Silage corn	100
Forage Crops Cultivated in dry conditions	40
Forage plant cultivation in the provinces in the Animal Breeding Zone	An additional 25% to the support received

Source: Ministry of Agriculture and Forestry, 2022.

According to the regulation on low-interest investment and business credit provided to producers by Ziraat Bank and Agricultural Credit Cooperatives for agricultural financing needs, a 50% discount is applied on investment and operation loans of the facilities to be established to support cattle breeding. A 75% discount is applied to the investments to be made for fodder plant production and the loans to be used. In these subsidy applications, there are additional supports for young farmers (those under the age of 40) and women entrepreneurs.

3. Benefiting from Supports of the Cattle Breeders: The Case of Hatay Province

3.1. Features of Cattle Breeders

Approximately 15% of animal husbandry, which is one of the indispensable livelihoods of people living in rural areas in Turkey, produced by Hatay province. A large part of cattle breeding is carried out in Antakya district. The total number of cattle in the province is 154,382 and 65% of this number is the pure culture breed. When we look at the number of other animals in the province, it is seen that the number of poultry is 492,776, the number of small cattle is 396,960, the number of single-clawed animals is 2,972, while the total amount of hives in the province is 92,926 (TUİK, 2018).

It was found that 54% of breeders were between 36-50 years of old, 39% were 51 and over and 7% were between 20-35. When the number of family members of the cattle breeding enterprises is examined, 75.3% of the enterprises has 5-8 family members, 15.3% of them has 1-4 members. Almost ten percent (9.4%) of the enterprises had more than 9 family members. All breeders can read and write. 84.7% of them had less than high school education, 14.2% were high school graduates and 1% were associate degree graduates. It has been observed that the majority of the enterprises engaged in fattening cattle breeding in Antakya district are managed by men, and the enterprises managed by women consist mostly of small enterprises. It was determined that 93% of the operators were male and 7% were female. When the occupational analyzes of the enterprises participating in the study were examined, it was seen that 93% of the producers and 2% were self-employed, 2% were tradesmen and the remaining 2% were in other occupational groups.

80% of the breeders engaged in fattening cattle breeding are only in animal production, 16.4% in vegetable and animal production, and 3.6% in small cattle breeding. While 39 of the small-scale enterprises make only animal production, 11 breeders are engaged in plant production as well as animal production. The remaining 1 enterprise is engaged in small cattle breeding with cattle. There are a total of 23 enterprises in medium-sized enterprises. Of these, 21 enterprises are engaged in animal production only, and 2 enterprises are engaged in both animal and plant production. There are no small cattle breeding enterprises in this group. It was determined that 8 enterprises made only animal production, 2 enterprises produced cattle and small cattle and 1 enterprise made plant and animal production together.

When the number of employees in enterprises is grouped according to the size of the enterprise, 1-2 people work in 62% of the enterprises, 3-4 people work in 35%, and 5-+ people work in 3%. 1-2 people work in 36 enterprises from small scale enterprises, 3-4 people work in 14 enterprises, and 5-+ people work in 1 enterprise. Among medium-sized enterprises, 1-2 people work in 13 enterprises, 3-4 people work in 8 enterprises, and 5-+ people work in 2 enterprises. Finally, among a total of 11 large-scale enterprises, 3-4 people work in 7 enterprises, while 1-2 people work in 3 enterprises and 5-+ people work in 1 enterprise. Of the total 85 enterprises, 90.6% had family members working in various jobs in the business and 9.4% were not working. It was determined that family members did not work in 8 enterprises where family members worked in 77 enterprises engaged in fattening cattle breeding enterprises. Among these enterprises, 1 or 2 family members working in 36 enterprises are 1 or 2 people, 3 or 4 people are working in 10 enterprises, while 5 or more people work in 1 enterprise. There are 21 enterprises in medium-sized enterprises. Of these enterprises, 1 or 2 people work in 13 enterprises, 3 or 4 people work in 7 enterprises and 5 or more family members work in 1 enterprise. There are a total of 9 enterprises that work as family members in large-scale enterprises. Within these enterprises, 3 or 4 people work in 5 enterprises, 1 or 2 people work in 3 enterprises, and 5 or more family members work in 1 enterprise. According to these results, as the scale of the enterprises grows, the rate of family members working in business jobs decreases.

When it is examined how many years the operators have been engaged in fattening cattle breeding, it is determined that 14 enterprises have 1-10 years, 23 enterprises have 11-20 years, and 14 enterprises have 21 years or more of fattening cattle breeding experience among small-scale enterprises. Within the second group of enterprises, 4 enterprises have been engaged in fattening cattle breeding for 1-10 years, 8 enterprises for 11-20 years and 11 enterprises for 21 years or more. Among the 11 large-scale enterprises, 2 enterprises have 1-10 years, 4 enterprises have 11-20 years and 5 enterprises have 21 years or more of fattening cattle breeding.

Turkey is a country known to be suitable for animal husbandry and agriculture both in terms of its geography and ecology. However, this reality has come to a position to be ignored in terms of agriculture and animal husbandry. With the increase in mass housing and urbanization, it is seen that agricultural lands and meadow-pasture lands are disappearing one by one. Livestock, which continues in difficult conditions, has become possible only in closed barns with decreasing agricultural lands. It is seen that these developments are also living in the Antakya region. While 88% of the producers examined within the scope of the research cannot use any meadow-pasture, only 12% can use meadow-pasture area.

According to the agricultural production status of 85 enterprises engaged in fattening cattle, 73% of 85 enterprises stated that they did not make agricultural production, and 27% of enterprises stated that they made agricultural production. There are 23 enterprises engaged in plant production activities among the enterprises engaged in fattening cattle breeding. 65.2% of these enterprises are engaged in field products, 21.7% in garden products, 8.7%

in greenhouse cultivation and 4.3% in poultry and other agricultural production activities. Despite 23 enterprises engaged in crop production activities among the enterprises engaged in fattening cattle breeding, there is no additional agricultural production activity in 62 enterprises.

It was determined that 92% of the enterprises did not produce feed, while only 7 enterprises of 8% were engaged in feed production. Since feed costs are the most important expense factor in animal production, it is very important for enterprises to produce at least a part of their feed. When the feed supply methods of the enterprises participating in the research are examined, 92% procure their feed from the factory, while only 8% partially prepare the feed supply themselves and procure the rest from outside. When the size of 7 enterprises that can partially provide their own feed is examined, it is determined that 5 breeders are small-scale breeders and the remaining 2 enterprises are large-scale enterprises. When the situation of fattening cattle breeding enterprises to produce concentrate feed in their own enterprises is examined, it is determined that 94.1% (80 enterprises) of the enterprises do not produce cut feed and the remaining 5.9% (5 enterprises) enterprises produce cut feed.

It was observed that the fattening period of the fattening cattle breeding enterprises was 11 months in small enterprises, 11 months in medium-sized enterprises and 10 months in large-scale enterprises. When the number of animals is considered, it is seen that there are the most calves, while the least cattle breed is bull. When it was examined where the livestock enterprises engaged in fattening cattle were obtained from the province of Hatay at the rate of 45.9% (39 enterprises), it was determined that 13 enterprises with a rate of 15.3% were procured from the provinces of Hatay and Sivas, and 10.6% (9 enterprises) enterprises were partially obtained from the provinces of Hatay and Adana and the remaining 24 enterprises at the rate of 28.3% were procuring their livestock from the provinces of Sivas, Yozgat, Bursa, İzmir and Kars.

In the sales preference of the enterprises with 64.7%, the first preferences are butchers, 28.2% are other sales forms and 7.1% of the enterprises are distributed as slaughterhouses. It has been observed that fattening cattle breeding enterprises mostly feed hay, fattening feed, silage, and other feed varieties in raising their animals.

3.2. Benefit from Agricultural Supports

It was found that 69.4% of the enterprises did not use credit in fattening, while 30.6% of the enterprises used credit. Among them, 84.6% used their loans in fattening, 11.5% used them for other needs and 3.8% enterprises used other loans. Fattening male cattle support is a type of support that is almost never received in the Antakya region. It has been seen that only two enterprises, one from small business and one from large business, out of 85 enterprises have received the support of fattening male cattle. In 2019, fattening male cattle support was 200 ₺ per animal. Most breeders did not benefit this support because they sold their animals either butchers or other places. To benefit from this support, enterprises are required to slaughter their animals in slaughterhouses approved by the Ministry. Calf support is the most intensive type of support received by cattle breeding enterprises in the Antakya region. It is known that this support received by almost all businesses is 300 ₺ per calf in 2019. 81 enterprises out of 85 enterprises received this support. The average income of small enterprises is 1470 ₺ while it was 1170 ₺ in medium-sized and 850 ₺ in large-scale enterprises. It was determined that 85 enterprises engaged in fattening cattle breeding did not receive vaccination support. None of the fattening cattle enterprises received animal disease compensation support. Only one medium-sized enterprise received the support of forage crops.

3.3. Information Resources

It was found that main information source of farmers about agricultural support was Provincial and District Directorates of Agriculture (94.1%). Also, neighbors (3.5%) and their neighbors and relatives (2.4%) used as information source. When asked whether they knew that the livestock enterprises were within the scope of support before starting fattening, they stated that they did not know that 81.2% of the enterprises were within the scope of business support and 18.8% of them knew that the livestock was within the scope of support.

3.4. Satisfaction about Subsidies

As a result, it was found that 38.8% are satisfied, 25.8% are not satisfied, 18.8% are undecided, 9.4% are not satisfied at all and 2.3% are very satisfied about subsidies. The average level of satisfaction according to the farm groups is around the average value (3: Undecided) in the first group of enterprises, while it is below the average answer in the medium and large business groups. It can be said that the level of satisfaction of enterprises with this support is low.

85% of the enterprises stated that the supports were insufficient while 15% reported not. Among 69 enterprises, 88.4% of them stated that the support was insufficient and needed to be increased, while 11.6% expressed that feed and input prices should be reduced. High input prices is the main problem of all farmers. It was expressed that if the managers solve these problems as soon as possible and prevent increases in input prices, the producer can continue production without the need for additional support.

When the opinions of the fattening enterprises on the increase in agricultural income after the supports were examined, the rate of producers who stated that they definitely did not agree was 84.7%, while the rate of those who disagreed was 10.5%. In general, 87% of the enterprises participating in the research state that the quality of the feeds used after the support has not increased. Accordingly, it can be said that additional measures are needed for breeders to benefit more from feed support. After the supports, it was determined that there was no significant increase in the feed use of the producers. It can be said that the utilization of veterinary services has been partially improved with the supports provided. The opinion that the use of vaccines and drugs has not increased in most of the enterprises has been mainly stated.

In order to continue their operations, many of the cattle breeding enterprises have to keep their businesses afloat by allocating money from the family budgets, if any, for the expenses in the enterprise or by borrowing. Because fattening enterprises can only obtain cash resources after feeding and selling their animals for at least 5-6 months. So there is no cash flow for daily expenses. For this reason, most breeders complete this period by borrowing and can close their debts at the end of fattening. It is seen that the solvency of the debt of the feeder enterprises has not increased after the support.

In general, there is not much trouble with the lack of timely payment of subsidies. Of the 85 enterprises within the scope of the research, it was seen that 78.8% agreed, 9.4% were undecided, 8.2% disagreed, 3.5% strongly disagreed. According to the results of the survey, it was sufficient for the breeders to support only 21% of the section.

When the opinions of the Provincial / District Directorates of Agriculture and Forestry about their informative studies were examined in order to inform the enterprises within the scope of the research, 35.2% of the operators disagreed, 24.7% of them definitely disagreed, 28.2% of them agreed and 11.7% of them were undecided. Looking at these results, it can be said that the Provincial / District Directorates have been sufficiently helped by the publication and training activities. Because I strongly disagree with the question of non-disclosure and the proportion of producers who answer that they do not agree is around 60% in total.

When the opinions of the operators regarding the long duration of the applications made to the Provincial / District Directorates of Agriculture and Forestry in support and similar official transactions were examined, 34.1% disagreed, 23.5% definitely disagreed, 12.9% undecided and 29.4% agreed. There was no breeder who gave the answer that I strongly agree. In terms of playing, 58% of the producers stated that there was no problem in their support applications. If the producers who express an undecided opinion on this issue are taken into consideration, it can be said that around 65% of the producers have expressed a positive opinion. Today, due to the developing information and communication technologies and increasing education levels, it can be said that official transactions are solved faster than in previous years.

4. Conclusion

Migration from rural to urban still continuous in Turkey. Main reasons for migration were social, cultural and economical problems in rural areas. Also, more opportunities in education and work areas had a positive impact on migration. Decrease in agricultural land and grazing areas had a negative impact on agriculture and animal husbandry. Low grazing opportunities increased feed cost. Increasing breeding cost cause low animal food consumption per capita. Small producers facing more problems everyday. They had to use their supports in daily life activities instead of animal production. Because of these problems, the price of animal foods increasing while number of animal decreasing. Government, to close the gap between the number of animal and production in a short and medium term, began to import animals and carcass meats. Instead of these temporary preventions, long-term precatuions are needed to solve the basic problems in animal husbandry. Otherwise, the situation in which livestock is located will continue to worsen. Today, animal breeders got calf supports, heifer supports, rootstock supports, milk supports, shepherd supports, disease compensation supports, disease-free business support, vaccine and earring supports, on-site protection of genetic resources supports, and fodder crop supports. Fattening enterprises can only benefit from a part of these supports.

Based on the fact that the purpose of the supports is to benefit the producers, it is very clear that studies should be carried out to increase the support rates in animal husbandry in the evaluations to be made. In addition, in order to receive more support, it is useful to encourage producers and, if necessary, to arrange the criteria according to the size of the enterprise and on a regional basis. It is necessary to implement a more professional and dynamic process by making the final analyzes of the supports made to the livestock enterprises whose numbers are about to decrease day by day and making updates again according to the feedbacks to be received from the enterprises. Despite having all kinds of geographical and climatic conditions suitable for animal husbandry as a country, consumers cannot consume sufficient animal products as a result of increasing costs. New regulations should be made by taking into account the consumer side of the issue. In addition to consumers consuming and becoming aware of animal products, policies that will increase healthy and balanced nutrition should be put forward.

One of the main problem is high input prices for all producers. That is why it is important to keep the prices at low level. If the decision-makers and policy makers related to the sector show determination to solve these problems, it is understood that if the reductions in input prices can be achieved, the producer can continue production without the need for other supports. In addition, by protecting agricultural and pasture areas, increases in input costs can be partially prevented and significant contributions can be made to the development of cattle breeding. Farmers in both regions have often heard of livestock support through relatives or neighbors. In this context, in order to achieve the purpose of the supports, it is thought that it will be important to increase the farmer training activities for the promotion of the supports and to ensure the continuity of the supports.

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CHAPTER VIII

THE LOCOMOTIVES OF SMALL RUMINANT PRODUCTION IN THE SOUTHEASTERN ANATOLIA REGION: KOÇERS

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1. Introduction

Nomadism is an important activity that has been going on in Anatolia for centruies, bothes in terms of cultural richness it harbors and the development and sustainability of small ruminant production. In nomadic culture, going to the plateaus is a culture that has its roots in the Central Asian horse nomadic culture and has been reshaped in Anatolia for more than a thousand years and continues to exist by changing its shape depending on the modernization process(Somuncu, 2005; Savaş et all., 2020). Nomadic pastoralism basically refers to a traditional culture and economy of moving large herds from one place to another in search of pasture and water. In this respect, nomadism is a climate-friendly production method as a livestock system that needs the least fossil fuel energy by reducing the demand for industrial feeds which cause large amounts of greenhouse gas emissions in production. Studies that make comparative analysis between traditional methods such as nomadic animal husbandry and industrial animal husbandry show that traditional animal husbandry as a food system is a sustainable livestock system in terms of climate crisis (Anonim, 2022). However, many factors such as socio-economic developments, decrease in pastures, settlement policies, more attractive city life and security problems, have unfortunately led to a gradual decrease in nomadic livestock and an extinction of this rich culture. In this paper, the effect of Koçers who began to settle down since 1990s, in small ruminant production in Southeastern Anatolia Region.

2. Koçers

Nomadic families in Turkey are defined by various names in different regions, while the nomads in the Western part of the country called "Yörük" or "Türkmen", the nomads living in the Eastern and Southeastern Anatolia region are called "Koçer" (Işık, 2016). The Koçer is a word that is widely used among the Kurdish people who lives in the Eastern and Southeastern Anatolia region of Turkey. Koçer is used for families who are in migration or originally from a nomadic culture. Koçers, who usually introduce themselves as loyal to their clans (aşiret) and other members of the family, known that they care about both their ancestry and family ties. Clan means a large form of social organization. Being a clan is one of the values that complete Koçer and is important to provide cooperation to communities who lives in hard conditions. The clan is shown that as a way of defense against other groups and communities as well as providing unity among themselves (Gültekin ve Tan, 2017).

Koçers in the Eastern and Southeastern Anatolia Regions are organized in two different way as fully nomadic and semi-nomadic. Animal husbandry is the main production activity of the fully nomadic group. They spend five months of the year in the winter pastures in the Southeastern Anatolia Region provinces (Batman, Siirt, Mardin, Şanlıurfa, etc.) and five months in the plateaus in the Eastern Anatolia Region provinces (Van, Erzurum, Bingöl, Elazığ, Tunceli, etc). Since the majority of them are walking during migration process, it tooks two months; one month to reach the winter pastures and one month to reach the plateaus. However, it is known that there are also Koçers, who carry their animals to winter pastures and/or plateaus by vehicles. Semi-nomadic koçers, on the other hand, are communities that have completely settled down and whose main economic activity is not animal husbandry, but who are rooted in a nomadic culture. These groups, who had winter settlements and went to pasture areas to graze their animals in the summer months, engaged in different agricultural activities in their winter months, engaged in different agricultural activities in their quarter, indicating that they did not live a fully nomadic life (Sever, 2016).

Some of the clans known as Koçer in the research area are: Beritan clan, Kejan clan, Karakecililer clan, Dudêran clan, Alikan/Aliki clan, Mahmediyan clan and Silokyan clan. These clans, which serve as the locomotives in small ruminant production, have tried to maintain their economic activities and preserve their culture by living in tents with thousands of members for centuries. For example, Hammer (2012) found that in the 1940s, only the Alikan tribe had 200 tents and more than a million sheep, while the Beritan, Kejan and Dudêran clan were of similar size. A significant part of the Koçer tribes (Tayanç, 2018), some of whom started to settle down in the 1950s, did not adopt settled life until the 1980s, but the security problems that started in the region since 1984 and the blocking of migration routes and the prevention of their entry to many regions due to the pressures of the central authority started to change the social structure of the Koçers. Since the 1990s, their sedentarization has accelerated (Yılmaz and Baran, 2011; Yazıcı, 2016).

Table 1. Sheep and Goat Population in Turkey Between 1984 and 2000

Years	Number of animal (head)	
	Sheep	Goat
1984	48.707.008	16.732.000
1985	40.391.008	13.100.000
1986	42.500.000	13.336.000
1987	43.758.000	13.406.000
1988	43.796.000	13.057.000
1989	45.384.000	12.914.000
1990	43.647.008	11.942.000
1991	40.553.008	10.977.000
1992	40.433.008	10.764.000
1993	39.416.000	10.454.000
1994	37.541.000	10.133.000
1995	35.646.000	9.564.000
1996	33.791.000	9.111.000
1997	33.072.000	8.951.000
1998	30.238.000	8.376.000
1999	29.435.000	8.057.000
2000	30.256.000	7.774.000

Source: FAO, 2022

It would probably not wrong to say that one of the most important reason for the decline in the number of small ruminants in Turkey since the mentioned period is the reduction or termination of Koçers activities with their settlement. As can be seen in Table 1, Turkey had 48.7 million sheep and 16.7 million goats in 1984, while these numbers declined to 30.2 million and 7.8 million head, respectively, in 2000. Similar indicators were observed in the live ovine livestock trade in the same period. Between 1984 and the mid-1990s, Turkey exported an average of 1.9 million head of sheep and 40 thousand head of goat per year (Table 2).

Table 2. Live Sheep and Goat Trade in Turkey Between 1984 and 2000

Years	Number of animals imported (head)		Number of animals exported (head)	
	Sheep	Goat	Sheep	Goat
1984	0	0	2.117.614	0
1985	11.477	0	1.772.296	11.477
1986	21.385	297	2.583.224	21.385
1987	303.067	0	2.644.010	303.067
1988	66.614	3	2.945.477	66.614
1989	19.262	0	2.891.687	19.262
1990	7.103	0	2.276.061	7.103
1991	1.042	0	1.901.234	1.042
1992	403	0	799.143	403
1993	50	0	1.201.271	50
1994	4.834	0	1.659.933	4.834
1995	48.143	0	740.385	48.143
1996	311	65	240.576	311
1997	335	59	232.437	335
1998	0	0	129.460	0
1999	5.900	0	55.185	5.900
2000	0	9	166	0

Source: FAO, 2022

3. Researchs about Koçers

Hütteroth (1959), who conducted the first detailed research on nomadic animal husbandry in Turkey, defines nomadism as the periodic migration of ethnic groups consisting of livestock owners and their families with herds from one place to another with their herds. He basically divides nomadism into three groups: a) Saharan Nomadism (Horizantal Nomadism), in which displacements and migrations take place over large distances and pastures are altered horizontally, b) Mountain Nomadism (Vertical Nomadism), which developed in mountainous regions and realized by changing the pastures in the vertical direction, that is, from the plains to the mountains, and c) Apart from these two forms of nomadism, semi-nomadism and plateauing, which are characterized as forms of transition from nomadism to settled life (transmited by Denker, 1960).

Kılıç (2014) examined the historical, cultural and economic structures, lifestyles and problems of the Kejan tribe, which is the only tribe practicing nomadic animal husbandry in the Karacadağ region. At the time of the research, he found out that there were 300 households and 200 thousand heads of small ruminant. However, the transition to settled life was continuing. The plateaus of the nomads of the Kejan tribe start from the elevations around 1500 meters and continue until the summit of Karacadağ. They spend the whole year in tents and they they generally make cheese and butter from their milk and sell them.

Işık (2016) conducted a qualitative study on the Koçers of the Dudêran and Mahmediyan tribes in Batman province and examined Koçers' habits of using media tools, family structures, living spaces, economic activities and the changes brought about by new communication technologies in the living conditions of Koçers. As a result, he was reported that Koçer use new communication technologies and media intensively, They prefer to use portable vehicles. This intensive use causes to strengthen their tendency to settle down, especially women and youth.

Gültekin and Tan (2017) investigated the urbanization process and the changes in the social and cultural structures of the Koçer members of the Dudêran tribe who settled down in Siirt. They found out that, tribal ties were significantly dissolved in the family. They also have been exposed to social, cultural, economic and political processes because they could not adapt to urban life. Therefore, it was reported that the members of the Dudêran tribe, who could not get rid of their traditional lifestyles and tried to adapt to the city, experienced mental tension between nomadic life practices and their goals.

Turk (2020) analyzed the socioeconomic and sociocultural structure of the koçers of the Aliki and Dudêran tribes in Batman. He reported that koçers who belonging to the Aliki tribe had 1200-1300 animals in 12 tents and four tents for their daily life. On the other hand, The Dudêran tribe had three or four for each family and a total of 26 animal tents for more than 2000 heads of sheep. He emphasized that koçers have really important problems. However, he insistently ponted out that Dudêran ve Aliki tribes are firmly attached to the nomadic life practices that have been practiced for centuries and insist on maintaining these practices by determining new strategies.

Alkan (2020) investigated the migration routes of nomadic families in Siirt province and found that nomads spend the winter months in Siirt and go to the highlands in Bitlis, Van, Muş, Şırnak and Hakkari in the summer period. This vertical mobility starts in April-May period and the ascent to the plateaus takes place, and the return to the winter areas starts in October-November period. It was found that nomads use three main routes for ascending and descending to the plateau, the first of which is the road extending towards Eruh-Sırnak-Uludere-Beytüşşebap and Hakkari. The second and more preferred route is the northward migration to the Eastern Anatolian plateaus. This route takes place along the Siirt-Bitlis Stream Valley-Rahva Plain-Tatvan-Ahlat-Adilcevaz-Van-Muş plateaus. The third migration route is Şirvan-Pervari-Hizan-Bahçesaray Gürpınar.

4. Main Problems of Koçers

Several studies have been conducted on Koçers in different provinces and they found out similar problems. These problems are as follows:

a. Difficult living conditions: The fact that Koçers live in very difficult conditions in tents in the highlands and winter pastures throughout the year causes them to be uneducated and less access to health services (Acıbuca, 2019; Türk, 2020). In addition to all these difficulties, the fact that there are nomads who have settled down with the development of technology and communication tools causes the younger generations to not want to continue the centuries-old koçers culture and therefore an ancient culture faces the danger of extinction (Alkan, 2020).

b. Pasture bans and security problems: In accordance with the pasture Law No. 4342, the determination, restriction and allocation of pastures, summer and winter pastures are carried out by the commission established by the Ministry of Agriculture and Forestry. However, due to terrorist incidents in the regions where the Koçers live, every year many pastures are declared military security zones and banned for security reasons (Acıbuca, 2019; Türk, 2020). This situation significantly complicates the activities of nomadic livestock production. It has been reported that nomads have problems such as extortion, theft and lack of life security, since they are generally located in aeas far from settlements (Acıbuca, 2019).

c. Social problems: Not only in small ruminant production activity but also in social life, Koçers face very important problems. The frequent association of terrorism with nomads is the most important one. Due to the fact that the areas of activity of nomads and terrorsit activities are close to each other, the nomads were seen as both an important human potential and a great logistic resource fort he organization. This leads to the exclusion of this group by the society and the state (Alkan, 2020). On the other hand, the inability to adopt to urban life is seen as an important problem fort he Koçers, who have settled down, many of whom do not speak Turkish and could not even get a sufficient level of primary education

d. Problems with pasture rents: One of the important problems of the Koçers is that they have to pay rent to the villagers for the pastures used as summer pastures and winter quarters. The Official Gazette (2013) said, "for the renting of pastures, winter and summer pastures nomadic livestock producers, priority is given to nomads registered in the same province"(Official Gazette, 2013). Therefore, nomads who rent pastures and/or winter pastures from the state have their own pastures and do not have pasture problems. These prices, which have increased considerably in recent years, vary between 50 thousand and 100 thousand Turkish Liras (TL) depending on the nature of the plateau (Alkan, 2020; Türk, 2020). However, it was also reported that villagers paid high fees to the people residing in the village for the pastures previously rented by the villagers or rented by the nomads themselves (Acıbuca, 2019).

e. Prohibitions on pedestrian crossing: Nomads prefer to go on foot, both to save on transportation cost and for the health of animals, when migrating from highlands to winter quarters or from winter pastures to highlands. However, on this journey, which lasts for about a month or two, pedestrian crossings are not allowed due to damage to the environment, disseminate the diseases to the transition areas and causing accidents on the highways, and the detected nomads are penalized per animal (Acıbuca, 2019; Alkan, 2020; Türk, 2020).

5. Conclusion

Small ruminant production is one of the oldest economic activities that has an important place in Turkey as in many countries of the world. The tribes known as "Koçer", who have been carrying out this activity in the Eastern and Southeastern Region for centuries under the harshest living conditions. They have inspired them to be named as the locomotives of the region's small ruminant production in this study because this activity can be expressed as both ecological due to its climate friendliness and economically because they feed thousands of animal with minimum cost.

With the settlement of the koçers since 1980s due to many reasons, especially security problems, it has caused both a decrease in the number of sheep and goat, which has a significant contribution to the country's economy, and a rich culture that has lasted for centuries to come to the verge of disappearance. Researches have revealed that Koçers have very important problems. It is extremely important to solve the problems of Koçers both in production activities but also social problems of them in the urbanization process. With the establishment of houses where Koçers can reşide in summer and winter pastures, they will be able to adapt to social life and benefit from education, health and other services. In addition, solar panels support should be provided to meet the energy needs in their region. Due to the constant distruption of the education of Koçers children, it should be ensured to complete their education through additional courses by the national education directorates in their regions. Finally, it is extremely important to follow the results of the research on Koçers and solve their problems by the relevant institutions, both for the development of small suminant production and to save important culture.

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CHAPTER IX

OVERVIEW OF FOREIGN TRADE OF AGRICULTURAL AND FOOD PRODUCTS IN THE WORLD

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1. Introduction

The developments in the world in recent years increase the importance of the agricultural sector even more. At the beginning of these developments, increasing population, global warming, increasing level of urbanization, migration from rural to urban areas, increasing food demand as a result of wars, regional conflicts and other uncertainties, and other functions of the agricultural sector, especially nutrition, come to the fore. On the other hand, the expansion of agricultural production areas is extremely limited, then again, increasing food prices due to increasing population, urbanization, erosion, misuse, misuse of agricultural lands, global climate change and developments in agricultural commodity markets do not affect the food security of agricultural lands, further increases its importance. The economic growth rates of countries may vary depending on the resources they have and various factors (Agwu, 2015). In addition, trade between countries can be a problem in poorly regulated contexts or a solution when it allows access to alternative sourcing models that reduce global environmental pressures (Schiavo, 2022). Thus, there are some factors (growing trade liberalization, population growth, changes in urbanization, changing diets) that cause considerable increases in international trade in agricultural products (Anderson, 2010). This situation puts pressure on agricultural lands. In this context, the effective and efficient use of natural resources used in the production process and the use of production methods that will increase the yield per unit area become inevitable.

When the total land properties in the world are examined, as of 2020, 36.2% (4.7 billion hectares) of nearly 13 billion hectares of land is allocated for agricultural production, 31.5% (4.1 billion ha) is forest area, and the rest (32.3%) consists of other areas such as cities, barrens, deserts, etc. Within the total land used for agricultural production, grain production area is 1.6 billion hectares, and wheat and corn are the most produced agricultural products). In the 2000-2020 period, the total agricultural lands in the world, meadow and pasture areas decreased by 134 million hectares, from 4.9 billion hectares in 2000 to 4.7 billion hectares in 2020. Accordingly, per capita arable land decreased by 18% in the same period and decreased to 0.2 hectares in 2020. It is noticed that this situation is important in terms of a faster increase in the population, increasing the nutritional requirement more, and this is important in terms of putting pressure on agricultural lands (FAO, 2022). However, according to the United Nations, while the world population is expected to reach 9.7 billion by 2050, the food demand is expected to increase by 60%. This makes food safety an issue that needs urgent intervention. As a result, both production and foreign trade policies become more important in strategic products such as wheat, corn, soybean, rice, potatoes, sugar cane, red and white meat, and it is also important to monitor the developments in these products.

2. General Situation of Agricultural Production in the World

Wheat and corn are the most produced agricultural products in the world, followed by soybean, sugarcane, rice, potatoes, red and white meat production. In 2020, four crops consisting of sugarcane, corn, paddy, and wheat account for half of the production of basic crops. At the global level, there was a 52% increase in the production of basic products in the period of 2000-2020, and as of 2020, the product with the highest production is 1.9 billion tons of sugar cane, 1.2 billion tons of corn, 761 million tons of wheat, 505 million tons of wheat. tons of paddy, 359 million tons of potatoes and 354 million tons of soy. In addition, significant increases were observed in the production of animal products, especially meat, milk, and egg production.

The most important countries in **sugar cane** production (1.9 billion tons) are Brazil with 39.8%, followed by India with 19.5% and China with 5.7%. The total sugar cane production of these three countries is 1.2 billion tons, which corresponds to 65.1% of the world's total sugar cane production.

The most important countries in **corn** production (1.2 billion tons) are USA with 31%, followed by China with 22.5% and Brazil with 8.9%. The total corn production of these three countries corresponds to 62.4% of the world's total corn production.

The most important countries in **wheat** production (761 million tons) are China with a 17.6%, followed by India with 14.3%, Russia with 11.3% and the USA with 6.5%. The total wheat production of these four countries meets 49.6% of the world's total wheat production.

The most important countries in **paddy** production (505 million tons) are China with a 28%, followed by India with 23.5%, Russia with 7.3% and Indonesia with 7.2%. The total paddy production of these four countries constitutes 66% of the world's total paddy production.

The most important countries in **potato** production (359 million tons) are China with a 21.8%, followed by India with 14.3%, Ukraine with 5.8% and Russia with 5.5%. The total potato production of these four countries is approximately 170 million tons, which corresponds to 47.3% of the world's total potato production.

The most important countries in **soybean** production (354 million tons) are Brazil with a 34.5%, followed by the USA with 31.8%, Argentina with 13.8% and China with 5.5%. The total soybean production of these four countries constitutes 85.7% of the world's total soybean production.

When we look at current situation of **animal** products, the world's total meat production has reached 337 million tons (2020) and has increased by 45% in the 2000-2020 period. China and the USA stand out as the countries that produce the most meat. World total milk production has reached 887 million tons (2020) and has increased by 53% in the same period. The top milk producing country is India with 21%, followed by the USA, Pakistan and China, Germany, Russia, and France. World total egg production has reached 87 million tons (2020) and has increased by 69% in the same period. The eight countries that produce the most eggs account for 69% of the total production. China, which meets 35% of the world production, ranks first with 30 million eggs, followed by the USA, India, Indonesia, Brazil, Mexico, Japan, and Russia (FAO, 2021).

Although significant increases in yield of agricultural production have been achieved in the world in recent years, these yield increases are insufficient when compared to advances in technology. The agricultural sector is no longer a sector that runs with the classical agricultural techniques. In this context, new technologies not only change many things from production to business models, but also change the agriculture sector. New technology start-ups and digital agricultural tools play a very important role in this transformation. In particular, the internet of things is used for data collection, analysis, increasing productivity and fertility, future predictions, etc. on agricultural applications has enormous implications (Akbas and Bagci, 2021). Many different horizontal technologies, from artificial intelligence to biotechnology, from sensor technologies to blockchain, are affecting this transformation in agriculture. Agricultural areas changing with the effect of climate change, the use of 70% of the world's water for agricultural purposes in response to the increasing water problem, the problem of increasing food supply and security with population change, resource constraints and the problem of yield in agricultural products, which are on the global agenda are important topics related to agriculture. Also, local, traditional/regional, direct selling, short food supply chain, labelling and quality regulations for GI foods are component of policy on food issues today (Giray and Tarakcıoglu, 2016). On the other hand, according to the estimates made by international organizations, agricultural product demand will increase by 15% in the next ten years due to population pressure. This change in agricultural production also affects the trade of these products. Many institutions and organizations, especially the World Trade Organization (WTO), have carried out various studies for agreements regulating both world trade and agricultural production since the mid-1990s.

The main purpose of these studies is the abolition of customs tariffs and other border measures, the liberalization of trade, including agricultural products, by reducing the supports that distort internal trade, and the gaining of both developed countries and others from this situation with the trade that will arise between the south and the north. Countries such as Brazil, which have very large and fertile agricultural lands and support agriculture relatively less, advocated the reduction of subsidies and the abolition of protection measures, while countries that are heavily dependent on foreign agriculture, such as Japan, have taken the opposite position. As a result, despite several rounds of negotiations, a full agreement could never be reached as a result, supply-side agricultural supports directly related to production and the protection of agricultural producers with border measures continued in many countries. In developed countries, it has led to various health problems, especially obesity, to high food waste, to hunger in underdeveloped or developing countries, and to health problems related to hunger. In addition to these, the fact that environmental problems such as climate change and pollution are increasingly experienced for the whole world is associated with production methods including conventional agriculture. Each increase in global average temperature is projected to reduce global land yields on average by 6% for wheat, 7.4% for maize, 3.2% for rice and 3.1% for soybeans. At this point, it has focused on the operation of sustainable food systems, which aim to make almost the entire world ecosystem and natural environment liveable for future generations, and the implementation of measures that include some commitments to reduce global warming. What will leave its mark on the 21st century in a way is to leave a more liveable environment to future generations, not only the agricultural sector, but all producing sectors. Agreements such as the Paris Climate Agreement focusing on this purpose, a series of regulations announced by the European Union as the Green Agreement, aim to bring carbon emissions to certain levels and to control global warming in 2050.

At the global level, food systems focus on three main areas today. The first is to provide food security and adequate nutrition to the ever-increasing world population, the second is to provide income to hundreds of millions of people who make their living from agriculture and related areas of the food chain, and the third is to reduce and contribute reduce of greenhouse gas emissions with sustainable production methods without harming land, water, and other resources.

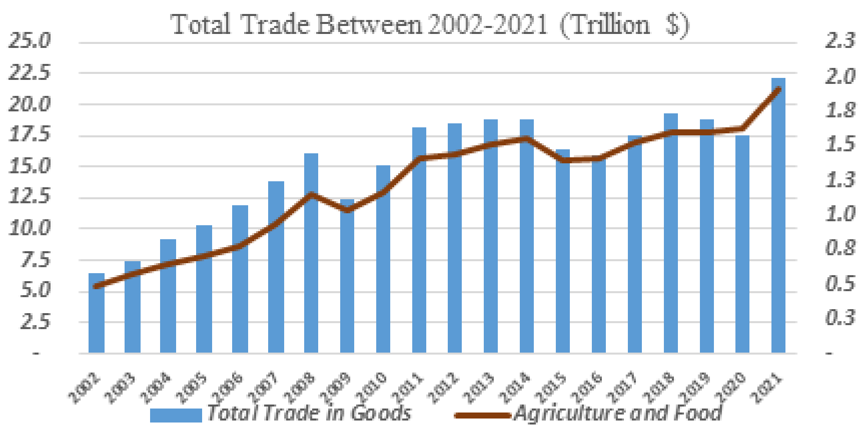
3. Global Outlook of Foreign Trade of Food and Agricultural Products

These developments in the agricultural sector in the world through production and commercial agreements also have important effects on the trade of agricultural products. Thanks to the technological developments and the logistics sector, especially digitalization, infrastructure has been established that can bring a product produced in any part of the world to the buyer in a very short time. Although all countries partially benefit from this situation, international goods trade is dominated by the USA, China, Brazil, and EU countries in many product groups, both in exports and imports. Since the beginning of the global pandemic and effects of Russian-Ukrainian war, the agriculture and food sector has become more strategic in all countries, and some major producer countries have implemented short-term export bans, citing pandemics, wars, and regional conflicts. It is important to monitor and evaluate the short- and long-term supply-demand, export-import and production-consumption changes of food and agricultural products and the possible effects of these changes and developments in the distribution chain on prices. It has also been understood that this is indispensable for the citizens of the country not to experience any disruption in their access to food. In this context, the analysis of foreign trade of food and agricultural products become more importance.

3.1. Global Agriculture and Food Products Trade

Global total exports of goods, which were $6.4 trillion in 2002, increased by 244% in the 2002-2021 period and reached $22.1 trillion in 2021. In the same period, foreign trade of agricultural and food products increased from $ 0.5 trillion in 2002 to $ 1.9 trillion with an increase of 292% (Figure 1). However, while the ratio of export value of agricultural and food products in total exports of goods was 7.6% in 2002, it increased to 8.5% in 2015, 9.3% in 2020, and decreased to 8.7% in 2021.

Figure 1. Total Foreign Trade Between 2002-2021



Source: ITC, 2022

When the important countries in the global agricultural and food products foreign trade and exports are examined, the USA has a share of 9.2%, the Netherlands 6.2%, Brazil 5.2%, and China 4.3% in the export of agricultural and food products, which is 1.9 trillion dollars in 2021, while the top five countries have the highest share. It is seen that it exports a total of 572 billion $ and the rate of concentration in exports is CR5 29.9%. On the other hand, when the import data are analysed, it is seen that China imported 209 billion $, USA 202 billion $, Germany 121 billion $, Netherlands 80 billion $ and Japan 76 billion $

of agricultural and food products. In addition, first five countries imported a total of $761 billion and the concentration ratio in imports was CR5 38.8% (Table 1). On the other hand, while Turkey ranks 24th with an export value of $25 billion, it ranks 25th with an import value of $17.8 billion.

Table 1. Major Countries in Global Agriculture and Food Trade in 2021 (Billion $)

Countries	Export	%	Countries	Import	%
USA	176	*9.2*	**China**	209	*10.7*
Netherland	120	*6.2*	**USA**	202	*10.3*
Brazil	100	*5.2*	**Germany**	121	*6.1*
Germany	94	*4.9*	**Netherland**	80	*4.1*
China	82	*4.3*	**Japan**	76	*3.9*

Source: ITC, 2022

When the share of countries in global agriculture and food foreign trade is analysed for period 2010-2021, the share of the USA, which was 10% in 2010, decreased to 9.2% in 2021. In the same period, the Netherlands' share decreased from 6.7% to 6.2%, Germany's share from 6.3% to 4.9%, Russia's share from 0.7% to 1%, 7, India's share increased from 1.7% to 2.4% and Turkey's share from 1% to 1.3%.

3.2. Balance in Global Agriculture and Food Products Trade

According to the balance (export-import) analysis of global agricultural and food products trade, in 2021, Brazil had a foreign trade surplus of 87 billion $, Argentina 45 billion $, Netherlands 39 billion $, Indonesia 28 billion $ and Australia 24 billion $. In the same period, China has a deficit of -127 billion $, Japan - 66 billion $, United Kingdom -38 billion $, South Korea - 29 billion $ and Germany - 27 billion $ (Table 2). Turkey, on the other hand, ranks 18th with a foreign trade surplus of $7.2 billion.

Table 2. Balance in Global Agriculture and Food Trade as of 2021 (Billion $)

Countries with positive	Value	Countries with negative	Value
Brazil	87	China	-127
Argentina	45	Japan	-66
Netherland	39	UK	-38
Indonesia	28	South Korea	-29
Australia	24	Germany	-27

Source: ITC, 2022

3.3. Major Product Groups and Products in Global Agriculture and Food Products Trade

When the foreign trade data of 229 countries and customs regions are analyzed, in 2021, meat ranked first with 154 billion $ in products or product group, followed by cereals with 153 billion $, oils 149 billion $, fruits 146 billion $, beverages. $141 billion and fish make up the forefront products with a value of $134 billion. The total trade value of these products is 877 billion $, and it constitutes approximately half (45.8%) of the total exports of agricultural and food products (Table 3).

Table 3. Major Product Groups in Global Agriculture and Food Trade for 2021

Product Group	Value (billion $)	%
Meats	154	8.0
Cereals	153	8.0
Oils (Animal and Plants)	149	7.8
Fruits	146	7.7
Beverages	141	7.3
Fish	134	7.0
Total	**877**	**45.8**

Source: ITC, 2022

The main products in global trade in the world are soybean, wheat, corn, palm oil, beef, wine, coffee, and cheese. When the export values of these products in 2021 are analysed, soybean 78 billion $, wheat 52 billion $, corn 49 billion $. In addition, the share of soybean, wheat, and corn in the total export of agricultural and food products is 9.4%. In 2012-2021, soybean increased by 49.1%, wheat increased by 29%, corn by 48.7%, palm oil by 49.3%, beef by 66.2%, wine by 18.7 and cheese by 15.6%. In the same period, there was a 6.1% decrease in coffee exports (Table 4).

Table 4. Major Products in Global Agriculture and Food Trade

Products	2012	2015	2020	2021	Ratio (%)	Change in 2012-2021 (%)
Soybean	52	51	64	78	4.1	49.1
Wheat	41	34	41	52	2.8	29.0
Corn	33	26	34	49	2.6	48.7
Palm Oil	25	20	23	38	2.0	49.3
Beef Meat	17	21	25	29	1.5	66.2
Wine	24	23	24	28	1.5	18.7
Coffea	23	19	18	22	1.1	- 6.1
Cheese	19	17	20	21	1.1	15.6
Total	234	212	247	317	16.7	35.7
%	16.3	15.3	15.2	16.7	16.7	-
General Total	**1.430**	**1.387**	**1.623**	**1.898**	**100.0**	**32.7**

Source: ITC, 2022

4. Conclusion

In the agricultural production system in the early 2000s, production policies based on the increase in area and support-oriented have been replaced by production policies based on the increase in yield from unit area. In this context, production methods based on infrastructure investments, land consolidation, irrigation, digitalization, and technology use for agricultural lands have become more popular. Countries are still seeking to use technology as an effective tool in agricultural production. For example, while bio-farms established in Japan reduce dependence on weather conditions, production based on robotic technology can be considered as important signs of the transition to the next generation agriculture.

Furthermore, China's efforts to increase agricultural production through the instrument of space technology, the EU's preparation for technological transformation with the Agriculture 4.0 strategy, the US National Agriculture and Food Institute's research in physics, engineering and computer sciences, agricultural tools, sensor and software production, Israel's support for agricultural technologies, especially irrigation systems, biotechnology and technologies for the reuse of waste water, are also important developments. However, as a result of the liberalization process in foreign trade, increasing agricultural and food exports tended to slow down yet more due to the current pandemic and global uncertainties. Advances such as global socio-economic developments, pandemics and water problems, wars, border security, export restrictions appear as developments that threaten agricultural production and food security. On the other hand, the problems caused by climate change worldwide affect all sectors, especially agriculture, in various ways. Developed countries share their commitments to more sustainable production methods and medium and long-term targets in all sectors with the world public in order to reduce global carbon emissions. Recently, the European Union has enacted a series of environmental commitments, called the "Green Agreement". On the other hand, the USA has committed to reduce its greenhouse gas emissions by 52% compared to 2005 levels by 2030. In the face of these developments, undeveloped and developing countries, including Turkey, are also preparing for the negotiations to use the relevant international funds in order to make their production infrastructure environmentally sustainable. In this context, it will be inevitable to adopt new approaches both in agricultural production and in foreign trade of agricultural and food products. Turkey is a country that has a high intra-industry trade advantage in foreign trade of agricultural and food products and has a potential for the future (Berk, 2019). Moreover, Turkey joined Paris Climate Agreement in 2021. This means commitments that will have significant impacts on agricultural production and foreign trade in the medium and long term. A policy framework centred on environmental sustainability should be established as soon as possible and some of the costs should be covered by relevant international funds.

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CHAPTER X

TURKEY'S COMPETITIVE POWER IN THE INTERNATIONAL TABLE GRAPE MARKET

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1. Introduction

According to geological and archaeological research, it was determined that the vine has grown in many parts of the world for millions of years and many civilizations mention it in their history (Çalkan et al., 2018). Although there are varying opinions, the south of the Caspian Sea, the Caucasus, and North East Anatolia regions are accepted as the homeland of the vine. Important civilizations that have left their mark on history have been known to cultivate vines. Today, viticulture is a high-value-added agricultural activity that contributes to the development of the region with a variety of products including table grapes, wine, raisins, grape juice, must, vine leaves, molasses, vinegar, jam, verjuice juice, and fruit pulp.

It has been reported that 71% of the grapes produced in the world are used for wine production, 27% for fresh consumption as table grapes, and 2% for raisin production. In Turkey, 52% of the grapes produced are used for fresh consumption as table grapes, 37% for raisin production), and 11% for wine production (TURKSTAT, 2021). Table grape production provides significant contributions to income, employment, and economic development in Turkey. The pioneering provinces in Turkey's grape production are Manisa, Denizli, and Mersin, with a production of 1.5 million tons, 440 thousand tons, and 330 thousand tons respectively. Most of the raisins are produced from seedless grapes, and it was observed that almost all of these grapes were produced in the Aegean Region. Seeded raisins are mostly produced in the warm and dry provinces of

Southeast Anatolia. Mersin province, located in the Mediterranean region, is at the forefront with its table grape production due to its suitable climate. Turkey has an important global share in the grape trade in terms of table grape and raisins, however, the market share in grape products has been quite low (Güler, 2021).

Competitiveness analysis studies for products that have a significant share in world trade have been the subject of research in many countries and products. Some of these studies were carried out on different products adopting different methods (Akgüngör et al., 2002). In their study investigating the competitiveness of the Turkish fruit and vegetable processing industry in the European Union (EU) market, Akgüngör et al. (2002) examined tomatoes, grapes, and citrus, which have the highest share in total fruit and vegetable exports in Turkey. As a result of the study, it was revealed that Greece, Spain, and Portugal are the competitors of Turkey in the fresh fruit and vegetable product group. The comparative advantage index and the comparative export performance index obtained indicated that Turkey's competitiveness in processed grape exports is higher than those of Spain, Portugal, and Greece. Also, it has been reported that the citrus exports were higher than those of Portugal. Öztürk et al. (2013), in their study covering the years 1995-2012, have reported that Moldova and Turkey had a higher competitive advantage in the fresh fruit and vegetable product group compared to Belarus, Russia, and Ukraine. It was also mentioned that Turkey is exposed to imports at a lower level than Moldova. Seccia et al. (2015), in their study in which they examined the competitiveness of table grapes from a global perspective in the 1961-2011 period, have reported that, in the northern hemisphere, the new competition is between China, Egypt, India, Mexico, and Turkey whereas in the southern hemisphere, the main competitors are Chile and South Africa, and the rising competition is between Argentina, Brazil, and Peru.

Çukur et al. (2017), examined the competitiveness of the olive oil sector in Turkey in international markets. The researchers concluded that, although the olive oil industry in Turkey has almost zero dependence on other countries, it does not have sufficient international competitive advantages. Duru et al. (2021), in their study examining the structure and competitiveness of Turkey's sugar foreign trade, determined the competitiveness of Turkey's sugar foreign trade in the 2000-2019 period utilizing the Revealed Comparative Advantage (RCA) index. With the decrease in sugar exports over the years, the sugar industry's RCA value fell below 1 and lost its competitive advantage, however, the researchers concluded that the added value provided by the confectionery sector allows for more export income.

Özdemir and Kösekahyaoğlu (2018) examined Turkey's export competitiveness in hazelnut, olive oil, and dried apricot in their Balassa RCA analysis for the 2001-2016 period. According to their results, Turkey's most competitive product is dried apricots while the least competitive product is olive oil.

Giray and Kılıç (2021) examined Turkey's export competitiveness in wheat and wheat products in their Balassa RCA analysis for the 2001-2018 period. The researchers have reported that Turkey did not have competitiveness in unprocessed wheat, however, the competitiveness of wheat flour and products related to export is high.

Li et al. (2021), in their study on the US table grape market, the effects of labor cuts and related market shocks on producers, consumers, and trade during the Covid-19 pandemic period, created a new model in which they integrated the supply chain model from farms to consumers with a market model in table grapes and raisins. Utilizing this model, the researchers determined that the trade effects of shocks on domestic demand may be greater than the trade shocks themselves and that the shock to fresh product demand puts pressure on the trade of processed products.

In terms of production area, Turkey ranks 6th after Spain, France, China, Italy, and South Africa with a vineyard area of 468,792 hectares. According to United Nations, Food and Agriculture Organization (FAO)'s 2021 data, Turkey ranks 6th in grape production after China, Italy, the USA, Spain, and France. Turkey seems to be unable to reflect the ecological advantage it has gained in table grape production to exports. For developing countries such as Turkey, it is of great importance to increase export revenues and establish a healthy structure in foreign trade (Uysal et al., 2016a). Therefore, it is necessary for table grape production in Turkey to play a more active role in foreign trade and to transform the ecological, climatic and geographical advantage into an economic advantage, especially against competing countries. In the present study, Turkey's competitiveness against the countries that have a significant share in the world's table grape export, and the current state and suggestions in terms of table grape production and export support policies to be created in the future were discussed.

2. Material and Methodology

The data used in the research were determined by following the relevant statistical sources and scientific literature. The main data sources were the Turkish Statistical Institute (TURKSTAT), the United Nations Food and Agriculture Organization (FAO), the International Trade Centre (INTRACEN), and the Turkish Ministry of Agriculture and Forestry (TOB), and IndexMundi.

The data used cover the years 2004-2020. In accordance with the aim and the method of analysis, table grape production, consumption, and foreign trade data were obtained from the online databases of the specified sources for the period 2004-2020. To reveal the international competitiveness of the Turkish viticulture sector, the Revealed Comparative Advantage (RCA) Index and the Relative Export Advantage Index (RXA) were calculated. In comparing the countries, labor productivity, capital structure, raw material costs, and labor costs can also be used as criteria (Gündüz et al., 2004). In measuring the competitiveness of countries at the international level, Balassa (1965)'s RCA index has been conventionally used. Although Balassa's RCA index has conventionally been used to measure the competitiveness of countries at the international level, another method, the RXA method, was also used in the present study, and the two methods were evaluated together.

To calculate the comparative advantage of a country in terms of a particular product, Balassa developed an index that expresses the ratio of the share of the relevant product in total world exports to its share in the country's total exports. This index determines whether a country has a comparative advantage rather than identifying the sources of comparative advantage (Öztürk et al., 2013).

The RCA index used to measure the export performance of a product is shown in equation (1) below (Aktan et al., 2004).

$RCAij = (Xij / Xit) / (Xwj / Xwt)$ (1)

Xij: Total export value of item j in country i.

Xit: Total export value of country i.

Xwj: World export value of item j.

Xwt: World export value.

According to Coxhead (2007), if an RCA coefficient for a product of a country is bigger than 1, it indicates that the export share of that product of the country in the year t is greater than its share in total world exports. In other words, the country has specialized in this product and has competitive power in its export (Erkan, 2012).

To easily interpret the comparison of differences in Balassa's RCA Index, the index is divided into four classes (Hinloopen and Marrewijk, 2001):

Class a = $0 < RCA \leq 1$; No comparative advantage

Class b = $1 < RCA \leq 2$; Weak comparative advantage

Class c = $2 < RCA \leq 4$; Moderate comparative advantage

Class d = $4 < RCA$; It is considered to have a high comparative advantage.

The Relative Export Advantage Index (RXA) global trade intensity measurement developed by Vollrath can be described as a continuation or a differentiated form of Balassa's RCA method. RXA index can be defined as the ratio of the export share of any country in world markets in a particular product to its share in world exports of all other goods. This feature of the index prevents the country and goods in question from being excluded from the calculation of total world exports, hence the inclusion of countries and goods in the calculation twice.

The RXA index used to measure the export performance of a product is shown in equation (2) below (Frohberg et al.,1997).

$$RXA\dot{I}J = (X\dot{I}J / \sum Xil) / (\sum xkj / \sum \sum xkl) \quad (2)$$

$l,l \neq j \quad k,k \neq i \quad k,k \neq i \quad l,l \neq j$

This index is shown in equation (2). X refers to exports. The subscripts i and k denote the product categories and j and l the countries. The index is defined as the ratio of a country's export share of a certain product in the world market to the same country's share in the world export of all other commodities. The special feature of this measure is that the world 'total' is always taken as the sum across all countries except for the one studied. Thus, instead of including all exports in the summations of equation (2), the commodity and the country considered are excluded when total exports are summed up. This aspect is especially relevant if a country is fairly important in trade on international markets, and/or if the commodity considered is important in the total trade. In these cases, double counting would lead to biased index values. (Frohberg et al.,1997). In the present study, Balassa's RCA and Volltrah's RXA methods were considered together and it was aimed to reveal the competitiveness of Turkey's table grape export in the world market for both methods.

3. Results and Discussion

3.1. World Table Grape Production and Foreign Trade

Analyzing the world vineyard area, grape production, and yield, decreases were observed in vineyard areas between 2001 and 2020 whereas significant increases were observed in grape production and yields for the same years. The total vineyard area was 7 million 286 thousand hectares in 2004, whereas it decreased to 6 million 951 thousand hectares in 2020. On the other hand, the total grape production volume was 67 million 208 thousand tons in 2004 and increased to 78 million 343 thousand tons in 2020. There had been a decrease of approximately 5% in the vineyard areas during the years examined whereas there has been an increase of 17% in the volume of grape production. In the same period, grape yields increased approximately by 22%, from 9,225 kg/ha in 2004 to 11,226 kg/ha in 2020. Despite the decrease in vineyard areas, the increase in grape production was associated with an increase in yield (FAO.,2021a). In terms of grape production amount and shares, China ranks first in the world with 14,283,532 tons of grape production. This amount, constitutes 18.52 percent of the world grape production. Italy with 10.24%, USA with 8.08%, Spain with 7.45% and France with 7.12% production share, respectively. Turkey ranks 6th in this ranking with its grape production of 4,100,000 tons and a production share of 5.32% (FAO., 2021a).

Presented In Table 1, the foreign trade of table grapes in the world was examined in terms of production, consumption, export, and import values for 2020. China had ranked 1st in world production with 11 million tons of table grape production, however, became the 3rd after Chile and Peru with 420 thousand tons due to the very high amount of domestic consumption. Chile ranks 1st with 510 thousand tons of table grape export. Turkey ranks 3rd in the world table grape production with 2 million tons and ranks 6th in the world table grape export by exporting 215 thousand tons (IndexMundi, 2021).

Table 1. World table grape production, consumption, export and import (tons) (2020)

Countries	Table Grape Production Quantity	Table Grape Exported Quantity	Table Grape Domestic Consumption Quantity	Table Grape Imported Quantity
China	11,000,000	420,000	10,790,000	210,000
India	2,072,000	185,000	1,892,000	5,000
Turkey	2,000,000	215,000	1,785,300	300
Brazil	1,592,000	60,000	1,537,000	5,000
Uzbekistan	1,589,927	115,000	1,474,800	127
Egypt	1,420,000	170,000	1,370,000	120,000
EU-27	1,402,500	80,000	2,047,500	725,000
United States	870,988	314,227	1,227,175	670,414
Peru	664,000	470,000	194,900	900
Chile	619,700	510,000	110,000	300
Mexico	391,168	205,000	276,168	90,000
S.Africa	330,000	325,000	10,000	5,000
Australia	240,000	170,000	80,000	10,000

Source: Indexmundi, (2021).

As shown in Table 2, examining the export values of table grapes between 2016 and 2020 in USD, at the beginning of the period, it is seen that the USA, Chile, and Italy are the first three leading countries. China has taken first place by increasing its export value considerably since 2020. In the same years, Peru and the Netherlands showed significant increases in terms of export value. Turkey, on the other hand, is in 6th place in terms of table grape export volume, however, it could not reflect this in the export value and took 13th place. As of 2020, 13.56% of the world table grapes' total export value is by China, followed by Peru with 11.08%, and Chile with 10.34%. Turkey realized 1.76% of the world's total table grape export value, with an export value of approximately 158 thousand USD. The share of the total value of all other countries in the world table grape export is 9.63% (INTRACEN, 2021a).

Table 2. World table grape exported values

Rank	Countries	Exported value ($)				
		2016	2017	2018	2019	2020
1	China	663,606	735,177	689,599	987,242	1,212,702
2	Peru	646,318	653,449	763,142	811,771	991,105
3	Chile	1,048,758	993,044	1,074,239	949,712	924,774
4	Italy	745,975	863,476	799,773	724,608	832,035
5	United States	916,396	902,978	924,505	855,945	822,385
6	Netherlands	591,602	653,289	778,103	721,695	792,174
7	South Africa	437,707	541,704	541,910	521,161	520,219
8	Spain	325,472	338,022	410,349	343,190	471,337
9	Avustralia	325,701	299,432	295,920	406,353	457,188
10	Hong Kong	354,651	363,648	369,197	396,159	376,597
11	India	219,449	275,964	275,656	307,972	286,118
12	Egypt	218,493	237,354	221,546	234,888	235,770
13	Turkey	104,607	195,392	120,888	150,104	157,885
	Other Countries	871,321	1,096,967	1,047,434	1,085,652	861,536
	World	7,470,056	8,149,896	8,312,261	8,496,452	8,941,825

Source: INTRACEN, (2021a)

When the changes in the world table grape imports for the years 2016-2020 are examined, it has been determined that the USA, Netherlands and Germany have the highest import values for table grapes, respectively. The USA ranked first in the analyzed period with its increasing import value. Germany, which ranked second with its high import value at the beginning of the period, ranked 3rd after the Netherlands at the end of the period. These countries are followed by England, China, Canada and the Russian Federation, respectively. Turkey ranked 152nd as of 2020 with the decrease in import value. As of 2020, 19.07% of the world table grape import value is USA, 8.30% is Netherlands and 7.98% is Germany. Since Turkey is among the countries that export table grapes and is self-sufficient in terms of domestic consumption, it did not import a significant amount (INTRACEN, 2021a).

3.2. Turkey's Table Grape Production and Foreign Trade

Table 3 shows the vineyard areas and the production volume of table grapes, raisins, and wine grapes in Turkey for the period 2004-2020. Examining the table, it is seen that there is a significant decrease in the vineyard areas over the years. The total vineyard area was 520 thousand hectares in 2004 which decreased by approximately 23% to 401thousand hectares in 2020 (TURKSTAT, 2021).

Table 3. Turkey vineyard area, production statistics

	Area		Production			
Years	**Hectare (ha)**	**Index (2004 = 100)**	**Table grape (000 tons)**	**Index (2004=100)**	**Raisins (000 tons)**	**Wine (000 tons)**
2004	520,000	100	1,900	100	1,230	370
2005	516,000	99	2,000	105	1,400	450
2006	513,835	99	2,060	108	1,496	444
2007	484,610	93	1,913	101	1,218	482
2008	482,789	93	1,971	104	1,477	470
2009	479,024	92	2,257	119	1,532	476
2010	477,786	92	2,250	118	1,544	462
2011	472,545	91	2,269	119	1,562	465
2012	462,296	89	2,220	117	1,614	401
2013	468,792	90	2,133	112	1,424	455
2014	467,093	90	2,166	114	1,564	445
2015	461,956	89	1,892	100	1,335	424
2016	435,227	84	1,991	105	1,537	473
2017	416,907	80	2,109	111	1,603	488
2018	417,041	80	1,945	102	1,524	464
2019	405,439	78	2,050	108	1,599	451
2020	400,998	77	2,218	117	1,535	456

Source: TURKSTAT,(2021)

Examining the production volume of grapes according to the consumption patterns in Turkey, it is seen that grape production is mainly carried out for table grapes. Despite the decrease in production areas, there has been an increase in the volume of production in table grapes, raisins, and wine grape varieties. Examining the indices, a 17% increase is seen in the production of table grapes by 2020. Despite the decrease in the production areas, the increase in the volume of production can be explained by the addition of new and high-yield grape varieties to production over the years, and the increase in yields due to the development of materials used in the maintenance processes and novel techniques. Also, the development and dissemination of disease/pest-resistant vine rootstocks also played an important role in the increase in the yield. In Table 4, Turkey's import and export data for table grapes by years are given separately both qualitatively and quantitatively. Examining the Table, it is seen that the export volume of table grapes was 142 thousand tons in 2004 which increased by 49% to 212 thousand tons in 2020. The export value increased by 117% in the same period, from 72 thousand USD to 157 thousand USD. In addition to the increase in the volume and value of foreign sales, there was also an increase in the amount and value of foreign purchases in the same period. (INTRACEN, 2021a). The import volume of table grapes was 106 tons in 2004 and increased by 180% to 298 tons in 2020.

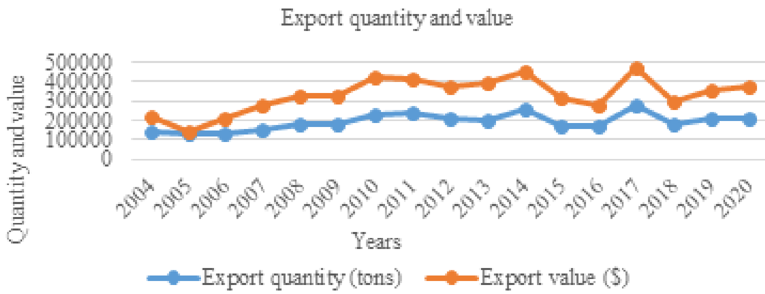
Table 4. Turkey's table grape export and import by years*

Years	Export quantity		Export value		Import quantity		Import value	
	tons	Index 2004 = 100	$	Index 2004 = 100	tons	Index 2004 = 100	$	Index 2004 = 100
2004	142,369	100	72,838	100	106	100	120	100
2005	134,043	94	79,610	109	143	135	159	133
2006	132,908	93	74,225	102	317	298	365	304
2007	155,756	109	118,304	162	378	356	500	417
2008	177,853	125	146,149	201	376	354	639	533
2009	181,270	127	147,238	202	337	317	494	412
2010	230,565	162	196,616	270	676	636	781	651
2011	239,899	169	175,494	241	771	725	829	691
2012	209,547	147	162,702	223	855	805	778	648
2013	203,358	143	187,689	258	697	656	633	528
2014	255,867	180	199,683	274	596	561	575	479
2015	175,175	123	141,401	194	680	640	549	458
2016	172,592	121	104,555	143	646	608	566	472
2017	277,673	195	195,426	268	450	424	363	303
2018	180,067	126	120,855	166	435	410	270	225
2019	205,603	144	149,987	206	422	397	355	296
2020	212,330	149	157,823	217	298	280	226	188

Source: INTRACEN,(2021a)

The import value increased to 226 USD by 88%. However, this increase should not be interpreted as Turkey's transition to a table grape importer country. Considering the country's population growth and changes in consumption habits in the 17 years, it should be considered as a very low increase in terms of imports (Figure 1).

Figure 1. Turkey's table grape export quantity and export value (*)



(*) From Table 4

Analyzing the supply, consumption, and adequacy status of table grape production in Turkey (Table 5), there was a 5% increase in the supply of table grapes during the period, and the consumption volume increased by 3%. On the other hand, the self-sufficiency rate decreased from 102% to 96%. Also, the sales prices of table grapes showed a decreasing trend in the world markets, from 550 USD/ton in 2004 to 449 USD/ton in 2019 (IndexMundi, 2021; FAO.,2021b). It can be argued that due to the decrease in the sales price of table grapes in USD and the downward exchange rate of the Turkish Lira against the USD in recent years, a significant decline has occurred in the export value of table grapes recent years.

In order to interpret Turkey's competitive power in the world table grape market, according to the data of the table grape export value of the important countries and the total export value of these countries; Between 2004 and 2020, the biggest increase in the export value of table grapes was in China. While China's table grape export value was 7,000 USD in 2004, it increased to 1,213,000 USD in 2020. The same increase is also seen in China's total export value. When the foreign sales values of the countries that have a say in the world table grape market are examined, there is an increase in value in all countries over the years. A high rate of increase was determined In Peru and Chile in the export value of table grapes, constituting a significant part of the total export value. Examining Turkey's table grape export values for the years 2004-2020, It is seen that the export value of table grapes increased from 73 thousand USD to 158 thousand USD. The total export value also increased from 63 million 121 thousand USD to 167 million 924 thousand USD. However, the share of table grapes in Turkey's total export value decreased from 0.11% to 0.09% (INTRACEN, 2021a).

Table 5. Table grape supply, consumption and self-sufficiency in Turkey

Years	Supply		Consumption		Self sufficiency	Price (*)	
	tons	Index 2004 = 100	tons	Index 2004 = 100	%	$/ton	Index 2004 = 100
2004	1,900,200	100	1,739,900	100	102	550	100
2005	2,400,000	126	1,844,200	106	99	852	155
2006	2,060,667	108	1,910,167	106	92	787	143
2007	1,912,939	101	1,741,939	100	91	888	161
2008	1,971,086	104	1,768,886	102	93	945	172
2009	2,257,545	119	2,069,645	119	94	723	131
2010	2,250,230	118	2,013,830	116	83	782	142
2011	2,269,767	119	2,029,267	117	81	737	134
2012	2,220,613	117	2,011,513	116	77	700	127
2013	2,133,202	112	1,929,202	111	81	692	126
2014	2,167,749	114	1,910,349	110	86	556	101
2015	1,893,010	99	1,718,410	99	79	545	99
2016	1,991,204	105	1,817,904	104	81	492	89
2017	2,109,400	111	1,829,700	105	92	436	79
2018	1,950,400	103	1,771,100	102	88	414	75
2019	2,050,400	108	1,845,300	106	90	449	82
2020	2,000,300	105	1,785,300	103	96	-	-

Source: Indexmundi,(2021) (*) FAO,(2021b)

The RCA index values were calculated for Turkey and the countries that have a significant share in table grape production for the period 2004-2020 and are given in Table 6. Accordingly, it is seen that the RCA index of 3.31 and RXA index of 3.43 calculated in Turkey's table grape export have a moderate comparative advantage at the beginning of the period. In 2010, it was determined that Turkey increased this advantage to a high comparative advantage with an RCA index of 4.27 and an RXA index of 4.86. In the following years, Turkey gradually lost its competitive power in the export of table grapes and experienced a significant decrease with an RCA index of 1.78 and an RXA index of 1.70 in 2020, receding to a country with a weak comparative advantage. During the period, South Africa, Chile and Peru are seen as having a high comparative advantage, and the Netherlands, Italy, and Spain are seen as having a moderate comparative advantage in table grape export competitiveness. It was determined that Hong Kong, India, and the USA had a "weak comparative advantage" in table grape exports, whereas China did not have a comparative advantage since its RCA index was 0.90. The Netherlands and Hong Kong are not table grape producers but are trading countries. Since their presence in the table grape market depends on the producer countries, their competitive advantages are not discussed in this study.

Table 6. Table grape RCA index values by countries and years (*)

Years	Turkey	China	Peru	Chile	Italy	USA	Netherlands	South Africa	Spain	HongKong	India
2004	3.31	0.03	4.37	67.91	3.43	1.87	2.02	18.01	1.87	0.46	0.65
2005	2.99	0.03	4.95	53.40	3.72	1.86	2.35	15.15	2.00	0.52	1.04
2006	2.67	0.05	5.66	45.00	3.55	1.74	2.24	13.15	2.44	0.45	1.20
2007	3.37	0.07	5.95	41.86	4.05	1.67	2.31	13.50	2.27	0.47	1.14
2008	3.39	0.09	7.24	52.90	4.33	1.60	3.01	11.23	2.54	0.57	1.32
2009	3.30	0.15	11.01	46.77	3.16	1.56	2.85	14.42	2.20	0.99	0.84
2010	4.27	0.16	12.42	45.48	4.00	1.55	2.75	12.16	2.52	0.91	1.11
2011	3.37	0.22	16.06	46.51	4.01	1.59	3.05	10.33	2.81	1.31	0.67
2012	2.73	0.33	20.24	46.95	3.94	1.62	3.00	11.23	2.39	1.35	1.16
2013	2.80	0.29	25.04	49.19	3.80	1.65	3.25	11.17	2.47	1.26	1.38
2014	2.81	0.36	38.60	46.50	3.32	1.48	3.12	12.46	2.50	1.42	1.64
2015	2.17	0.75	45.77	38.76	3.46	1.33	2.49	13.02	2.61	1.48	1.02
2016	1.55	0.66	37.92	38.41	3.42	1.34	2.67	12.09	2.43	1.45	1.78
2017	2.66	0.69	31.59	32.23	3.64	1.25	2.65	12.93	2.32	1.41	1.99
2018	1.66	0.64	37.27	32.86	3.35	1.28	3.05	13.13	2.73	1.50	1.96
2019	1.82	0.86	39.35	30.05	2.95	1.14	2.74	12.61	2.23	1.62	2.08
2020	1.78	0.90	49.02	26.24	3.22	1.20	2.75	11.64	2.90	1.31	1.99

* Calculated from INTRACEN data

Table 7 shows Turkey's Relative Export Advantage Index (RXA) for table grapes. Examining the Table, the RXA index was 3.43 in 2004 whereas decreased to 1.70 in 2020, as was the case in the RCA index. The highest RXA index value was determined in 2010, again in line with the RCA index. However, comparing both index values in Table 6 and Table 7 for Turkey, it was determined that the RXA index value was relatively higher than the RCA index value throughout the period. This can be explained by the significant share of table grape exports in Turkey's exports, especially at the beginning of the analyzed period, as explained in the methodology. The high share of the examined product in total product exports is based on the themore accurate results obtained from the RXA analysis. This is seen in Figure 2.

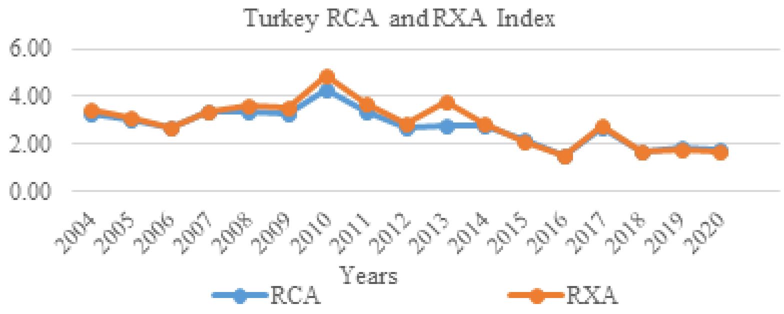
Table 7. Table grape RXA index values Turkey and years (*)

Years	Turkey Table Grape Exports (Xij) (000 $)	Table Grape Exports in Countries Except Turkey (Xil) (000 $)	Export of all Sectors Except Table Grapes in Turkey (Xkj) (000 $)	Export of all Sectors Except Table Grapes in Countries Except Turkey (Xkl) (000 $)	RXA
2004	82	3,462	63,039	9,093,533	3.43
2005	91	4,202	73,385	10,338,191	3.14
2006	84	4,310	85,451	11,950,592	2.71
2007	131	4,862	107,141	13,778,954	3.37
2008	169	5,871	131,858	15,960,226	3.62
2009	156	5,541	101,987	12,337,081	3.50
2010	204	6,063	113,679	15,088,513	4.86
2011	175	6,769	134,732	18,137,468	3.71
2012	163	6,971	152,299	18,392,457	2.87
2013	188	5,573	161,293	18,852,584	3.78
2014	202	7,853	166,303	18,851,047	2.89
2015	141	7,239	143,703	16,405,865	2.11
2016	105	7,358	142,502	15,919,624	1.56
2017	195	7,954	156,797	17,560,234	2.78
2018	121	8,192	167,803	19,324,172	1.67
2019	150	8,358	180,721	18,754,771	1.80
2020	158	9,124	169,500	17,489,890	1.70

* Calculated from INTRACEN data

From Figure 2, examining the increasing trend in the power of Turkey’s RCA and RXA indexes over the years, it is seen that the most substantial increase was in 2010 whereas the most substantial decrease was seen in 2016. In recent years, the RCA and RXA index in Turkey’s export sales of table grapes, after a slight increase in 2017, continued to follow the sharp decline levels in 2016.

Figure 2. Table grape RCA and RXA Index values Turkey and years (*)



(*) From Table 6 and Table 7

The important countries to which Turkey exports table grapes over the years and the export values related to exports are given in Table 8 (INTRACEN, 2021b). It is seen that the Russian Federation and Ukraine are the exported countries with the highest export value.

In 2020, the Russian Federation purchased table grapes for 91 thousand USD by providing 57% of Turkey’s table grape export value of approximately 158 thousand USD while. Lithuania accounts for 12%. Germany provided 23% of Turkey’s table grape export value at the beginning of the period, whereas this figure decreased considerably to approximately 5% at the end of the period. Examining the EU countries where Turkey exports table grapes, it was seen that the Netherlands and Austria’s shares, which were 8% at the beginning of the period, decreased to 1% at the end of the period, as was the case for Germany. In this case, considering the decreasing comparative advantage of Turkey over the years, as seen in Tables 6 and 7, it can be argued that the market of the EU countries is gradually lost in Turkey’s export of table grapes. On the other hand, Turkey’s export share in Poland, Romania, Belarus, and Latvia, which was 2% at the beginning of the period, increased to approximately 4% at the end of the period. This increase can be associated with Turkey’s recent political crises with Germany and Russia, and that both countries import table grapes through the Eastern European countries.

Table 8. Countries that import the most table grapes from Turkey and their import values ($)

Years	Russian Federation	Ukraine	Germany	Poland	Belarus	Romania	Saudi Arabia	Latvia	United Kingdom	Netherlands	Austria
2004	38,239	134	16,690	901	1,413	1,744	5,506	1,123	1,294	5,490	5,622
2005	41,484	4,561	16,047	2,010	2,101	3,025	5,418	967	794	4,643	7,258
2006	32,918	13,064	11,511	1,653	3,271	1,659	3,618	725	922	3,710	5,396
2007	61,936	19,110	15,474	3,503	4,805	2,641	6,812	1,295	1,120	1,897	6,068
2008	77,859	19,445	17,917	3,027	5,322	2,456	8,488	1,024	1,565	1,369	5,066
2009	77,859	10,172	13,574	2,482	3,237	1,261	8,939	450	1,263	1,189	2,723
2010	130472	13,232	12,399	2,164	5,579	1,077	7,650	486	954	1,081	1,830
2011	101,648	12,114	17,262	2,027	5,196	1,027	6,341	836	1,214	903	1,218
2012	106,472	14,709	13,199	1,730	4,899	599	3,971	728	1,411	1,235	1,210
2013	117,603	13,313	12,814	1,480	8,052	527	3,554	588	1,742	1,428	1,038
2014	126,344	12,120	12,049	4,500	9,894	1,229	3,643	1,592	2,097	1,993	1,056
2015	97,560	4,511	9,484	4,970	5,519	789	6,203	1,574	1,570	1,640	2,648
2016	0	10,991	9,948	7,504	25,581	1,584	12,029	1,379	1,738	1,738	2,200
2017	120,255	12,496	10,142	9,611	9,767	3,697	7,380	2,823	2,020	2,361	2,074
2018	65,942	9,856	7,653	4,915	7,021	2,174	6,584	1,689	2,039	1,604	872
2019	86,039	15,172	7,589	6,507	7,112	2,591	5,548	2,314	2,374	1,282	1,798
2020	90,717	19,635	7,393	5,976	5,102	4,983	3,057	2,899	2,038	1,724	1,664

Source: INTRACEN, (2021 b)

4. Conclusion

Production and export volumes and values of the world's major grape-producing countries vary depending on the country's labor productivity, capital structure, product and labor costs, climate, geographical structure, and habits. Periodic changes in the economic and social balances of countries also affect their national and international commercial behavior and income. Between 2001 and 2020, the world's grape production increased significantly despite the decrease in cultivation areas. Although the increase in the production volume changes depending on the grape variety, the yield increased in general. The grape yield was 8,355 kg/ha in 2001 and reached 11,137 kg/ha in 2019. Table grape production and yields also increased, showing the same course as the total grape production. Italy, France, and Spain, members of the European Union, have an important share in the production and export of table grapes and have been in an important position in the wine grape market in recent years, mostly with the advantage of their competitive power in wine production and export. Turkey should create a production and marketing strategy that can increase its competitive power in table grape production in the EU market, which has decreased wine grape production in recent years (Uysal et al., 2016b).

Turkey also has significant advantages in terms of competitive factors such as geographical location and low labor costs. However, significant increases in agricultural production and input costs within the country in recent years have eliminated Turkey's overall cost advantage in table grape production. Balassa's RCA and Vollrath's RXA Index calculations for the period 2004-2020 showed that Turkey's competitiveness in table grapes has been gradually decreasing. Exports reached their lowest value in 2020 due to the Covid-19 pandemic. The logistics services had been disabled or disrupted during the earlier part of the pandemic period. Also, as stated by Fernandez et al.(2016), long distances, poorly held transportation and bureaucracy are important adverse conditions for products with short shelf-life such as table grapes. Considering the increasing costs of transportation for the whole world and the damage of transportation channels to the climate and environment, nearby markets have become more attractive and accessible in recent years. Although Turkey has a "weak comparative advantage" in the export of table grapes by 2020, it can be argued that Turkey can increase its market share to an advantageous level by aiming to increase its close-distance export sales, especially in the Russian Federation, which is the most important importer of table grapes, and in countries such as Ukraine, Latvia, Belarus, and Romania. However, since the export policies of countries are directly affected by the general political conjuncture, any possible global change (climate crisis, wars, epidemics/pandemics, economic crisis, etc.) can change these predictions and suggestions. Therefore, country-specific products and products that are strategically important, such as table grapes, as is the case for all export products, should be supported with a high production and strong transportation network and correct foreign trade policies to have a voice in foreign sales. In addition, grapes produced as a result of organic and good agricultural practices should be supported more effectively and measures should be taken to improve their export potential. In order to eliminate or minimize the residue problem in the sector, it is essential to popularize early warning systems and effective control and inspection activities, especially in export-oriented production.

For Turkey, the added value of table grapes, foreign sales revenues, and hence the competitiveness can be increased firstly, by making detailed and long-term production planning based on the variety. Improvements can be made by revealing the weaknesses and strengths in the supply chain. Also, professional organizations such as producer and exporter associations and proper branding will contribute to the integration into a wider communication and trade network. Strengthening the agricultural sales cooperatives, which have become more important in Turkey in recent years, with improvements in favor of the producers, reviewing the management structures, and making the necessary arrangements are important step for the producer not to withdraw from the production of table grapes. Turkey's presence in the foreign table grape market with almost a single variety (Sultani Seedless) and chemical pesticide residue problems also limit the increase in market share. To expand the share, it is necessary to establish a traceable production system that meets the demands of the market regarding residues and to diversify the export by evaluating the production potentials of different grape varieties (Uysal, et al.,2016c). Marketing a limited number of table grape varieties exported from Turkey to the world under a specific variety and local name/brand, as in the wine grape market, may facilitate the recognition and, hence, the marketing of the local varieties in the world market.

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CHAPTER XI

THE IMPORTANCE OF ANIMAL MANURE IN SUSTAINABLE SOIL FERTILITY

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1. Introduction

Demand for animal products continues to grow as the world's population increases. 34% of the world's protein needs come from animal production (FAO, 2022). It is estimated that with a world population of 9.7 billion in 2050, the demand for protein will increase even further (Henchion, Moloney, Hyland, Zimmermann, & McCarthy, 2021). Demand for animal protein is increasing rapidly in both developed and developing countries, and this increase (including poultry, beef, and sheep production) is expected to continue in the coming years. Livestock production (cattle, sheep, goats, pigs and poultry) is also growing rapidly worldwide and plays an important role in agricultural production.

Animal manure is the oldest fertilizer used on earth. Especially in countries where it is difficult to obtain inorganic fertilizers, the use of animal manure is playing a significant role in plant nutrition. In small farms, the main source of soil nutrients is animal manure (Fageria, 2012). In organic farming, the agricultural inputs are not supplied from the outside, but from the system itself (Foissy, Vian, & David, 2013). Zhang et al. (2017) found in their study that 43.7% of the world's N production in 2014 came from animal manure. In addition, animal manure application can be an important source of phosphorus for crop production (Toth, Dou, Ferguson, Galligan, & Ramberg, 2006). Animal manure application has a positive effect on nutrient uptake and soil properties (Li & Marschner, 2019).

Soil organic matter (SOM) improves the biological, chemical and physical properties of soil (Diacono & Montemurro, 2010; Fageria, 2012). Animal manure is known to have a positive effect on soil bioactivity and soil organic carbon (SOC) content (Marinari, Mancinelli, Campiglia, & Grego, 2006; Heinze, Raupp, & Joergensen, 2009).

Excessive and unconscious use of animal manure can lead to environmental pollution. Application of animal manure leads to eutrophication of water bodies (Stout, Weaver, Gburek, Folmar, & Schnabel, 2000; Boesch, Brinsfield, & Magnien, 2001). Reducing the impact of animal manure on agricultural production and the environment through proper management has become an important issue worldwide (Li et al., 2015; Sharpley et al., 2015; McDowell et al., 2016).

2. Effect of Animal Manure on Soil Properties

Manure resulting from animal husbandry is very important in maintaining soil fertility. The beneficial effects of animal manure on soil can be attributed to increased nutrient content, a source of organic matter, increased microbial activity in the soil, and a contribution to soil physical and chemical properties (Singh, Singh, & Reddy, 2001; Sanz-Cobena et al., 2017). Animal manure also contributes to improving soil properties by adding nutrients and organic matter to the soil (Edmeades, 2003).

2.1. Animal Manure as a Source of Plant Nutrients

In terms of sustainability in agricultural production, it is recommended that animal manure be applied worldwide. In parallel with population growth, the increasing demand for agricultural products has also increased the need of nutrients.

Animal manures, litters and slurries are important plant nutrient application for improving soil properties (Kulhánek, Balík, Černý, Vašák, & Shejbalová, 2018). The nutrient components of animal manures vary depending on the animal species, feed, storage method, and moisture content (Fuentes, Bolan, Naidu, & Mora, 2006). Before using animal manure, you need to know the amount of nutrients it contains. To do this, you need to analyse the existing soil and the animal manure to be applied.

Adiloğlu, Bellitürk, Yeşilyurt Adiloğlu, & Solmaz (2020) found that dry matter, macro- and micronutrient contents of rye plants increased significantly with increasing application of farm manure. Sharma, Bali, & Gupta (2000) reported an increase in soil N, P, and sulphur (S) availability due to crop residues and farm manure application. Sharma, Datt, & Chander, (2009) reported that the highest NPK content was obtained by the application of animal manure. The increase in N content due to the addition of organic manure can be explained by the release of N through mineralization of organic fertilizers in the soil (Kumar & Narwal, 2016). Application of swine manure increased total K content by 35% (Yost, Schmidt, Koelsch, & Schott, 2022). The application of animal manure significantly increased the phosphorus concentration of the wheat plant (Akpinar, 2020).

Adding organic matter to garden soils makes the soils rich in microelements (Sharma, Jassal, Sawhney, & Sidhu, 1999). According to Benke, Indraratne, Hao, Chang, & Goh (2008) found that long-term application of cattle manure increases the content of extractable Zn, Cd, and Cu in soil. Patel, Patel, & Patel (2007) reported that application of animal manure increased the availability of microelements (Zn, Cu, Fe, and Mn) in soybean and wheat crop rotations. In the study by Nikoli & Matsi (2011), it was found that the application of animal manure significantly increased the levels of available Cu, Zn, Mn and B' over a period of nine years. Chaudhary & Narwal (2005) reported that both application and dose of animal manure had significant effects on extractable and total Zn, Fe, Mn and Cu. Application of sulphur and animal manure to calcareous, saline, and clay soils had no effect on Fe, Zn, and Mn content of tomato plants, but had a significant effect on Cu content (Orman, 2012).

It is also considered that the nutrient content of animal manure is insufficient for areas with intensive agriculture. Therefore, in some cases, animal manure and inorganic fertilizers are mixed and applied in certain proportions. Application of animal manure and organic fertilizers alone or together with chemical fertilizers has been found to increase soil N, P, and K content (Singh et al., 2001; Kaur, Kapoor, & Gupta, 2005). Singh, Singh, & Singh (2013) found that application of animal manure and nitrogen together increased soil organic carbon and N, P, K content. It has been reported that the combined application of animal manure and mineral fertilizers leads to an increase in available N in the soil (Mann, Brar, & Dhillon, 2006). According to Kulandaivel, Mishra, Gangaiah, & Mishra (2004) found that application of animal manure and application of 30 kg $ZnSO_4$ × 5 kg $FeSO_4$ ha^{-1} as chemical fertilizer was the best combination for microelement uptake in terms of chelation. Khan, Iqbal, & Islam (2007) found that the addition of 10 Mg ha^{-1} and 20 Mg ha^{-1} animal manures to mineral fertilizers increased soil nitrogen content by 24% and 27%, respectively. Conversely, it was reported that increasing the application of poultry manure to 5 to 10 Mg/ha did not cause a statistically significant increase in soil N (Busari, Salako, & Adetunji, 2008). Karki, Kumar, & Gautam (2005) reported that the root K content of maize plants increased with the application of chemical fertilizer + 10 t animal manure + 5 kg Zn ha^{-1}.

2.2. Effect on Chemical Properties of Soil

The application of animal manure leads to an increase in soil pH (Ano & Ubochi, 2007; Han, An, Hwang, Kim, & Park, 2016). The reason for this increase in pH is attributed to the calcium carbonate and bicarbonate it contains (Eghball, Binford, & Baltensperger, 1996; Whalen, Chang, Clayton, & Carefoot, 2000). In contrast, Hao & Chang (2003) found that soil pH decreased with the application of cattle manure in varying amounts. Similarly, Schlegel, Assefa, Bond, Wetter, & Stone (2015) and Iyyemperumal & Shi, (2007) reported that the pH of the soils decreased due to the acidic nature of swine manure.

Soil electrical conductivity (EC) is closely related to various soil properties such as soil organic matter content, texture, moisture content, salinity, and cation exchange capacity (CEC) (Grisso, Alley, Holshouser, & Thomason, 2005). Jagtap, Patil, Nimbalkar, & Kadlag (2007) found that the addition of animal manure along with chemical fertilizers in saline soils lowers soil pH and increases soil electrical conductivity. O‘Hallorans, Muñoz, & Colberg (1993) found that there was a significant relationship between the application of chicken manure in increasing amounts and EC.

CEC is important for soil fertility. It is known that the CEC of clay and organic soils is high. Miller, Beasley, Drury, Larney, & Hao (2016) found that CEC increased with organic fertilizer application over many years, but this increase was not observed with one-year applications. Also, Steiner et al. (2007) found that chicken manure application significantly increased CEC compared to control plots. Hao & Chang (2003) found that under dry conditions, soluble Na^+ and K^+ ions and adsorption rates increased with long-term application of cattle manure. Application of gypsum, farm manure, and sulfuric acid to soil in varying amounts decreased soil sodium adsorption rate (Hussain, Hamdy, Arshadullah, & Mujeeb, 2001).

2.3. Effect on Soil Organic Carbon

It has been determined that the application of animal manure to the soil increases the soil organic matter (SOM) and prolongs the decomposition time of the soil organic matter (Schulten & Leinweber, 1991;Bakayoko et al., 2009; Ortas, Akpinar, & Lal, 2013). The persistence of SOM in the soil has many benefits, such as reducing erosion (Rhoton, 2000), increasing infiltration (Franzluebbers, 2002), and improving soil structure (Bot & Bernites, 2005). Wang et al. (2015) reported that pig manure application along with chemical fertilizers increased soil organic carbon (SOC) by 25% and 30% over many years compared to those who did not. According to Körschens et al. (2016), the application of animal manure to agricultural soils was found to increase SOC content more than the application of straw and cattle manure.

The effect of animal manure varies with soil structure. According to Dunjana et al. (2012), cattle manure application on clay soils had a significant ($P < 0.01$) effect SOC and aggregate stability, but no effect on sandy soils. Celik et al. (2010) in their study investigating the effects of organic and mineral fertilizers on soil properties found that the organic matter content was higher when animal manure was applied than when mineral fertilizer was applied. It was found that application of swine manure to soils generally increases SOC and soil organic matter (SOM) (Yost et al., 2022). Desai, Patel, Patel, & Das (2009), found that the application of animal manure and crop residues increased the organic carbon of soils compared to the application of chemical fertilizers.

2.4. Effect on Soil Physical Properties

Application of animal manure to soils has been found to increase water holding capacity, soil structure, and infiltration capacity (Acharya, Bisnoi, & Yaduvanshi, 1988; Bhagat & Verma, 1991) and decreases bulk weight (Khaleel, Reddy, & Overcash, 1981).

Nyamangara, Gotosa, & Mpofu (2001) reported that cattle manure application increased soil water holding capacity compared to control application. Ankenbauer & Loheide (2017) found that the effect of organic matter on water holding capacity was better for soils with low clay content. When pig slurry was applied to sandy soils, it was observed that the water holding capacity of the soils increased by more than 20% (Adesanya, Akinremi, & Zvomuya, 2016; Bao, Chen, Vetsch, & Randall, 2013), while the hydraulic conductivity increases by 12-71% (Adesanya et al., 2016; Edwards, 2010). Sharma et al. (2000) observed a decrease in particle density and an increase in the water-holding capacity of the soil when the application of animal manure was compared to chemical fertilizer application in their field experiment for five years.

An increase in bulk density and a decrease in porosity were found following the application of swine manure to clay soils (Scheid et al., 2020). Meena et al. (2018) found that the average total porosity of the soil increased significantly with the application of animal manure.

Organic matter from animal manure affects some physical properties of soils such as the bulk density (Rees, Ball, Campbell, & Watson, 2000), and total porosity (Kay, 1998). Soil bulk density is an indicator of soil compaction and there is a relationship between soil organic matters (Usda-Nrcs, 2008). Meng, Ma, Zhang, & Yu (2019) found that long-term application of animal manure increased total soil porosity by 11.9% and decreased soil bulk density by 13.1%. Short and long-term studies have shown that the application of animal manure leads to a reduction in soil bulk density (Diacono & Montemurro, 2010; Thangarajan, Bolan, Tian, Naidu, & Kunhikrishnan, 2013).

Soil biological activity, uptake and cycling of nutrients are affected by soil temperature (Toselli, Flore, Marangoni, & Masia, 1999; Allison, Wallenstein, & Bradford, 2010; Wallenstein, Allison, Ernakovich, Steinweg, & Sinsabaugh, 2011; Ylivainio & Peltovuori, 2012). The addition of organic material helps insulate the soil from rising temperatures in summer (Zhu et al., 2019) and to warm the soil in winter. The addition of organic material decreased evaporation in soil and temperature of soil increased accordingly (Deguchi, Kawamoto, Tanaka, Fushimi, & Uozumi, 2009).

2.5. Effect on Microbiological Structure of Soils

Soils treated with animal manure are very rich in soil biodiversity. Application of animal manure can positively change soil biodiversity, microbial activity, and enzyme activity (Watts, Torbert, Feng, & Prior, 2010). Katayama, Hu, Nozawa, Takahashi, & Fujie (2002) found that microbial structure changes with the application of animal manure to soil over many years. It was found that the total number of bacteria in soils treated with animal manure increased by an average of 19% (Järvan, Edesi, Adamson, & Võsa, 2014). In addition, it was observed that dehydrogenase activity, which is one of the most important indicators of microbiological activity in soils (Wolińska & Stepniewska, 2012), increased by 23% due to animal manure application (Järvan et al., 2014). Long-term application of cattle manure to soil had a positive effect on microbiological activity and P cycling (Parham, Deng, Raun, & Johnson, 2002).

Mohammadi (2011) in his study on different fertilizer methods found that application of animal manure and compost increased soil microbial biomass carbon. Also, microbial biomass N describes the nitrogen assimilated by soil bacteria and fungi. Lalande, Gagnon, Simard, & Cote (2000) applied pig manure to soil and found a 36% increase in microbial biomass N, Pardo, Clemente, Epelde, Garbisu, & Bernal (2014) found that microbial biomass N increased by 140% as a result of pig manure application.

3. The Effect of Animal Manure Application on Soil and Environmental Pollution

Many studies on animal manure have mentioned the benefits of animal manure for soil and plants. Apart from the positive contributions of animal manure to the biological, chemical and physical properties of soil, it is also a pollutant to air, water and soil. These pollutants can take many forms. After organic fertilizer is applied, the nutrients are released slowly. The nutrients are not available as quickly as with chemical fertilizers. Because of this slow release, farmers are increasing the application rate of organic fertilizer (Nishio, 1997). However, it is noted that the application of animal manure in excess of the optimal dose results in nutrient losses and losses due to surface runoff (Edmeades, 2003; Diacono & Montemurro, 2010). On the other hand, environmental risk is minimized by appropriate dosing and reduction of potential risks (Diacono & Montemurro, 2010; Sharma, Sarkar, Singh, & Singh, 2017).

Waste from animal production is a problem for the environment, especially for soil and water. The most important pollution problem is nitrogen (N) and phosphorus (P) pollution (Hakeem, Ahmad, & Ozturk, 2013). Eutrophication results from an increase in N and P concentrations in surface waters (Walker, 2000). The application of animal manure for many years leads to excessive accumulation of N and P in the soil (Edmeades, 2003). While the application of animal manure has a positive effect on soil properties, it has a negative effect on water (Yokota, Ito, & Saigusa, 2003). Inorganic P content was determined to be 90% in cattle manure compost, 93% in pig manure compost, and 83% in poultry manure compost. Accumulation of P in agricultural soils as a result of various organic applications leads to P eutrophication in lakes and rivers (Carpenter et al., 1998; Kleinman, Wolf, Sharpley, Beegle, & Saporito, 2005). P mixed with surface water from manure piles causes an increase in algae density in the water. The increased amount of algae harms aquatic organisms. As the algae begin to decompose, aerobic bacteria consume the oxygen in the water, decreasing the amount of oxygen in the water and harming fish (Walker, 2000).

Long-term application of animal manure to light sandy soils reduces Zn and Cu accumulation in soil and groundwater (Ogiyama et al., 2005). It has been reported that the application of animal manure reduces plant availability of Cd, Cu, Pb and Zn (Singh, Agrawal, & Marshall, 2010), decreases Cd toxicity (Indoria & Poonia, 2006) and also causes a decrease in mobile As content in the soil (Batool & Farooqi, 2012). Application of animal manure is a suitable method to reduce the harmful effects of heavy metals in the soil.

The greenhouse gases that cause global warming can be referred to as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Livestock plays an important role in greenhouse gas emissions in agricultural production, and its contribution to agricultural greenhouse gas emissions is about 14% (Parry, Canziani, Palutikof, van der Linden, & Hanson, 2007). 80% of the total Ammonia (NH_3) emissions from agricultural activities originate from barns (Anderson, Strader, & Davidson, 2003). When animal manure is applied to the soil, more than 50% of the N can be lost with NH_3 in the first 24 hours (Sommer et al., 2003). This loss also leads to the loss of $NH4^+$ (Huijsmans, Hol, & Vermeulen, 2003). Waste from animal production becomes emissions that pollute the environment and negatively affect nature. The most important of these emissions is methane emission (32%) (WMO, 2021). Composting animal manure causes a 75% decrease in CH_4 release (Chen, Lin, Wang, & Hu, 2011). In the analysis of CH_4 emissions, the share of farm yard manure (FYM) increased by 26% and that of green manure by 192% compared to inorganic fertilizers (Linquist et al., 2012). In European countries, methods such as closing storage tanks, changing animal feed, and injecting manure are used to control and minimize NH_3 emissions on livestock farms (Balsari, Dinuccio, & Gioelli, 2006; Aarnink & Verstegen, 2007;Webb, Pain, Bittman, & Morgan, 2010).

A significant portion of the content of biochar is carbon. It has been reported that by converting organic waste into biochar, environmental damage is reduced and soil properties are improved (Sun et al., 2011; Abel et al., 2013). It is along the lines that there is inadequate management of animal manure around the world and no effective success in combating pollution. Proper storage of fertilizers on farms is very important.

3.1. Animal Manure and Antibiotics Pollution

All over the world, large quantities of livestock manure are produced and used in agricultural production (Dolliver & Gupta, 2008; Qian et al., 2016). The negative environmental impact of the intensive use of antibiotics in animal agriculture is of great concern. Although some studies have reported low levels of antibiotics in animal manures (Qian et al., 2016; Zhang et al., 2018), there are not many studies on the levels of these antibiotics. After animal fertilizers are applied to the soil, some of them may remain in the soil (Sun, Zeng, Tsang, Zhu, & Li, 2017). These antibiotics in the soil can affect seed germination, inhibit plant growth, and penetrate plant tissues, posing a risk to the environment (Malchi, Maor, Tadmor, Shenker, & Chefetz, 2014 ; Gros et al., 2018) and human health (Hu, Zhou, & Luo, 2010). The most important environmental problem associated with antibiotics is the emergence of resistant microorganisms and the deterioration of microbial structure (Ahmed, Zhou, Ngo, & Guo, 2015; Kuppusamy et al., 2018).

In some cases, high concentrations of antibiotics were found in animal manure. Doxycycline, sulfadiazine, and lincomycin were detected at high concentrations in pig slurry (Rasschaert et al., 2020). High levels of sulfadiazine have been detected in poultry in Austria (Martínez-Carballo, Gonzalez-Barreiro, Scharf, & Gans, 2007). Antibiotic use in livestock has reportedly reached alarming levels in China (Wang et al., 2017; Wei et al., 2018). Growth promoters, therapeutics, and prophylactics are used in livestock farms (Ramaswamy, Prasher, Patel, Hussain, & Barrington, 2010). After ingestion of such drugs, most of them are excreted through urine and feces (Halling-Sørensen, Sengeløv, & Tjørnelund, 2002; Sarmah, Meyer, & Boxall, 2006). Fründ, Schlösser, & Westendarp (2000); Sengeløv et al. (2003) reported an increase in antibiotic-resistant bacteria in soil and groundwater. Kumar, Gupta, Baidoo, Chander, & Rosen (2005) reported that antibiotic-resistant bacteria can be transmitted to humans through food. Kemper (2008) reported that some of the antibiotic residues found in the soil can remain in the soil for a very long time, while others dissipate very quickly.

The conversion of animal manure to compost by microorganisms is important for traditional manure management (Bernal, Alburquerque, & Moral, 2009). Composting is used and recommended as the most ideal method to reduce the ecological risks of antibiotics (Ho, Zakaria, Latif, & Saari, 2013; Selvam, Xu, Zhao, & Wong, 2012). Composting of animal manure leads to the destruction of naturally occurring pathogens (Ndegwa & Thompson, 2001). In addition, composted animal manure also contributes to plant nutrition (Akpinar, Demirbas, & Ortas, 2019).

4. Effect on Yield

Application of animal manure has a positive effect on parameters such as soil fertility and yield. Jan, Ahmadzai, Liaqat, Ahmad, & Rehan (2018) reported that poultry manure application increased 1000-grain weight and yield of wheat plants. In the study on wheat plant growth parameters under different organic applications, the highest production and profitability were obtained when vermicompost and animal manure were applied (Ali et al., 2020). Koutroubas, Antoniadis, Damalas, & Fotiadis (2016) found that the application of animal manure did not significantly increase wheat yield and dry matter. Yang, Gao, & Ren, (2015) found that organic manure application increased soil organic matter, total soil nitrogen, and yield of wheat (*Triticum aestivum*) and corn (Zea mays) over many years. In a study on blackgram (*Phaselous mungo* L.), it was found that application of 10 t/ha of animal manure, 20 kg ha^{-1} of nitrogen, and 15 kg ha^{-1} of zinc had a positive effect on yield and other parameters (Sharma & Abraham, 2010). The mixture of poultry manure and chemical fertilizer helped to increase the maize yield (Ayeni & Kayode, 2013).

5. Conclusion

In organic production systems, soil fertility protection and sustainability are closely linked to organic matter. Animal manure is now an indispensable source of organic matter. Organic matter, one of the soil's sources of nutrients, comes from animal manure, compost, and other organic wastes. It is extremely important to apply animal manure on a long-term basis to increase the amount of organic matter.

By decomposing organic matter through mineralization, it provides an important source of nutrients for the soil. From the literature reviewed, macro and micronutrient uptake of soils increased with the application of different combinations of chemical and organic fertilizers. The decrease in soil pH when animal manure was applied was due to the decomposition of organic matter and the formation of organic acids. Lower values of electrical conductivity were found in soils when animal manure was applied. The intensification of animal husbandry in some regions and the transport of animal manure to other regions is an important problem. Therefore, countries need to develop good strategies for the use of animal manure depending on the region. The following points should be considered when making animal manure: Storage, application methods, nutrient content of animal manure, alternative uses (energy production, compost, etc.). In this context, proper management of animal manure is extremely important. Improper use of animal manure can lead to nutrient losses (N, P and others). It is known that antibiotics in manure can have a harmful effect above a certain concentration. It is important to intensively apply animal manure containing antibiotics as compost.

All these negative effects of animal manure application are not an insoluble problem compared to chemical fertilizers. Such ecological practices are crucial for soil sustainability and healthy food.

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CHAPTER XII

BIOLOGICAL CONTROL OF BACTERIAL PLANT DISEASE

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1. Introduction

Strong winds, droughts, floods, and heat waves that have started to be experienced within the scope of climate change today affect our production, producers, and all our people negatively. Unplanned urbanization for the sake of income, energy structures, and mining activities built without adequate examination and evaluation destroy natural assets and triggers the negative effects of climate change. In an environment where agricultural production declines, agricultural lands are misused, and the cultivated lands are shrinking, our natural assets, which are the living resources that we will leave as a legacy to our future generations, are running out. The purpose of agricultural policy; should be to increase the quality of life of those engaged in high-quality agricultural production and agriculture, to ensure the use of technical innovations and inventions and to modernize, to ensure food safety and sustainability in agriculture, to keep the rural economy alive and to protect the environment and biological diversity while doing these. One of the important problems of agricultural production, which has an undeniable place in our lives, is diseases caused by pathogenic bacteria. In short, “plant protection”, which we can define as the protection of plants from diseases to increase, protect and improve agricultural production, has an important place in terms of the sustainability of human nutrients. Cultural, legal, physical, chemical, mechanical and biological methods are used in the control of the factors that adversely affect the yield and quality of plants, but chemical control is the most widely used method due to its ease of use and speed of action. As a result of wide and repeated fungicide operations, resistant populations of pathogens and pests crop, and advanced boluses or further effective fungicides are needed to control them. As a result of this vicious circle, it damages natural life and beneficial organisms by causing soil and water pollution, also the plants are caused damaged because of phytotoxicity. Fungicides produce environmental pollution in non-target areas both during and after the operation.

Biological control is a method of struggle that is suitable for sustainable agriculture techniques, sensitive to the environment, human and animal health. Ecology-focused researchers are in search of gradually reducing pesticide use without much loss in yield or costs. Today, especially environmental researchers in countries with developed ecology awareness; different stakeholders of the issue, especially consumers and NGOs; agrees that pesticide use should be reduced gradually, pesticide use should be reduced to an effective level to ensure efficiency in agriculture with an understanding of sustainability, and pesticide application risks should be reduced as much as possible. Experience around the world shows that pesticide use can be significantly reduced without drastically reducing productivity in agricultural production or increasing production costs. Today, increasing biological control practices by gradually reducing the use of pesticides is possible with the knowledge, technologies and alternatives available in current production systems. Adding salutary organisms, like mycorrhizal fungi or plant growth-promoting root bacteria, to the soil or growing medium are practices that promote plant growth and prevent plant disease. The biological control agent isolates and the bioactive secondary metabolites produced by these isolates are considered environmentally friendly reliable control agents in disease management by directly activating various mechanisms such as antibiotics, promoting plant growth and development, and promoting systemic resistance in host plants.

2. Biological Control of Bacterial Plant Disease from the Past to Nowadays

Biological control of plant diseases is the most popular research topic in phytopathology. Sanford's Potato Scabies Disease (*Streptomyces scabies*) using green manure in the 1920s has created an important beginning in biological control studies. In the 1940s and 1950s, the relationship between pathogen and antagonist began to be studied in the laboratory. According to Cook and

Baker, the first biological control application was made between 1920-1940 (Bora and Özaktan, 1998). *Peniophora gigantea*'s suspensions have been used against Fomes annosus causing rot in forest trees to prevent spore, and very effective results have been obtained. This antagonist was the first commercially prepared fungus. For many years, the difficulties in applying effective antagonists have been tried to overcome. Scientists have had problems in conveying the antagonistic relationships determined in the laboratory to nature, so this kind of biological control study remained at the laboratory level for a long time. Fluorescent *pseudomonas*, which is sure to determine the future of the fight against plant diseases first came to the fore in the 1980s. Fluorescent pseudomonas, very common in soil and the rhizosphere, have attracted attention because they both stimulate plant growth and prevent diseases. They have an indirect effect on the pathogen. Important steps have been taken in biological control against antagonistic bacteria that feed on the soil and subsoil organs (root bacteria) of the plants as epiphytic on the phyllosphere, which is the surface of the plant tissue, and as endophytes on the inner tissues (Aktepe et al. 2013; Soylu et al. 2016; Aktepe, 2018; Aktepe et al. 2019; Doan et al. 2022). The main thing in biological control is the direct or indirect role of the living organism in the prevention of diseases. In this context, all effects that reduce the disease such as microbial antagonism, the effect of hypovirulent races, increasing the host resistance to the physical and chemical environment, or stimulating the effect on the host by initiating the resistance mechanism in the host (induce resistance) are called biological control. Today, international organizations allocate more resources to biological warfare research than ever before. In addition, increasing demands of environmental movements and organic farming coincide with the goals of biological warfare.

The success of biological control is possible by understanding the interactions between the biological control element and the surrounding microbial community. Thus, we can determine in advance under which conditions the biological control strategy will be successful or unsuccessful. Therefore, the effectiveness of a specific disease prevention mechanism in the environment of the plant and the environmental and host factors that affect the microbial committee should be known in advance. In other words, knowing the interaction between the pathogen causing the disease and the antagonist that suppresses this disease is necessary for successful biological control. Antagonists can inhibit or suppress the development of the pathogen by producing antibiotics, competing with the pathogen for nutrients and/or place, and living as a hyperparasite, the antagonist microorganism on the pathogen. Antibiosis is when one organism blocks or destroys another with the metabolites it produces, which are called antibiotics. Many studies are showing that antibiotics are effective in suppressing plant diseases. *Agrobacterium tumefaciens* causing crown gall disease with radiobacter K84 (Smitt and Town) is one of the best examples of antibiotic-based biological control. Commercial preparations of Strain K84 are used in many countries for biological control of crown gall disease on a wide variety of hosts, including stone fruit trees and roses. When susceptible planting material is dipped into suspensions prepared from the commercial preparation of *Agrobacterium radiobacter* strain K84 (NO-GALL, GALLTROL-A, etc.) before being planted in soil contaminated with *A. tumefaciens* It can be effectively protected from root product, and also the effect of Agrocin-84 is not curative, but pathogen inhibitory (Bora and Özaktan 1998). When two or more microorganisms need the same resource, only one uses it and the other cannot benefit, and the suppression of their growth is the competition mechanism. The less there is in the environment, the more microorganisms compete for it. If an antagonist has an effective nutritional system, it uses the nutrients in the environment and prevents the pathogen from getting the nutrients it needs.

Ultimately, the pathogen dies from insufficient nutrients. Nutrients that limit growth vary according to the microorganism, environment and host plant. These can be iron, carbon, nitrogen, or any micronutrient. The best example in this regard is the iron competition. Iron is found in soil in a water-insoluble form (Fe+3). By producing a substance called siderophore, the antagonists reduce the iron in the environment to the usable form Fe+2 (Fadiji & Babalola, 2020). Siderophores produced by antagonists in the soil inhibit the development of some soil-borne pathogens. For example, siderophores produced by Pseudomonas putida, one of the fluorescent *Pseudomonas*, inhibit the germination of chlamydospores of the wilt-causing Fusarium species or the elongation of the grass tube of microconidia, and cannot cause disease in the plant since the pathogen cannot develop (Elad and Baker 1985; Scher and Baker 1982). Especially fluorescent Pseudomonas are of great interest both as biological control agents and as plant growth-promoting bacteria, and many studies are being conducted on this subject (Küsek and Çınar, 2012; Panneerselvam et al. 2015; Çelikten and Bozkurt, 2018; Oksel et al. 2022). Today, there are many microbial pesticides available in commercial formulations and in practice against plant diseases. Most of these preparations have been developed for the control of soil-borne fungal agents by the mechanism of antibiotics. *Pseudomonas fluorescens* A506 (Nurofarm, USA), *Pantoea agglomerans* P10 (Gro-Chem, New Zealand) and *Bacillus subtilis* QST 713 (Bayer, USA) are used in the biological control of *Erwinia amylovora* which causes Fire Blight Disease. (Lindow et al. 1996; Özaktan and Bora 2004; Sundin et al. 2009). *Bacillus* subtilis QST 713 exhibits antimicrobial activity by producing lipopeptide metabolism (Alexandrova et al. 2002). When applied to flowers, Yeasts prevent to blossom infections caused by *Erwinia amylovora*. The trading bioproduct named Blossom Protect (BIO-FERM, Austria) containing *Aureobasidium pullulans* yeast is an approved biological bactericide to fire blight on pears in Turkey. *Aureobasidium pullulans* have a mechanism preventing the pathogen's growth by bringing the environment's pH to an acidic form after colonizing the flower (Kunz 2004). These preparations are used as part of the integrated control of fire blight disease. Biological control with antagonistic microorganisms has long been a research topic, resulting in a wide range of products available and marketed around the world (Colinge et all., 2022). Biocontrol ingredients support other sustainable disease management applications such as disease resistance and offer opportunities to control plant diseases where other approaches are ineffective or unavailable (Aysan et al., 1999). One form of hyperparasitism that is receiving increasing attention as a novel approach to bioengineering is the use of viruses to disrupt and weaken plant pathogens. The potential to use mycoviruses to control Chestnut Blight Disease caused by *Cryphonectria parasitica* has been explored for years but has not proven effective enough in some places (Milgroom & Cortesi, 2004). It is hard to control bacteria outside of cultural practice and disease resistance if any. Recent studies display the potential of bacteriophages to control bacterial diseases (Ahern et al., 2014; Cement et al., 2018; Carstens et al., 2019). And, the first product against Pierce's Disease, based on a cocktail of four bacteriophages, has now attained the market (Das et al. al., 2015). A challenge with bacteriophages is the need to prepare bacteriophage mixes specific to each of the component genotypes in the mix of host bacterial species causing a problem. This also means that resistance will be a major and rapidly emerging problem due to the naturally occurring host-bacteriophage coevolutionary race underlying the need to use initial mixtures. Thus, there are two points here: (a) specific coupling for efficacy, and (b) complications of the host-bacteriophage-driven evolutionary process. Agriphi was established in 1989 as the first commercial company to produce specific phages to control plant bacterial diseases. OmniLytics Inc, established in the USA, produces a commercial preparation containing bacteriophage (the virus that dissolves bacteria) in the biological control of bacterial diseases. Agriphage is successfully used in tomato greenhouses in the USA. This biopesticide that prevents and controls harmful bacteria on tomato and pepper plants, apple and pear trees, and citrus trees is registered by EPA (U.S. Environmental Protection Agency). AgriPhage is available for the control of bacterial spot (XCV), bacterial speck (PST), bacterial canker (CMM), fire blight (EA), and citrus canker (XCC).

Another exciting area of research in biocontrol is the interaction between the plant host genotype and the microbiome. Just as disease resistance is inherited, the microbiome of a plant related to biological control activity can be predicted to be affected by the genotype. While this will complicate management, consideration of various susceptibility to various diseases is routinely part of farm decision-making. Another factor that plant breeders should consider is the genotype of the host and its native microbiome. Some *Trichoderma* strains endophytically colonize host roots and shoots, establishing a molecular dialogue that results in desired effects on plants. Mostafa and Gyed first defined this event and reported that Trichoderma improved fresh and dry weight in cotton plants in 1952. More than 20 years later, Trichoderma in the next It has been reported to have a beneficial effect on the germination of conidia, indicating the mutual benefit between fungi and plants (Catskă et al., 1975). What is suspect, and leads researchers to more principal studies, is that the beneficial effects of Trichoderma application rely on the genotype of the plant. (Harman, 2006; Tucci et al., 2011). Plant genotype, including hosts already affected by a disease, appears to play a crucial role in the uptake of rhizosphere bacterial microbiota, at least in a controlled setting; This is an approach that suggests more research is needed on the suppression of soil-borne plant diseases.

3. Conclusion

Biological control practices around the world have gained importance in integrated control. Biological control is environmentally friendly and does not leave any residue that can be harmful to the product. It does not cause any disturbance in agricultural applications. It is a sustainable method, once successful, it ensures sustainability and becomes self-sufficient, and can completely manage the disease. As in every control method, there are some difficulties in the biological control method. These; can be summarized as the strict dependence of farmers on chemical control, lack of awareness among farmers and policymakers, inadequate mass production laboratories/infrastructures, insufficient trained manpower capable of commercially producing biological control agents, and inadequacies in promotion and marketing. Factors affecting the widespread use of biological control; Lack of researchers who will carry out effective R& D and innovation studies in biological control, lack of sustainable financial support for researchers working on biological control, inadequacies in training programs, lack of information about commercial biological control strategies, and inadequacy of information flow from experts to manufacturers. Undoubtedly, important studies on biological control factors are carried out in our country. However, most of these studies remained at the academic level and could not be commercialized. Overview of biological control in our country; contains significant differences in terms of policymakers, academics and farmers. Policymakers are asking farmers to reduce their pesticide consumption. The academic sector generally focuses on routine R&D studies and keeps on the agenda that this research is not supported sustainably. Manufacturers, on the other hand, turn to imported solutions because they cannot reach ready-to-use local economic biological control agents. As a result, the producer's orientation is generally toward the use of pesticides. 95% of the biological control agents that are in limited use in our country are imported from European companies. However, despite all the negativities, several very successful domestic biological control companies have established themselves in the conditions of the producer. Our country can establish and commercially operate large-scale mass production facilities. However, our country has not yet reached this goal, mostly due to the inadequacies in cooperation and organization. Despite all these negativities, the new generation of plant protectionists consisting of young entrepreneurs in our country has started to take important steps towards the commercialization of biological control agents with effective R& D and innovation studies. When we look at the future of biological control in our country, it has many possibilities. Our country is very lucky in the presence of biological control factors. Existing capabilities in identifying local biological control agents and their hosts can be strengthened by R& D and innovation studies. More suitable techniques can be developed to increase the efficacy of the selected biological control agents for application. Effective production techniques can be developed to encourage large-scale production of the main agents to be addressed primarily in biological control. With the widespread use of biological control practices in our country, many sectors will be able to benefit from this. Producers will be able to reduce human health risks by having more effective means of suppressing diseases sustainably at a lower cost. Agricultural workers will be exposed to fewer pesticide risks. Consumers will have access to less risky foods. Wildlife will be exposed to fewer pesticides. water, air and soil; will cause less pesticide pollution. After all, society; will be less affected by potentially dangerous chemicals, and healthier production conditions and healthier products will be achieved in more protected areas. Biological control is a control method developed by using nature's pressure mechanisms and has almost no negative effects. With this aspect, biological control applications should be seen as a method that should be handled and applied primarily in integrated pest management. However, pesticide use is cheaper in the short term than all other methods, including biological control. On the other hand, the sector and consumers; Inexpensive and visually stunning products await. This situation triggers the use of pesticides. The pesticides used in the application and their amounts vary depending on the agricultural system in the application. In the last decade, the diversity in agricultural production has decreased drastically in terms of the number and variety of crops grown. To reduce pesticide, use and/or be successful in biological control practices, biodiversity must be brought back into agriculture.

All farming systems must be redesigned and adjusted based on current knowledge of ecology to ensure sustainability. Agricultural practices such as appropriate crop rotation and resistant varieties are key measures for reducing pesticides and increasing biological control practices, as integrated pest management requires. Breeding strategies that will form the basis to produce resistant varieties are necessary to expand ecological agriculture systems supported by biological control. In addition, farmers must utilize different plant protection practices other than biological control to effectively manage pests, diseases and weeds. The use of plant-derived extracts instead of synthetic pesticides offers promising options for the publication of biological control applications. More public opinion is needed to develop all alternative methods to synthetic pesticides for the development of biological control practices. To disseminate biological control practices, farmers should be given vocational training on agricultural ecology, integrated disease management and the use of pesticide alternatives, and this training should be integrated with practice and technical advice. In addition, farmers must be aware of the risks associated with pesticide use and are equipped with actionable measures to reduce these risks. The dissemination of biological control agents in nature is a shared responsibility of society, including scientists, farmers, consumers, governments and the private sector. Food companies, processors and retailers can be effective in using biological control practices instead of pesticides. Increasing the demand for products produced with sustainable farming methods and products from integrated production based on biological control can make a significant contribution to reducing pesticide use. Increasing the sales of products produced with sustainable techniques makes a significant contribution to pesticide reduction. In addition, food companies and retailers; By addressing minimum sustainability standards in their products, they can contribute to both reducing the use of pesticides and increasing biological control practices. Consumers need more awareness of what " good food" is. In the last few years, the issue of access to safe food has been increasing in the media. On the other hand, many research results indicate that pesticides have an increased risk of serious health problems such as cancer, Parkinson's, and cause dementia, diabetes and other diseases. The World Health Organization International Agency for Research on Cancer (IARC) has classified the most used herbicide, glyphosate, as a "probable carcinogen" and sparked a heated debate. Multiple pesticide residues: It has begun to be found in food, drinking water, surface water, breast milk and urine. It has been revealed that systemic pesticides (neonicotinoids) may be responsible for the collapse of bee colonies. There is a significant loss of biodiversity with the use of pesticides (Ozay and Arslantas, 2016). The transparent acceptance of these problems caused by pesticide use is the first step in solving the problem. Among the existing pesticide alternative control methods in agricultural production, it is the most self-sustainable, promising, and environmentally friendly "BIOLOGICAL CONTROL" method. Awareness of biological control practices should be created in all segments of society, including children for a healthy future and safe food.

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CHAPTER XIII

THE SELECTION AND SETTING OF FURROW OPENERS, CLOSER AND PRESS WHEELS FOR IMPROVING SEED EMERGENCE AND PLANT GROWTH IN CONSERVATION TILLAGE SYSTEMS

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1. Introduction

Planters and drills have to cut and handle residue, penetrate the soil to the desired seeding depth, establish proper seed-to-soil contact and close the seed-vee (Murray et al., 2006). The selection and setting of sowing mechanisms used in conservation tillage systems have a significant effect on furrow opening and closing, and the uniformity of seeding depth significantly affecting plant growth and crop yield. Proper seed placement is important to allow adequate moisture for the seed to germinate and prevent exposure to undesirable environmental conditionals (Aikins et al., 2017; O'Connor, 2022). However, handling crop residue during planting operations has been a very important challenge in conservation tillage systems. The presence of surface plant residue in conservation tillage systems may result in blockage of furrow openers, with accumulated residues and hairpinning in seed furrow. In addition, soil disturbed by furrow opener in the wet soil conditions will stick to the planter's sowing mechanisms and other components (Aikins et al., 2019; Altikat et al., 2013). This situation inhibits crop establishment and yield potential due to uneven seedling emergence, and thus limits the adoption of this method by farmers (Aikins et al., 2020; Baker et al., 1996). Appropriate seeding machinery has crucial importance to improve crop performance for conservation tillage system's adopters, which must be able to cut and handle residue, penetrate the soil to the proper seeding depth, and establish good seed-to-soil contact (Özaslan et al., 2015). Therefore, it is very important to select and set the furrow opener and closer units of the seeder according to the soil type, soil condition, and soil surface residue characteristics in order to achieve satisfactory opening and closing of furrows, and uniform seeding depth and seed-spacing. Similarly, several authors (e.g. Tessier et al., 1991; Sawant et al., 2016; Aikins et al., 2017; Aikins et al., 2020) reported that the selection of appropriate furrow openers/closer and their correct settings always have been very important issue in conservation tillage systems in order to retain adequate on-row residue cover, ensure accurate and uniform depth of seed placement, and plant spacing.

Several factors (design parameters and working manners of furrow opener/closer, field conditions including type and amount of residues at soil surface and soil properties such as texture, moisture content, resistance) influence the performance of a furrow opener/closer (Kushwaha et al., 1986; Altikat et al., 2013; Hasimu and Chen, 2014; Sawant et al., 2016; Ahmad et al., 2017). Until today, many types of furrow opener, closer and press wheel have been developed according to different farming requirements and soil conditions (Singh et al., 2016; Qin et al., 2018). Also, numbers of experiments had been carried out to evaluate the suitability of various types of furrow openers for conservation tillage conditions (Choudhary et al., 1985; Chaudhuri, 2001; Chen et al., 2004; Doan et al., 2005; Altikat et al., 2013; Aikins et al., 2017; Aikins et al., 2020). In general, these studies were about the performance evaluation of furrow opener/closer types or design parameters in different field and working conditions. Ahmad et al. (2015) reported that straw cutting efficiency and soil forces were significantly affected by the disc opener diameter, working depth and speed in no-till paddy soil conditions. Therefore, they evaluated the draft requirement and straw cutting performances of different sized furrow openers in no-till paddy soil conditions. The researchers observed that the diameter of a disc type furrow opener had a significant effect on straw cutting efficiency. Altikat et al. (2013) compared three different types of no-till seeders (hoe, disc and wing hoe type openers) on two different stubble heights (short and long) and two different stubble positions (standing and flat). They found that the no-till seeders with hoe-type furrow opener provided better sowing performance and seed emergence in comparison to the no-till seeders with disc- and wing hoe type furrow openers.

In the evaluation of the performance of furrow opener/closer and press wheels in conservation tillage systems, different approaches are considered. One of the methods mostly used in the performance evaluation of furrow openers/closers is the observation of plant emergence and crop yield. In the another approach used to evaluate the performance of the furrow opener/closers, the variables related to furrow characteristics and quality of operation, which indirectly affect plant emergence and crop yield are in general observed (Chaudhuri, 2001; Karayel and Özmerzi, 2007). Aikins et al. (2020) reported that the performance of a furrow opener used in conservation tillage systems might be determined primarily by assessing soil disturbance and the soil physical properties of the furrows created, seed-soil contact, uniformity and accuracy of the furrows and seed placement depth, good spread and optimum separation of seeds and fertilizer, and by their draught (power) and vertical (penetration) force requirements.

This chapter includes the information about conservation tillage systems and field conditions, agronomic requirements for seed emergence and plant growth, planter and drills for conservation tillage systems, the furrow opener/closer and press wheel types of planters commonly used in conservation tillage systems, their selection and settings, the main issues occurring during planting operations in conservation tillage systems and recommendations for avoiding these issues.

2. Conservation Tillage Systems and Field Conditions

Conservation tillage is defined as any tillage practice that builds up crop residues on the soil surface to minimize the impact of water and wind erosion. In another definition, it is stated as an agricultural management approach that aims to minimize the frequency or intensity of tillage operations in order to promote certain economic and environmental benefits (Gürsoy and Özaslan, 2014). There are a number of conservation tillage practices. Five types of conservation tillage systems are defined as no-tillage (sometimes termed direct drilling and zero-tillage), mulch tillage, strip or zonal tillage, ridge till (including no-till on ridges), reduced or minimum tillage by the Conservation Tillage Information Center (CTIC) (Opara-Nadi, 1993).

The most important factor in conservation tillage systems is the management of crop residues on the soil surface because it significantly affects the performance of seed planter/drill. Residue on soil surface before planting depends on pre-crop species, harvesting method, crop management system and tillage method. Figure 1 shows the residue amount on the soil surface after different residue management and tillage systems. This residue on soil surface is one of the important concerns encountering in conservation tillage systems because it results in plugging tillage implements or planters used in subsequent operations and non-uniformity in plant spacing (Nejadi and Raoufat, 2013). Swan et al. (1994) stated that the residues on soil surface resulted in decreasing the seeding depth and the uniformity of the plant spacing and increased the number of seeds placed closer to the surface. Many different soil conditions can be present during planting time. Moist soils covered with residue, which may also be wet, can dominate during the late fall and early spring and, occasionally in the summer. Although this condition provides an ideal environment for seed germination, it can make it difficult to cut through the residue. In contrast, hard and dry conditions may also prevail. Although cutting residue is easier during dry conditions, it is more difficult to penetrate the hard and dry soils. Therefore, a system approach in the management of residue is required in order to overcome the seed placement problems in conservation tillage systems. This system approach includes equipping the planters or the drills with rolling coulters and row cleaners, adjusting the combine to ensure uniform height, volume, and distribution of residue during harvest, and selecting and setting the furrow opener, closer and press wheels by considering field conditions.

Figure 1. Residue on the Soil Surface after Different Residue Management and Tillage Systems

3. Agronomic Requirements for Seedling Emergence and Plant Growth

Planting operation is the most critical practices in agricultural production because it has significant effect on the uniform and timely establishment of optimum plant populations, which increases crop yield, cropping reliability, cropping frequency and crop returns (Gürsoy et al., 2013). In agricultural production, a successful plant establishment is very important factor to reach a maximum crop yield. The most important factor in optimising plant establishment is to be aware of the agronomic requirements in crop production and to interpret this information so as to assist with the selection, setting and management of all farm machinery, especially planters. The period of germination and seedling emergence prior to establishment is the most important stage in all plant growing stage. Poor seed germination and seedling emergence significantly decrease crop yield. In conservation tillage systems, seedling emergence and plant growth are primarily dependent on the seedbed environment as determined by the interaction of soil, pre-crop residue, climatic and biotic factors during the plant-growing period (Radford and Nielsen, 1985; Miller et al., 1993). These environmental properties of seedbed can be mainly defined as soil water content, soil temperature, soil oxygen concentration, soil compaction or smearing, surface crusting after sowing and unevenly distributed residue, seed-soil contact, seed placement properties, soil insects or soil-born disease, (Stewart et al., 1999; Forbes and Watson, 1992; Nasr and Selles, 1995; Neira et al., 2015).

One of the most important factors affecting seed germination and emergence is the availability of soil moisture in the seed furrow and the water conservation in the soil (Tessier et al., 1991; Vamerali et al., 2006; Seidi et al., 2010). Reduction in soil moisture content causes a reduction in respiration and thus slows down ageing of the seed and prolongs viability. Therefore, in agricultural production, it is very important to conserve the moisture content of soil for better germination and seedling development. Khaneh (2012) reported that the seeds required sufficient water to break dormancy and develop from heterotrophic immature embryos to autotrophic seedlings. Appropriate selection and setting of planter according to soil condition is necessary to provide enough soil-seed contact and reducing the moisture loss rate for planting (Johnston et al., 2003; Tong et al., 2015). For example, several researchers (e.g. Tessier et al., 1991; Kushwaha and Foster, 1993;

Johnston et al., 2003; Vamerali et al., 2006; Xiangcai et al., 2016) observed that the soil disturbance influenced soil water availability in the seed furrow and rates of seedling emergence. Also, a number of authors (e.g. Choudhary and Baker, 1980; Erbach et al., 1983; Chaudhuri, 2001; Aikins et al., 2020) have noted that increasing seed surface contact with liquid phase water decreases germination time and increases germination percentage. At same time, these authors emphasized the importance of accurately placing the seed into soil furrow at a uniform depth with minimal soil disturbance for successful plant emergence and maximum yields. Mostly, in order to press the soil over the seeds, make available the supply of soil water and prevent the moisture loss in soil, the use of press wheels at planters might improve seedling emergence, crop establishment and yield (Radford, 1986; Rainbow et al., 1992; Rainbow and Yeatman, 1994; Johnston et al., 2003). Similarly, Tong et al. (2015) reported that press roller increased the contact between seeds and soil, reduced water evaporation and helped seeds to absorb water from soil. However, it is very important to select and set the press wheels correctly considering the field and soil conditions because excessive soil compaction due to using press wheel can increase soil strength and hamper root growth (Gürsoy and Türk, 2019).

Other factors affecting seedling emergence, plant establishment and growth can be defined as soil temperature, soil oxygen concentration, soil compaction or smearing, uniform seeding depth and space, the stubble and residue properties on soil surface, crusting of soil surface and rainfall patterns after planting, and soil-borne diseases. Soil temperature are especially very important factor for summer crops. In the production of these crops, cool-wet soil may delay seedling emergence and increase the likelihood of deterioration of the seed in the soil and susceptibility to soil-borne diseases. Several researchers (e.g. Walker, 1969; Barlow et al., 1977; Abu–Hamdah and Reeder, 2000; Berti and Johnson, 2007) reported that even a 1°C temperature difference could significantly affect seedling emergence and plant growth. Soil temperature is affected by a number of factors, including soil color, slope, vegetation cover, compaction, moisture, and naturally, the sunlight available. Among these factors, the soil water content and residue properties on soil surface has importance impact on soil temperature. Kaspar et al. (1990) reported that corn and soybean residue under no-tillage conditions reduced the average daily spring soil temperature by an average of 5.25 °C at a 5 cm soil depth and early corn growth and development was significantly be reduced due to decreased soil temperature. The researchers suggested the creation of a residue free band without soil disturbance in order to increase the seedling emergence and grain yields in corn production. Also, very loose soil as well as compacted soil results in reduced seed emergence and stand establishment. While very loose soil can be decrease plant establishment because the contact between soil and seed is deficient, excessive soil compaction results in reducing seedling emergence and growth due to lack of oxygen or reducing pore spaces between soil particles by increasing soil bulk density and penetration resistance (Gemtos and Lellis, 1997; Blunk et al., 2018; Gürsoy et al., 2019). Therefore, it is very important issue in agricultural production to provide an ideal seed environment, in which the seed depth and soil firmness provide adequate moisture, oxygen, and temperature to the seed but without excessive soil firmness that retards root development and seedling emergence.

Proper and uniform seed placement is extremely important for plant growing at the same time and decreasing harvest loss. The factors affecting seeding depth include seed species, climatic conditions, time of planting, residue on soil surface, soil type and soil moisture status. It is known that large seeds may need to be planted deeper, and dry soils require planting deeper than 25 mm to get the seed maximum benefit from the moisture in the soil. However, sowing too deep may reduce the seed's access to oxygen, thereby endangering the seed (Murray et al., 2006; Aikins et al., 2020).

When compared with conventional tillage systems, the soil under conservation tillage systems is harder, and has more stubble and residue on soil surface. This situation cause that the seeds can easily fall on the soil surface or stubble. Therefore, a low seed germination rate and emergence rate can occur due to poor soil-seeds contact. Also, the crop residue on soil surface may affect the performance of the seeder by blocking the furrow openers, preventing the soil from entering, and blocking other row units of the seeder (Çelik, 2009).

4. Planter and Drills for Conservation Tillage Systems

Planters can be broadly classified as broadcast, drill and precision by the horizontal pattern of seed placement. Broadcasting refers to random scattering of seeds on the soil surface. A broadcast fertiliser spreader is mostly used as the broadcast planter to distribute seed on the soil surface (Fig. 2). In broadcasting planting, as the seeds remain on the soil not in furrows created by a furrow opener, a secondary tillage operation may be performed to cover the seeds with soil.

Figure 2. A centrifugal broadcast seeder

Drilling is the random placement of seeds in furrows, and the seeds are then covered by soil. In this method, seeds are placed in furrows at uniform rate as a continuous stream and at controlled depth with an arrangement of covering the seeds with soil. A seed drill is commonly used to plant small seeds in rows closely spaced about 10-15 cm (Fig. 3).

Figure 3. The Drills Used in Conservation Tillage Systems (Özdöken, 2013; Şakalak, 2022; John Deere, 2022; AGCO, 2022)

Planters are mostly defined as precision planting machines. This planting method provides accurate placement of single seeds at equal intervals within rows; the rows are usually spaced widely enough to allow cultivation (Fig. 4). Planters are typically used to plant crops including almost all the horticultural crops and field crops such as sorghum, maize, sunflower, soybeans and cotton that require accurate control of plant population, and spacing between and along the rows. These planting machines have individual seed boxes associated seed meters for each row having wide spaces.

Figure 4. Precision Planters Used in Conservation Tillage Systems (Özdöken, 2013; Şakalak, 2022; Monosem, 2022a; John Deere, 2022)

Precision planters mainly include four functions, which open a furrow at controlled depth, metering seeds into the furrow at uniform intervals, covering the furrow, and firming the soil against the seeds. On some planters used in conservation tillage and no-tillage systems, soil and residue cutting devices are used to perform a residue and soil cutting function (Fig. 5).

Figure 5. Soil and Residue Cutting Devices Used in Conservation Tillage and No-Tillage Planters (Murray et al., 2006)

The main objective of soil and residue cutting devices is to cut soil and/or residue in the row area without significantly disturbing the seedbed in high residue conditions to guarantee the uniform seed spacing, desired seeding depth and good seed-soil contact (Yang et al., 2015). Several types of soil and residue cutting devices have been developed by considering soil and residue conditions until today (Raoufat and Matbooei, 2007; Fallahi and Raoufat, 2008; Gürsoy, 2014). Skeeles and Brandt (1993) evaluated two types of commercial row cleaners for their effects on stand establishment of corn. The researchers observed that the use of row cleaners increased the seedling emergence compared to rows where cleaners were not used. Fallahi and Raoufat (2008) reported that single pass of disc harrow and planting with row cleaner followed by rolling coulter attachment can successfully establish a conservation system offering advantages like less labor cost, less energy consumption and uniform seed spacings. Also, Gürsoy (2014) determined that the emergence rate and the uniformity of seed distribution along the length of the row were better with the row cleaner than without this attachment. Also, the quality of feed index, a measure of how often the spacings are close to the theoretical spacing, was significantly higher with the row cleaner than without it. Furthermore, Tourn et al. (2003) observed that row-crop planter equipped with row cleaner positioned in front of the coulter had the best performance in terms of crop emergence as compared to row-crop planter equipped with either a coulter followed by a row cleaner or a single coulter. Aikins et al. (2019) stated that the soil type, soil condition, and soil surface residue characteristics have significant effect on the design of the residue management unit of the seeder, and machinery settings. When the selection and setting of these units was conducted by considering soil and residue conditions, satisfactory opening and closing of furrows, and uniform seeding depth and seed-spacing are achieved. Also, the authors emphasized that improper selection of such units or settings can result in blockage of tine furrow openers, with accumulated residues and hairpinning when disc openers are used. Their review showed that smooth disc coulters, finger row cleaners, and their combinations can retain more than the minimum residue cover recommended for no-tillage systems, and power-assisted units can operate with surface residue up to about 9000 kg/ha without blockage, but their adoption in developing countries is restricted by relatively high fuel consumption.

5. The Furrow Opener, Closer and Press Wheel Types of Planters Commonly Used in Conservation Tillage Systems, Their Selection and Settings

One of the most important components of a seed drill or a planter is furrow opener that opens the furrow into which the seed is placed. The major function of seed furrow openers is to create a well-defined groove in the soil where the seed can be placed at the proper depth. Therefore, furrow opener is expected to penetrate in hard soil with a minimum of soil disturbance, open a narrow furrow while moving the residue cut by the coulter to both sides, place seeds at the bottom of the furrow where moisture is available, and maintain a uniform seeding depth. Many types of furrow openers for seed drills and planters used in conservation tillage systems have been released until today. The performance of these opener types is significantly influenced by soil and residue conditions, as well as proper machine adjustment and operation. Murray et al. (2006) mainly classified the furrow openers as runner, concave disc, disc coulter, bioblade, tine, punch or powered (Fig. 6).

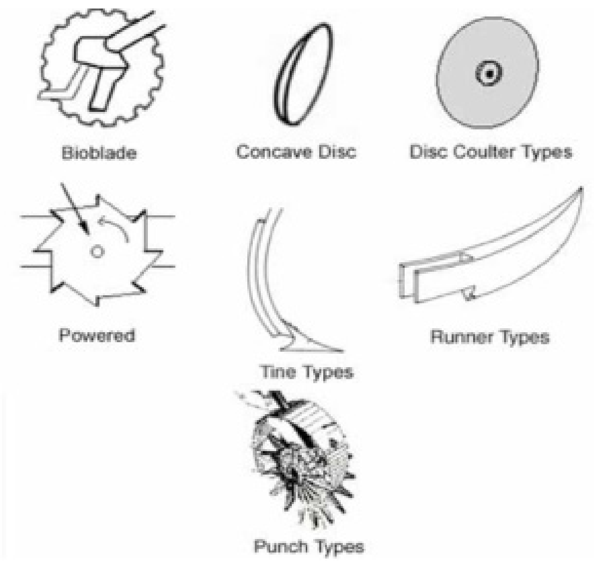

Figure 6. The Types of Furrow Opener Commonly Used in Seed Drill and Planters (Murray et al., 2006)

Aikins et al. (2020) grouped the furrow openers used in conservation tillage systems into three main classes as disc and tine furrow openers, and some hybrid versions also existing on the market (Fig. 7). They stated that the performance of these openers mainly depended on various design parameters, operational settings and soil conditions such as rake angle, cutting edge geometry, seeding depth settings, type of soil, soil moisture content, amount of residue on the field, residue handling unit, and forward speed.

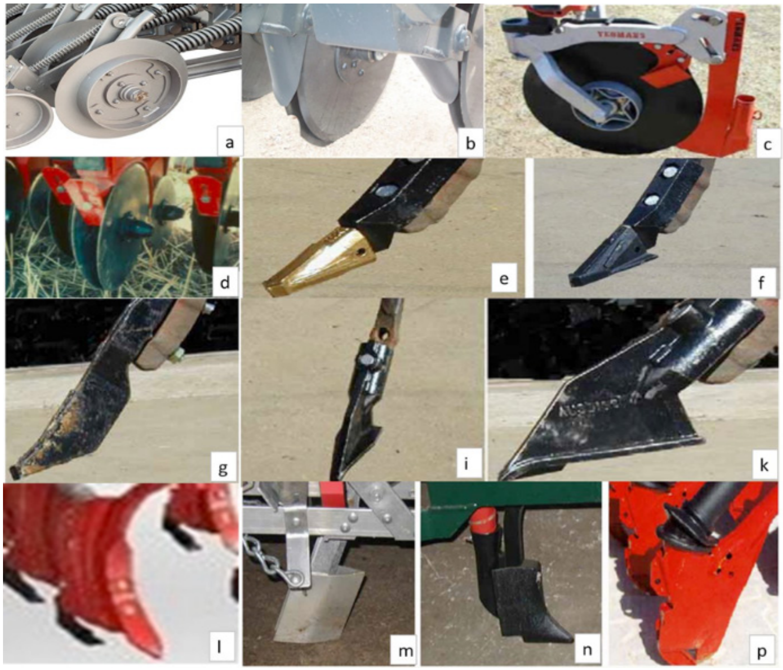

Figure 7. Some Types of Furrow Opener Commercially Available for Conservation Tillage Systems (a) Single Disc, (b) Double Disc, (c) Single Aligned Disc Coulter (d) Dedicated Triple Disc Coulter (e, f) Wingless and Winged Point Type Openers (g) Knife, (I, k) Inverted 'T' Type, (l, m, n, p) Shoe Type Tine Openers (Taylor and Schrock, 1999; Murray et al., 2006; Özdöken, 2013)

Basically, disc openers have one or two discs, sometimes dished outward, where the opener was modified into a seed shoe or runner just behind the disc openers (Figure 7a-d). Single disc furrow openers are mainly preferred for seeding drills used on the soils having plant debris and trash since the disc cuts or rolls over it without becoming clogged. The disc is set at a tilt angle of 5º to form a small ridge. The seeds are dropped in the delivery boot placed on the concave side of the center of the disc. A scrapper is provided on concave side to reduce soil throw at higher speed and prevent soil build up. Double disc openers have two side-by-side discs that contact each other at the bottom. These opener types are seen on many precision planters having gage wheels located in close proximity to the furrow opener and seed release point to insure controlled, uniform planting depth because the seeds need be placed at the proper spacing and also at the proper depth for precision planting. Disc openers have the advantages such as good seed placement if straw and chaff are evenly spread, minimum soil disturbance, capable of banding fertilizer while seeding and good packing (MNZTFA, 1994). However, most of these openers have do not perform well when the residue is wet or unevenly spread, and hairpinning resulting in poor seed-to-soil contact occurs in a wet field conditions because they may only bend the straw instead of cutting it (Baker, 1996). Also, disc-type openers do not perform well in no-till field with hard soils and residue cover because the disc-type openers need a larger vertical force and the high penetration forces to penetrate into the soil (Murray et al., 2006; Ashworth et al., 2010; Zhang et al., 2016a). Therefore, disc-type furrow openers used in conservation tillage systems are highly suitable for large and heavy planters, which in turn are most suited to large farms with high horsepower and heavy tractors. In addition, one of the most important disadvantages of disc openers is that they are unable to separate the seed from the fertilizer in the slot due to the V-shape of the slot (Baker et al., 1996). The performance of disc opener are significantly affected by opener geometric features such as disc diameter concavity and cutting edge configuration as well as soil properties and field residue conditions (Godwin et al., 1987; Ahmad et al., 2015; Ahmad et al., 2017). In general, disc-type furrow openers used in conservation tillage systems are classified as smooth-type, toothed-type, and notched-type. Bianchini and Magalhaes (2008) reported that toothed and notched disc openers had higher crop residue cutting performance than that of the smooth disc openers in sugarcane fields. Ahmad et al. (2017) assessed the straw-cutting ability and draft requirements of four different disc-type furrow openers (notched, toothed, smooth-edge single disc, and double disc) in no-till paddy fields. The researchers found that the double disc furrow opener produced the lowest level of hair-pinned straw and had the highest straw-cutting efficiency with a value of 88.6% at 90 mm operating depth, and therefore had the best performance in comparison with other furrow openers. In precision planters, gage wheels are located in close proximity to the furrow opener and seed release point to insure controlled, uniform planting depth (Fig. 8). The depth gauge wheel provides depth adjustment, cleans the leading face of the disc, and limits soil lifting and throw adjacent the disc.

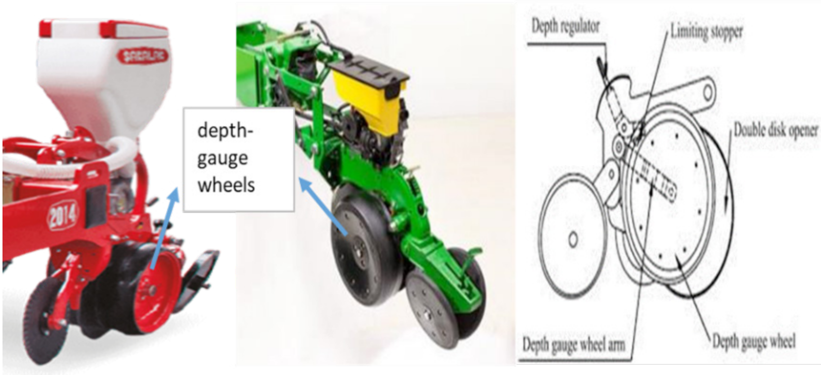

Figure 8. The Gauge Wheels Located in Close Proximity to the Furrow Opener (Zhang et al., 2016b; Şakalak 2022; John Deere 2022)

Tine type openers is known to have excellent penetration ability and handle hard seedbed conditions easily due to tending to dig a furrow by way of a positively raked tool moving through the soil (Murray et al., 2006). The most widely known types of tine openers are point, knife, inverted T, shoe, points, sweeps and duckfoot types. Aikins et al. (2020) reviewed the main performance indicators of furrow openers used in conservation tillage systems, and discussed how these performance indicators were affected by furrow opener geometric features, operating settings, and soil and residue conditions. They reported that the tine openers worked more successfully in wet soil conditions and were therefore suitable for sowing seeds that require deeper depth of placement, and were able to loosen soil below seeds, which facilitates root system development especially under hardpan conditions. Furthermore, the authors emphasised that tine openers caused greater soil disturbance, especially at high speeds, which limits the forward speed at which they can be operated and they were more likely to accumulate residue during sowing operations, which leads to clumping and seeder blockage. They stated that residue handling performance of a seeding system with tine openers could often be improved by modifying residue length to match the capacity of tine vertical clearance and inter-tine clearances within the layout, and by attaching residue cutting disc coulters and row cleaners. The main geometric features affecting the performance of tine opener are described as tine opener rake; penetration, underside or heel clearance angle; width or thickness and cutting edge shape and cross-section (Aikins et al., 2020). In recent years, several studies (e.g.

Solhjou et al., 2012; Solhjou et al., 2014; Barr et al., 2019; Barr et al., 2020) have been conducted for the development of the inverted T opener and bentleg furrow opener in order to improve performance of narrow tine openers in conservation tillage systems. Aikins et al. (2020) reported that inverted T openers could reduce moisture loss in the seed zone by achieving subsurface shattering and promoting high humidity chambers where seeds can be located. They stated that these opener types also had good residue handling capability.

For successful plant stands in conservation tillage systems, it is very important to know how to select appropriate seed depth according to soil and field conditions. Seed depth and downforce should be adjusted carefully to achieve the desired furrow depth without side-wall compaction. Proper adjustment instructions are outlined in the operator's manual. Therefore, growers should consult the operator's manual on recommended settings for different planter components. For double disc opener with depth gauge wheels, the seed depth adjustment on planters controls the distance between the bottom of the double-disc seed opener and bottom of depth-gauge wheels. Most planter row units have the ability to adjust this difference to at least 6 or 8 cm. Simply adjusting this depth difference between gauge wheels and seed opener, however, will not automatically mean seed is placed at the adjustment depth. A certain amount of weight or down force is required to push the seed opener into the soil before the adjacent depth wheel comes into contact with the surface. Therefore, it's very important to check that depth-gauge wheels are in contact with the soil surface when planting at deeper than normal depths or if dry soil increases penetration resistance encountered by the seed opener. If gauge wheels are not on the soil surface, extra weight must be transferred to the row unit via the down force system on the parallel links attaching the row unit to the planter frame (Hanna, 2013).

While seed covering devices have the crucial job of closing the seed slot in high residue conditions and promote soil flow back into the furrow to cover the seed after placement, soil press (firming) devices are designed to press uncovered seed into the soil at the base of the seed furrow to improve seed/soil contact (Murray et al., 2006). The seed covering devices are mainly classified as chain, concave disc, finger, knife, paddle, tine, disc coulter or finger wheel by Murray et al. (2006), seen in Figure 9.

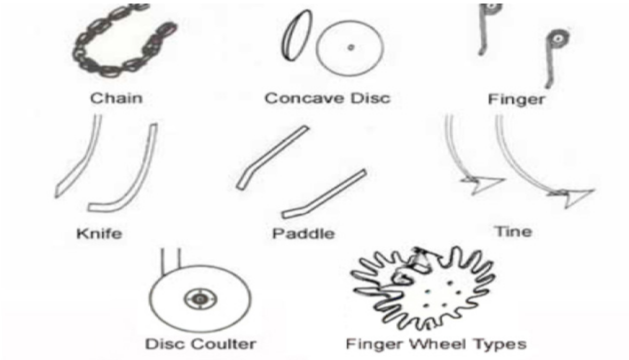

Figure 9. General Types of Seed Covering Devices (Murray et al., 2006)

The main objective of the soil press (firming) wheels is to provide the seed-soil contact. Also, a press wheel firm the soil so that the seed environment is moist enough and the plants emerge without any problems. Staggenborg (2004) also indicated that seed firmers reduced seed bounce in the trench and potentially improved seed−soil contact. Sometimes, a V-shaped tool to further shape the furrow provides a furrow cross section that minimizes seed bounce. After placing the seed into the furrow, covering disks or a scraper may be used to close the furrow.

Figure 10. General Types of Soil Press (Firming) Wheels Used in Conservation Tillage Systems (Özdöken, 2013; GreatPlains, 2022; Altınöz, 2022; John Deere, 2022; Agfocus, 2022)

A press wheel may be used to firm the soil to assure good moisture transfer to the seeds. Alternatively, both covering and soil firming can be accomplished by a set of soil firming wheels which move and firm the soil horizontally and without vertical pressure. There are different types of press wheels on the markets. Modern planters now offer multiple devices and options to close and firm the seed furrow. Some of these press wheels are seen in Figure 10. If closing and press wheels aren't set up and adjusted properly according to changing field conditions, furrows can dry out and open back up or sidewall compaction can seal too tightly and cause delays in germination or emergence.

Cast iron "V" and rubber "V" types of closing wheels are commonly used at conservation tillage systems. This type of closing wheels for planters firm the soil to get extraordinary seed-to-soil contact. The type of cast iron model is most suitable for rocky field conditions. Adjusting the distance between the closing wheels on a planter can significantly impact crop emergence. If they are set too narrow (left), they may pinch the top of the trench but leave an air pocket around the seed. If they're set too wide (right), the trench may not close properly. A 5-6 cm gap (center) is ideal (Fig. 11).

Figure 11. Adjusting the Distance between the Closing Wheels on a Planter (O'Connor, 2022).

Seeds should be sown in the exact depth to soil bed for growing and appearing on the soil surface at the same time. The lever at Figure 12 (a) changes the height of coulter. By this way, the depth of furrow made by furrow opener and seeding depth can be adjusted. Echeloned scale is used for adjusting all sowing units' feet on equal depth.

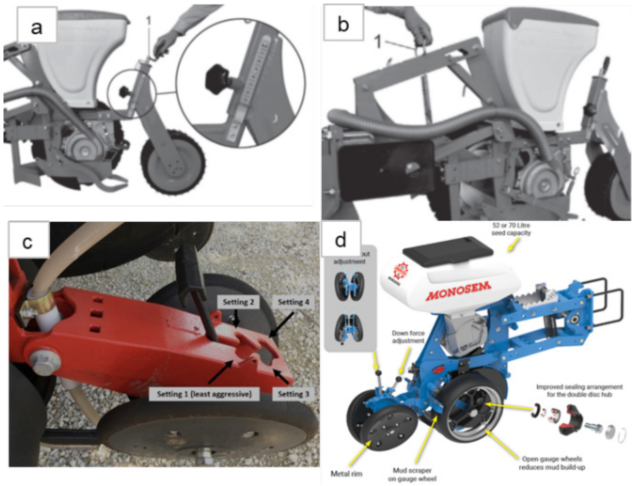

Figure 12. Setting of Press Wheel Used in Planters (Lee, 2021; Alpler, 2022; Monosem, 2022b)

The penetration process with furrow opener in soil is related with the force applied by spring. The pressure applied to soil can be changed due to different working conditions by changing position of spring to forward or backward (Fig. 12 (b)). Cast iron "V" and rubber "V" types of closing wheels should be set just enough pressure to consistently close the seed furrow (Fig. 12 (c)). Closing wheel aggressiveness will always need to be adjusted for soil type, soil moisture content, tillage practice and planting conditions. Excessive closing wheel force at the most aggressive setting can cause compaction in the row, particularly in moist soils, that result in inconsistent emergence.

6. The Main Issues Occurring during Planting Operations in Conservation Tillage Systems and Recommendations for Avoiding These Issues

A planters or seed drill used in conservation tillage systems is expected to cut and handle residue, penetrate the soil to the desired seeding depth, establish proper seed-to-soil contact, and close the seed-vee. When planting at the areas where conservation tillage systems are applied, many different soil conditions can be present at planting time. Although moist soils covered with residue provide an ideal environment for seed germination, it can make it difficult to cut through the residue. In contrast, although cutting residue is easier in hard and dry field conditions, it is more difficult to penetrate the hard and dry soils. Therefore, it is very important to know the problems encountered when planting in conservation tillage systems, and to select proper equipment and adjustments, and apply crop management methods in order to overcome these difficult problems.

The main problems encountered when planting in conservation tillage systems and the recommendations for avoiding these issues are following.

1. The main factor of successful planting at conservation tillage systems are the properties and management of the previous crop residue on soil surface. Uneven distribution of the previous crop residue may greatly limit the ability of the planter or drill to perform its functions. Therefore, the residue has to be uniformly spread behind the combine so that the opening devices cut through the material. Also, the coulters and row cleaners can be used in the field conditions where previous crop residues are heavy.

2. Uneven stand establishment due to uneven seed spacing, uneven emergence, delayed seed emergence and/or uneven seedling growth in conservation tillage systems can significantly reduce corn yields. Plant spacing variability is mainly related to misadjusted or malfunctioning planter mechanisms. Guiding the seed to the bottom of the seed furrow with a curved drop tube ensures that every seed is placed to the bottom of the furrow and greatly decreases the incidence of seed contacting the disk opener. Therefore, the selection and setting of furrow opener, closer and seed firmer by considering field conditions is important to eliminate seed bounce in the bottom of the furrow. Also, furrow opener, gauge wheel and seed closer and press wheel settings must be checked to reduce uneven seed spacing resulting from soil moisture variability and poor seed to soil contact due to inability of no-till coulters to slice cleanly through surface residues, worn disc openers, and misadjusted closing wheels. Determining the correct seeding depth may be one of the biggest problems when planting at the field conditions where conservation tillage systems were applied. Therefore, it is very important to place uniformly every seed at same depth. This can be done by adjusting down pressure, properly setting side gauge wheels and/or adjusting pressure on the trailing press wheel or closing wheels. The main processing applied when planting the seed are seen in Figure 13. This figure shows that for uniform and correct seeding depth, a planter need to cut and handle residue, penetrate the soil to the desired seeding depth, establish proper seed-to-soil contact, and close the seed-vee. Therefore, it is very important to check the condition of the double-disc openers before planting. For example, worn disc openers may slice a “W” shaped seed furrow rather than a “V” shaped one, making it difficult for the closing wheels to adequately firm the soil around the seed. Also, the seed depth can be affected by planting speed, which influences planter vibration, seed delivery and seed bounce.

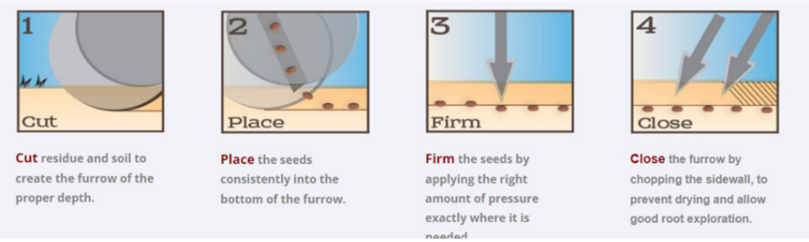

Figure 13. The Main Processing Applied When Planning the Seed (Exapta, 2022)

3. Sidewall compaction is another common planter-related problem in the field conditions where conservation tillage systems were applied. The sidewall compaction in the seed furrow often occur when the planter overcompacts wet soil and then the soil dries for several days after planting, building soil strength in the compacted areas and inhibiting early root growth. Especially, in wet field conditions, disk openers can compact soil to the point that roots cannot penetrate the sidewalls. This slick hard sidewall on the seed furrow inhibit the growth of roots along the path the seed furrow and the roots do not penetrate deeper into the soil profile (Hanna, 2007). This problem result from misadjustment of the V-press wheel units on planters rather than the double-disk openers (Staton, 2022). The main considerations for preventing sidewall compaction are recommended as adjusting downforce pressure on row-units to specific soil conditions, reducing the down pressure on both the gauge wheels and the closing wheels, avoiding shallow planting and target a 5 cm seeding depth, and utilizing a spiked closing wheel to till in the sidewall and improve seed-to-soil contact (Jasa, 2015).

4. Another problem faced when planting in conservation tillage systems is hair-pinning, in which residue is pushed into the soil rather than being cleanly sheared. Hair pinning creates a condition in which the seeds are unable to have good seed-soil contact, negatively affecting crop emergence and yield. In addition, the decomposition of the straw will then release substances that will decrease germination. Another major problem in conservation tillage systems is accumulation of pre crop residue on planting units, which may result in frequent stops to clean the equipment. Tine and disc openers use different mechanisms to plant seed through residue, and thus their ability to establish seeds effectively in high residue loads is expected to vary (Swanepoel et al., 2019). Several researchers (e.g. Baker et al., 1996; Ahmad et al., 2015; Aikins et al., 2017) emphasized that disc openers can cause hair-pinning when seeding into heavy and wet residue conditions because they does not cut through the residue, and instead pushes the residue into the seed slot. Also, these researchers stated that

excessive quantities of crop residues covering the soil mostly cause blockage of tine furrow openers. The main tips for preventing hair-pinning include: a) using a good, sharp cutting coulter ahead of the furrow opener; b) considering row cleaners for planters; c) using double disc openers with a leading edge that allows for better slicing through residue; d) using the correct down pressure, and select the right closing and press wheel for soil and operating conditions.

5. When planting in conservation tillage systems, one of the issues to be considered is moisture retention. In dry conditions, in order to conserve the water in soil and prevent the moisture loss of soil, press wheel and enough down pressure can be applied to remove air pockets and compact the soil around and above the seed to seal in moisture. In addition, for good germination, the seed must be placed in the bottom of the seed furrow in moist soil.

6. Conclusion

When planting/drilling under conservation tillage systems, the most important consideration is to use an appropriate seeding mechanism that can uniformly place seed through heavy residue and into firm, moist soil by considering soil and field conditions. The success of a planter under heavy and moist residue conditions mainly depends on planter features and attachments, as well as proper machine settings and operation according to soil properties such as soil texture, soil moisture, soil hardness, and pre-crop residue properties on soil surface. Therefore, it is very important to select and set up the planter units for existing field conditions. Satisfactory opening and closing of furrows, and the uniformity of seeding depth and seed-spacing significantly affecting plant growth and crop yield are achieved when the design of the furrow opener/closer and press wheel unit of a planter/drill are correctly selected and adjusted for the soil type, soil condition, and soil surface residue characteristics. Improper selection of such units or settings can result in blockage of furrow openers, with accumulated residues and hairpinning, sidewall compaction, and poor seed-soil contact. As conclusion, this situation result in uneven seedling emergence or sub-optimal plant stand, and reduce crop yield potential.

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CHAPTER XIV

HEAVY METAL STRESS IN PLANTS

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1. Introduction

Our world is facing a momentous environmental pollution problem, driven by increasing industrial activity every day. Urbanization, fossil fuel-powered vehicles, various chemicals, artificial agricultural fertilizers, detergents, pesticides, and radioactive substances are among the factors that give rise to this pollution. When discussing environmental pollution, another important factor that is augmenting in quantity and variety day by day is heavy metals. In nature, a high amount of heavy metal particles is released into the environment in the form of gases from coals and solid fuels that are burned unconsciously.

The term heavy metal is a term coined in view of the high atomic weight or specific weights of some elements. On the periodic table, elements with atomic weights between 63,546 and 200,590 with specific gravity above 4 are called "heavy metals". In another definition, heavy metals have a specific gravity of 5.0 g/cm^3 and above among elements in nature. These heavy metals threaten all living organisms, therefore future generations, depending on emerging technology and industry (Wo Niak and Basiak, 2003). Gases, air pollutants emanating from factory chimneys and a variety of waste cause negative effects on soil and plants. Soils contaminated with heavy metals cause many disadvantages, especially in plants that lack the ability to move actively.

Some heavy metals such as Copper (Cu), Zinc (Zn), Iron (Fe), Mangan (Mn), Molybdenum (Mo), Nickel (Ni), and Cobalt (Co) are elements in the trace or micro element class that are essential for plant growth and development. Some heavy metals, such as Arsenic (As), Mercury (Hg), Cadmium (Cd), Lead (Pb), and Chrome (Cr), are elements not necessary for plant development. Serious problems occur when all heavy metals are above a certain concentration in the atmosphere, water, and soil, regardless of whether they are useful or necessary for plants (Benavides et al., 2005).

Heavy metals affect the plant's yield and crop quality, threatening its vital function in advanced cases. Eliminating heavy metals from the soil is extremely challenging. It is necessary to take the required measures to prevent the pollution of the soils where agriculture is done, and it is of great importance to work on tolerant plants to be able to cultivate them in soils polluted with heavy metals.

2. Absorption of Heavy Metals by the Plant and Their Effects on the Plant

Heavy metals often infiltrate the plant as it uses the water supply in the environment to meet its water needs. Another contamination route occurs when metals in dust particles in the atmosphere get into the plant. These heavy metals, which can bind to the organism through the air, water, and nutrients, express their toxicological effects on metabolism in different ways (Lauwerys et al., 1993). For example, they can react with proteins, resulting in intracellular accumulation (Yoshikawa, 1982), or inhibit structural functions and enzymatic structures. They can also express toxic effects by replacing some basic elements (Bremner, 1974).

No matter how the route of infiltration is, heavy metals affect the vital functions of the plant, change it and cause it to become stressed. Owing to the excess density of heavy metals in the soil, plants are impotent to get the necessary nutrient elements and minerals they need. It has been revealed in many studies that heavy metals significantly prevent the vegetative development of plants. In heavy metal stress, the stem and root sizes of plants are known to be smaller, and the number of leaves and leaf lamina are also small (Mengoni et al., 2000; Jayakumar et al., 2007). One reason for the decrease in root length and branching of the plant is oxidative damage caused by the heavy metal effect. With oxidative damage, membrane structures are disrupted, cells on the stem epidermis are damaged and root cells are prevented from dividing and proliferating. Also, the increase of the compound called suberin, which has the ability to limit water in plant roots, disrupts plant-water balance, thus problems can arise in plant development (Mohanpuria et al., 2007; Soudek et al., 2010). Heavy metals impede the plant's vital function due to its many physiological and biological activities, such as transpiration, water intake, photosynthesis, protein synthesis, and hormone production (Kennedy and Gonsalves, 1987). The plant's not only vegetative but also generative organs are damaged (Jain et al., 2000).

3. Heavy Metal Stress in Plants

The fact that heavy metals are above the plant's tolerance limit, whether or not they are necessary for plant growth and development, causes a number of problems. These heavy metals and their effects on plant organisms are generally as follows.

3.1. Copper (Cu)

Copper is an extremely important micro element in the healthy vegetative and generative development of plants. Cu solubility and bioavailability in soils depend heavily on organic matter content and pH value (Bravin et al., 2012). Due to its low solubility in high pH, Cu bioavailability in chalky soils is limited (Adriano, 2001). As a result, Cu deficiency can be seen in plants. Serious problems occur in photosynthesis, respiration, cell membrane integrity, and enzyme activity in cases where the plant cannot get enough Cu (Rehman et al., 2019). Typical symptoms of Cu deficiency include reduced elongation in plants, necrosis of apical roots and shoot meristems, leaf deformation, increased susceptibility to biotic stresses, and chlorosis in young leaves (Adrees et al., 2015). However, Cu deficiency is a very rare condition in plants. But in case of lack or excess, the level of harm also varies based on plant species, the developmental stages of the plant, and the state of utilization of other nutrients (Adrees et al., 2015).

Intensive mining, melting, and industrial and agricultural activities are leading to excessive accumulation of Cu in the environment. This poses a serious risk to all living organisms and the environment (Rehman et al., 2019). Chemical drugs containing Cu have been used for many years to prevent and control plant diseases, especially in vineyards, as in the treatment of diseases such as Downey mildew. This triggers Cu accumulation in soils and leads to phytotoxicity (Chopin et al., 2008; Mackie et al., 2012). In the case of low soil ph, in other words, in acidic soils, Cu solubility in soil increases because Cu adsorptions on colloids and organic matter surfaces are limited (Adriano, 2001). In plants, Cu content varies by species but is considered toxic when it is over 15-30 mg/kg dry weight (DW) (Sosse et al., 2004).

Copper toxicity also negatively affects protein synthesis, photosynthesis, respiration, ion intake, and the membrane structure of the cell from the plant's vital functions (Sossé et al., 2004). Typical symptoms of Cu toxicity in plants are leaf chlorosis, blocking photosynthesis, senescence in leaves, stunted growth, reduction in stem length, and peroxidative damage of cell membranes (Kopittke and Menzies, 2006; Michaud et al., 2008; Lequeux et al., 2010; Feigl et al., 2013; Brunetto et al., 2016). In addition, copper binds to the cell wall, acting directly or via calcium. As a result, the cell wall loses its elasticity, reducing turgor pressure. This causes calcium moving from the roots to the leaves to be blocked (Ouzounidou, 1994).

It is necessary to know the strength or adaptation mechanisms that plants develop under stress conditions thanks to their genetic characteristics and their own capabilities. It has been stated that 400 accumulator plants accumulate heavy metals (Reeves and Baker, 1999). These can be explained as collecting heavy metals by the plant and binding them to the cell walls, preventing the heavy metals from advancing to the shoot and stem by keeping them in and around the stem to reduce the transport towards the cell membranes, preventing some heavy metals from being absorbed by vacuoles and dispersing and transporting them in the cell, and converting heavy metals into protein compounds through binding them (chelating) by organic acids (Aksu and Yıldız, 2004). Again, to discover the tolerance amounts of plants to heavy metal toxicity, the type, quantity, severity of the toxicity and the plant mechanism that is affected by the metal should be evaluated. Knowing these limits is important for the yield, quality, and population continuity of the plant (Paschke et al., 2005).

3.2. Zinc (Zn)

Zn is an element that mixes with soil from a variety of sources, such as rock erosion, forest fires, volcanoes, mining and smelting activities, fertilizer, sewage, and phosphate fertilizers (Kaur and Garg, 2021). Zn is the second most abundant transitional metal after iron in living organisms. Zn is an essential element for plant growth and development, given its many physicochemical functions in the plant (Kaur and Garg, 2021; Natasha et al., 2022). As it is indispensable for protein and carbohydrate production, it has a direct effect on enzyme activity, photosynthesis, and cell membrane stability (Rout and Das, 2003). However, it is also known that the useful Zn and toxic Zn limits in plants are very close to each other (Kaur and Garg, 2021).

The concentration of Zn required for growth and development in most plants is approximately 15-20 mg/kg (DW) (Çakmak et al., 1996). Zn toxicity in plants increases as the bioavailability of zinc increases. Factors limiting or increasing bioavailability are soil pH, root secretions, microbial communities, and soil organic matter (Wyszkowski and Modrzewska, 2016; Kwon et al., 2017). Zn phytotoxicity is one of the most common microelement phytotoxicity, especially in strongly acidic soils, and as soil pH decreases, Zn solubility increases, and its potential to be phytotoxic also increases. As in other heavy metals, some plants survive by developing the ability to grow in environments with high Zn concentrations in the hyperaccumulator position (Prasad, 2008). These plants can easily live at these Zn values, which are toxic to many other plants. Some of these hyperaccumulator plants have the ability to accumulate high amounts of Zn in aerial parts (Prasad, 2008; Tiecher et al., 2016). To date, 28 species have been identified as Zn hyperaccumulators (Balafrej et al., 2020).

Excess zinc in non-hyperaccumulator plants causes morphological, biochemical, and physiological disorders (Tiecher et al., 2016; Balafrej et al., 2020). Zinc at high values replaces the magnesium element in chlorophyll and prevents the synthesis of chlorophyll (Van Assche and Clijsters, 1990). Therefore, the phytotoxicity of Zn in leaves is quite complex due to its function both in chlorophyll biosynthesis and in other biochemical reactions (Chaney, 1993). Excess Zn causes significant changes in the root structure of the plant (Disante et al., 2014). In fact, some studies have revealed that plants exposed to high metal concentrations express changes in their root morphology, causing a greater number and rate of root branching, especially on contact surfaces (Emamverdian et al., 2015; Küpper and Andresen, 2016). However, in general, Zn stress causes a decrease in primary root length (Kranner and Colville, 2011). Suppression of root elongation is sourced from the inhibition of cell proliferation and growth (Marichali et al., 2016). As is known, Zn accumulates in the meristem cells at the root tip of the plant, preventing division during the mitosis phase (El Ghamery et al., 2003). Again, it is known that by causing an increase in the amount of lignin in cells, the growth of the root and stem is stopped, which leads to a decrease in growth in plants (El Ghamery et al., 2003). Li et al. (2013) stated that the increased level of lignification and a significant loss of cell viability at the root tips in the seedlings of *Triticum aestivum* exposed to high Zn concentration caused a decrease in root growth. A similar result was found in *Jatropha curcas* (Luo et al., 2010) and *Citrus reticulata* Blanco (Subba et al., 2014).

By examining the root part of *Phyllostachys pubescens*, it was determined that the addition of 0.2 mM Zn had serious effects on root epidermal and root tip cells. Microscopic observations have shown the presence of certain crystals in the xylem parenchyma. It has been reported that these crystals can inhibit nutrient transport and thus reduce root growth (Liu et al., 2014). This crystal structure has also been shown to affect root growth and reduce water and nutrient uptake capacity in *Senna multijuga* and *Erythrina* (Scheid et al., 2017). Zn triggers oxidative damage by increasing levels of reactive radicals (Natasha et al., 2022). Reactive oxygen species (ROS), such as hydrogen peroxide (H_2O_2) and superoxide anion (O_2), are usually produced in response to excess Zn in the roots of most plant species (Fernandez et al., 2012; Anwaar et al., 2015). In *Brassica napus*, 0.3 mM Zn caused an accumulation of H_2O_2 in the roots. However, in the *Brassica juncea* which is a resistant species, ROS levels remained low in Zn-treated roots (Feigl et al., 2015).

One of the first mechanisms affected by Zn toxicity in the aerial parts of plants is photosynthesis (Khan and Khan, 2014). In *Halimione portulacoides*, known as a hypertolerant to zinc, disruption in photosynthesis was observed at 70 mmol/L Zn concentration (Cambrollé et al., 2012). In *Solanum lycopersicum*, toxic Zn concentrations (43 ppm) affected plant growth, plasma membrane integrity was impaired due to its negative effect on photosynthetic electron transport, membrane permeability was reduced, and photosynthesis was inhibited by forming leaf chlorosis (Vijayarengan and Mahalakshmi, 2013). Monnet et al. (2001) associated the lack of photosynthetic activity with the production of ROS as in the roots. Stress symptoms such as an inward curl of leaf edges were observed in *Beta vulgaris* L. plants grown in an environment with excess Zn (Sagardoy et al., 2010). High Zn triggered chlorosis and necrosis in species belonging to the genus Populus and *Brassica rapa* resulting in a decrease in aerial biomass (Todeschini et al., 2011; Blasco et al., 2015).

Researchers have determined that the excess Zn is effective on seeds depending on the plant species, changing the germination speed and power of the seed (Balafrej et al., 2020). In *Macrotyloma uniflorum* and *Pinus sylvestris*, 0.1 mM dose of Zn did not block but delayed germination (Gokak and Taranath, 2015; Ivanov et al., 2016). Similar results were observed in *Coriandrum sativum* and *Nigella sativa* seeds at a dose of 2 mM, and in the radish (*Eruca sativa*) seeds at a dose of 5 mM. It has been stated that this is due to the protective effect of the seed coat against metal stress (Zhi et al., 2015; Marichali et al., 2016). However, other studies have shown that higher Zn concentrations significantly reduce the germination of some plants, including *Vigna unguiculata*, *Cassia angustifolia*, and *Glycine max* (Basha and Selvaraju, 2015; Nanda and Agrawal, 2016; Gupta et al., 2016). Bae et al. (2016) similarly stated that high Zn concentrations decreased the germination rate in *Trifolium arvense*.

3.3. Lead (Pb)

Lead is one of the most common heavy metals that pollute soils, affecting large areas (Li et al., 2012). Lead and its compounds remain stable in the soil for a long time, then decompose, and eventually reach throughout the food chain to the human body and accumulate (Jiao et al., 2012). It is not absolutely necessary for plants and can be found in the amount of 15-40 ppm in the soil. As long as the amount of lead in the soil does not exceed 150 ppm, it does not pose a danger to plants (Dürüst et al., 2004). High amounts of the lead element affect water balance in the plant because it adversely affects turgor pressure and cell wall, shrinks the leaf blade, and reduces stoma activities. In fact, during their uptake by plants with roots, most of the Pb ions remain at the root, and a small portion is transmitted to the aerial parts (Wińska Krysiak et al., 2015).

Monfared et al. (2013) noted that under Pb stress conditions, the growth of *Robinia pseudoacacia* seedlings is suppressed, and Pb ions are concentrated mostly in the roots. Due to the accumulation of Pb in the roots and inhibiting root development, the anion-cation balance in plants is disturbed and the necessary nutrient intake is prevented (Sharma and Dubey, 2005). Lead, which is transmitted to aerial parts, shows toxic effects on tissues and directly damages photosynthetic systems (Ahmad et al., 2011; Yang et al., 2015). All activities are therefore affected (Sharma and Dubey, 2005; Seregin and Kosevnikova, 2008; Lamhamdi et al., 2011; Yang et al., 2015). Lamhamdi et al. (2013) grew spinach (*Spinacia oleracea*) and wheat (*Triticum aestivum*) plants in the hydroponic environment at concentrations of 1.5, 3, and 15 mM $Pb(NO_3)_2$ to study the effects of lead stress on nutrient intake and metabolic activities. Lead accumulated in both plant species in a dose-dependent manner, resulting in reduced growth. It was determined that the intake of macro and micro element is in low quantities. In both species, a decrease in the content of proline and chlorophyll a and chlorophyll b were detected. But it was also noted that these effects are less pronounced in spinach than in wheat.

Santos et al. (2015) investigated the response of *Hypnea musciformis* to Pb stress and reported that plants under stress were stable in terms of photosystem II's maximum photosynthetic efficiency and electron transport rate, and were not much different from plants under control conditions. They noted that this could be due to an increase in starch synthesis in chloroplasts. Bai et al. (2015) stated that when the rye plant was exposed to 500 μM Pb, the levels of carotene, chlorophyll a, and chlorophyll b and photosynthesis rates were significantly lower than in the control plants. As a result of lead stress applied to the curly lettuce (*Lactuca sativa* var. crispa) in 3 different doses, a decrease in biomass, root, stem, and leaf area values occurred in parallel with dose increases. In addition, antioxidative enzymes have been reported to be very important and effective in protecting against Pb stress (Kıran et al., 2015). Zhou et al. (2018) investigated the effect of Pb stress on *Ligustrum lucidum* seedlings. They examined the photosynthetic activities, growth levels, physiological characteristics, and cellular structures of seedlings grown in soil containing Pb at doses of 0, 200, 600, 1000, 1400 mg/kg and also determined the accumulation of Pb in tissues. As a result of the research, it was determined that the growth of seedlings was restricted by increasing the concentration of Pb, and that the level of Pb ions increased in the roots, stems, and leaves of the seedlings, but most of these ions were concentrated in the roots. In addition, chlorophyll a, chlorophyll b, total chlorophyll, net photosynthesis, transpiration rate, stomatal conductivity, and maximum photochemical efficiency values decreased. Under Pb stress, chloroplasts are swollen and deformed.

Sofy et al. (2020) investigated the effect of exogenous applications of jasmonic acid, salicylic acid, and proline on Pb stress tolerance in corn plants. They noted that Pb stress seriously affects corn plants, reducing growth, yield, photosynthetic pigments, and the intake of minerals (nitrogen, phosphorus, and potassium). They stated that it increases electrolyte leakage, malondialdehyde (MDA) accumulation, osmolytes, and enzymatic and non-enzymatic antioxidants. Positive results have been obtained with the application of jasmonic acid, salicylic acid, and proline and their combinations. El Shora et al. (2021) examined the effect of 5-aminolevulinic acid (ALA) on the alleviation of Pb stress in sage plants (*Salvia officinalis* L.) cultivated with the hydroponic method. The effect of Pb (0; 100; 200; 400 μM) stress and ALA (0, 10, and 20 mg/L) was studied at different concentrations. In the research, they stated that Pb has a serious effect on physiological parameters, and the germination percentage and protein content decrease compared to stress-free plants. Pb stress increased the content of MDA and H_2O_2. In addition, lead stress increased the activities of anti-oxidative enzymes (ascorbate peroxide, superoxide dismutase, glutathione peroxide, and glutathione reductase). In contrast, the application of ALA increased the germination percentage and protein content compared to the control plants. As a consequence of the study, the researchers stated that the application of ALA to alleviate Pb stress in sage was effective. In a study examining the effects of salicylic acid applications on Pb stress in American vine rootstocks, salicylic acid increased rooting and chlorophyll content in plants under Pb stress, and also ensured that the percentages of membrane damage and physical appearance scale values were low (Daler et al., 2022).

3.4. Nickel (Ni)

Among all environmental pollutants, Ni is one of the ubiquitous trace elements that disperse into the environment, both naturally and through activities carried out by humans (Salt et al., 2000). Nickel is the 22nd most abundant element in the earth's crust (Hussain et al., 2013).

Nickel is a microelement that plays a role in plant growth and development and is necessary in very small quantities for optimal plant growth (Seregin and Kozhevnikova, 2006). From the point of view of plant physiology, Ni is an essential element for the optimal functioning of enzymes such as urease and hydrogenase metabolism (Harish et al., 2008). In addition, it has been found to play a role in the activity of some enzymes, such as hydrogenase, carbon monoxide dehydrogenase, peptide deformylase, acetyl-S-coenzyme A synthase, methylcoenzyme M reductase and Ni-containing superoxide dismutase (NiSOD) (Ermler et al., 1998; Mulrooney and Hausinger, 2003). In fact, Ni element is found in small quantities in agricultural soils. However, the combustion of fossil fuels in energy production, mining, domestic, urban, and industrial wastes, and steel and cement industries accelerate the release of Ni into the soil (Salt et al., 2000). The release of Ni into the environment is a major concern for agricultural lands (Jamil et al., 2014). Exposure of plants to Ni concentration affects the plant morphologically and biochemically. At high Ni concentrations in the soil, signs of toxicity, including chlorosis and necrosis, have been observed in numerous plant species, especially rice (Samantaray et al., 1997; Pandey and Sharma, 2002).

It has been determined that high concentrations of Ni reduce plant height and overall biomass production in some plants (Seregin et al., 2003). Bishnoi et al. (1993) found that leaf water potential, stomatal conductivity, transpiration rate, and total moisture content decreased under Ni stress, and found a strong correlation between Ni toxicity and leaf area. Molas (1998) revealed that excessive Ni in *Brassica oleracea* plants reduces the volume of intercellular space in the palisade and spongy parenchyma. Many researchers have reported that Ni stress frustrates water relationships such as osmosis and diffusion (Molas, 1998; Kevrešan et al., 1998; Schickler and Caspi, 1999). The root zone of the pea plant was exposed to zinc and nickel stress. As a result of stress, some structural changes were observed in the nucleus, nucleolus, endoplasmic reticulum, and vacuoles in stem cells. Although high amounts of nickel elements have a negative effect on chlorophyll synthesis and fat metabolism, they also cause some deficiencies by preventing the intake of nutritional elements (Zengin and Munzuroğlu, 2005). Seregin and Kozhevnikova (2006) stated that Ni stress causes serious damage to the leaves in wheat plants and affects leaf mesophyll cells, vascular bundles, and leaf epidermal cells. Ni toxicity also reduces the elasticity of cell walls (Shi and Cai, 2009). Velikova et al. (2011) reported that stomatal conductivity decreased in *Populus nigra* plants. In excess of Ni, disruption of the function of the ion balance in the cytoplasm is addressed as the main consequence of toxicity (Saad et al., 2016).

3.5. Cadmium (Cd)

The main sources of Cd in the environment are chemical fertilizers, pesticides, industrial activities, and mining (El Rasafi et al., 2022). Cd is a dangerous element for living organisms due to its mobility and toxicity. Cd is a non-essential element (Dowidar et al., 2013) that is toxic even in low doses for plants (Cho and Seo, 2005; Schutzendubel and Polle, 2002). Cadmium toxicity affects plants at morphological, physiological, biochemical, and molecular levels (Hussain et al., 2012; Rizwan et al., 2017). Cd stress prevents root development in plants and reduces water and ion intake (Salt et al., 1995). Cd leads to plant death with many adverse effects, such as blocking seed germination, decreasing plant size and root length, and decreasing leaf count (Mani et al., 2012; Soudek et al., 2014; Bae et al., 2016). It causes physiological negativities by altering the balance of nitrogen and carbohydrates in plants. It inactivates enzymes, and interrupts the event of photosynthesis, leading to the closure of stomata, inhibition of transpiration, and disruption of chlorophyll synthesis (Sheoran et al., 1990). Similarly, in plants exposed to large amounts of cadmium, chlorophyll was found to be destructed, thus preventing photosynthesis (Zengin and Munzuroğlu, 2005). Cadmium causes excess ROS production, particularly as a result of increased oxidative stress in the plant (Moradi et al., 2019). The activity of enzymes used in nitrogen metabolism under cadmium stress is decreasing. As a result, nitrate assimilation also decreases. In a study, the Matador spinach variety was exposed to Cd stress. The researchers reported that Cd stress adversely affects the plant in terms of many physical and biochemical properties (Akpınar et al., 2021).

3.6. Chromium (Cr)

Cr is the 17th most abundant element that occurs naturally on Earth (Bhalerao and Sharma, 2015). Although trace amounts of Cr are required in plants, at higher concentrations it is known to be an important pollutant for the environment. Various anthropogenic activities are responsible for the release of Cr into soil, air, and water, and Cr pollution occurs globally. Cr is a highly active metal and reacts easily with environmental oxygen. It directly or indirectly affects all life forms by being included in the water and food chain (Shrivastava et al., 2002; Batayneh, 2012; Mc Neill et al., 2012).

One of the most important problems in plants exposed to chromium stress is the prevention of seed germination. As a result of the increase in protease enzyme activity, sugar transport required for the development of the embryo decreases, amylase activities are inhibited and therefore germination is prevented (Jain et al., 2000). In *Cucumis melo*, excessive Cr (over 10 mg/L) prevented seed germination in the culture medium (Akıncı and Akıncı, 2010). In *Hibiscus esculentus*, more than 50 mg/kg Cr in the soil prevented germination (Amin et al., 2013). More than 25 mg/L Cr in nutrient solution in *Triticum aestivum* (Riaz et al., 2019) and more than 2.5 mg/L Cr in *Echinochola colona* limited the seed germination rate (Rout et al., 2000). As a result of the abnormal development of the root activities of the plant in Cr stress, the plant cannot grow and its development slows down because it cannot get the necessary nutrients and water at an adequate level (Khan et al., 2000). It has been determined that root development and shoot development are reduced in Cr toxicity, photosynthetic activity is disrupted, membranes are damaged, leaves turn pale and necrosis occurs (Amin et al., 2013), and the desired level of yield and quality can't be reached (Khan et al., 2000).

It is known that in excess Cr, growth slows down and biomass decreases in the aerial parts of the plant, similar to root development (Tang et al., 2012; Ding et al., 2019; Shiyab, 2019). Roots are damaged because they are directly related organs to Cr toxicity. In a study, orange seedlings were grown at concentrations of 50-200 mg/kg Cr (III) and a significant decrease in root length was determined at the level of 200 mg/kg and beyond (Shiyab, 2019). In *Pistia stratiotes*, Cr (0.25 mg/L) at low concentration increased root length, leaf length, and width compared to control, but at a higher concentration (2.5 mg/L), it reduced root length (Kakkalameli et al., 2018). *C. sinensis* roots were severely affected by the high concentration of Cr (600 mg/kg) and a reduction in the dry weight of the roots was determined (Tang et al., 2012). In *Oryza sativa*, the leaves were affected by Cr toxicity, the total leaf area decreased, and the number of leaves per plant decreased by 50% (Sundaramoorthy et al., 2010). In *Brassica oleracea* exposed to Cr, leaf size decreased, and wilting and chlorosis were observed (Chatterjee and Chatterjee, 2000), while the number of leaves decreased in *Prosopis laevigatar* (Buendía González et al., 2010). Cr toxicity also causes anatomical changes in the plant. In *Vigna radiata*, Cr caused changes in the epidermis, cortex, and stele in the stem (Ratheesh Chandra et al., 2010). The addition of Cr to the nutrient medium resulted in a less wax deposition in *Phyllanthus amarus* leaves and increased stomatal aperture (Rai and Mehrotra, 2008). Cr toxicity in *Pterisis vittata* caused a decrease in the number of palisade and spongy parenchyma cells in the leaves of the plant (Su et al., 2005). In a study conducted to determine the resistance of the plant against Cr stress, it was determined that the transcript levels of genes encoding different antioxidant enzymes [ascorbate peroxidase (APX), superoxide dismutase (SOD), peroxidase (POD), and glutathione peroxidase (GPX)] increased in *Oryza sativa* seedlings compared to control plants (Fan et al., 2020).

3.7. Arsenic (As)

Today, the increase in regions containing high concentrations of arsenic is recognized as a global environmental pollution problem (Rasheed et al., 2016). The proximity of these areas to settlements is a critical threat (Sun et al., 2020). As with other heavy metals, the main reason for the increase of As is the increase in anthropogenic activities. Urbanization and industrialization are key factors here, and natural activities such as volcanic eruption and the decomposition of arsenic-containing sediments are also triggering it (Al Makishah et al., 2020). The presence of As in water used in agricultural activities is also a problem for public health. On the other hand, there are problems for plants due to the absorption of As and its phytotoxic effect on plants (Kalita et al., 2018).

Tolerance to As in plants is highly variable (Yanez et al., 2019). There are hyperaccumulator plants that can absorb a high amount of As without physiological harm (Souri et al., 2017). For other plants, exposure to As at a very low level can cause death (Singh et al., 2006). Arsenic can be easily taken up by plant roots, especially due to its similarity to phosphate (Hasanuzzaman et al., 2015). The arsenic element that enters the plant is transported through the cells thanks to the transporter metabolism of phosphate (Finnegan and Chen, 2012). When As is absorbed by the plant, it reaches the stem, leaves, flowers, and fruits through the xylem, but the highest amount accumulates in the roots (Li et al., 2016; Suriyagoda et al., 2018). By replacing phosphate during the phosphorylation reactions required by the plant, it stops oxidative phosphorylation during ATP production (Finnegan and Chen, 2012). Oxidative stress occurs, which has harmful effects at the physiological and metabolic levels (Kalita et al., 2018). During this process, cells are damaged (Talukdar, 2013) and ROS production increases uncontrollably (Islam et al., 2015).

With As toxicity, growth, and development of the plant are restricted and root growth is inhibited (Garg and Singla, 2011; De Freitas Silva et al., 2016; Vezza et al., 2018). In addition, it acts on chlorophyll and chloroplast membranes, greatly reducing the efficiency and quality of photosynthesis (Miteva and Merakchiyska, 2002). In many terrestrial and aquatic plants, changes in antioxidant enzyme activities and metabolite levels in response to As stress have been determined (Dwivedi et al., 2010; Gupta and Ahmad, 2014; Mishra and Dubey, 2006; Srivastava et al., 2011; Tripathi et al., 2012).

4. Conclusion

The increasing population of the world requires an increase in productivity in agricultural production. However, it is a known fact that the land assets required to feed this population cannot be increased, and on the contrary, arable land is lost for various reasons. Today, it is known that as a result of increasing air pollution with industrialization and technology, uncontrolled spread of industrial wastes, motor vehicles, use of fertilizers and pesticides, and unconscious consumption of all natural resources, the present soils become arid, salted, and especially heavy metal accumulation increases as a consequence of the mentioned pollution. The accumulation of heavy metals in soils has an effect on all living organisms. It is certain that plants, which are indispensable to human nutrition and the ecosystem, are endangered in these polluted lands. On the other hand, the pollution of water due to water leaks in polluted soils should also be taken into consideration. Considering the cycle between air, water, soil, microorganisms, animals, humans, and plants, it is extremely important to reduce this pollution.

Industrial wastes should not be delivered into nature without any pre-treatment and it is necessary to carry out effective treatment. It is necessary to limit the areas of use of unconsciously consumed drugs and chemical fertilizers or to seek alternative natural solutions. For soils contaminated with heavy metals, it may be recommended to grow hyperaccumulator plants that have the ability to perform heavy metal phytoremediation. Raising people's awareness about the environment and heavy metals, reducing the use of fossil fuel motor vehicles, which cause one of the most metal emissions, and not employing them unless necessary, are also vital in reducing pollution.

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CHAPTER XV

THE SUSTAINABILITY OF HONEYBEES

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1. Introduction

Today, honeybees are distributed worldwide and comprise more than 20,000 species, many of these are not yet explained. The oldest known Apis bee fossil in the fossil record is 34 million years old, found at the Eocene-Oligocene boundary (Roubik & Vergara, 2021). Beekeeping, which started with honey hunting in ancient times, has now turned into a commercial activity using Apis mellifera (A. mellifera), which is mostly the Afro-European honeybee. Beekeeping, which started with honey hunting, has shown rapid changes and has obtained agricultural products produced by bees such as pollen, propolis, bee venom, royal jelly, beeswax as well as honey, and started to use the bee itself as a product such as queen bee, swarm bee, package bee and bee larvae, Apart from these, more importantly, in the service sector, bees have be used to earn income by evaluating them as pollinators in crop production, Bee products such as apitherapy for health are used as alternative medicine tools, and finally, beekeeping with bee tourism, another area of the service sector almost at its peak (Chauzat, et al., 2014).

These developments in beekeeping are mostly practiced by professional beekeepers. However, if you look at beekeepers around the world, you will find that the majority of beekeepers do not make beekeeping their main source

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of income. Beekeeping is the primary income source for about 9 per cent of European beekeepers (Chauzat, et al., 2014). Professional beekeepers, who constitute a small percentage of total beekeepers, show an essential position within side the beekeeping sector (Chauzat, et al., 2014). Across the world, beekeeping is primarily practiced by small and medium-sized enterprises and small family businesses, and in rural areas as an additional source of income.

Honeybees are highly affected by beekeepers' management, environmental conditions and quality. Today, the long-standing interrelationship between bees and humans are at risk due to recently decreases reported in bee populations (Potts, et al., 2018). Changes in land use and landscape structure have led to large-scale loss, fragmentation and degradation of bee habitats. The proliferation of parasites through inappropriate pesticide use has led to reduced resistance of bee colonies. Pests and diseases are also a major threat, as globalization allows them to easily travel long distances. Factors such as forage availability and diversity, climate change, and species competition all contribute to declining honeybee populations. (Goulson, Nicholls, & BOTÍAS, 2015; Sánchez-Bayo & Wyckhuys, 2019).

As a fundamental part of ecosystems, bees play a vital role in maintaining biodiversity, ensuring the survival of many plants, regenerating forests, ensuring sustainability and improving quality and adaptation to climate change and quality of agricultural production systems (FAO & Hurst, 2007).

Honeybees maintain Earth's life support systems and positively impact global sustainable development through diverse ecosystem services that contribute to human well-being (Wood & Goulson, 2017).

Today, however, more and more beekeepers are concerned that beekeeping is no longer sustainable. Beekeepers are unsure whether their bees will survive the next cycle as climate changes and the ability of colonies to produce surplus honey and survive becomes increasingly unpredictable. The essence of beekeeping is defined as "the relationship between the season and the number of bees" (Caron & Connor, 2013). However, it is very difficult to keep a reasonable relationship between season and bee population these days.

In order to sustain our ecosystems and pass on suitable ecosystems to future generations and feed both bees and beekeepers, beekeeping must be sustainable.

2. Environment, Ecosystem and Bees

An ecosystem is defined as "an inanimate environment that interacts as a functional unit with a dynamic complex of plant, animal and microorganism communities in a given area". pollination, replenishment of water and food resources are provided by ecosystems for humanity. (Assessment, 2005).

Pollination as an ecosystem service can improve the fruit or seed quality or quantity for 39 of the world's 57 major crops (Klein, Dewenter, & Tscharntke, 2003; Klein, et al., 2007; Klein, Brittain, & Hendrix, 2012).

Bees play a role as pollinators in all respects of the ecosystem. They encourage the growth of trees, flowers and other plants that provide food and shelter for large and small creatures. Bees contribute to complex, interconnected ecosystems that allow many different species to coexist (Quigley, Amdam, & Harwood, 2019,).

As the most effective commercial pollinator worldwide, honeybees are categorized as natural pollinators of many ecosystems and invasive alien pollinators of others, creating a prompt for sensing changes in agricultural landscapes (Potts, et al., 2018).

Honeybees are both environmentally influenced and environmentally affected. The bee colony obtains food from its environment and in turn contributes to the function and health of the environment through vital pollination (FAO, IZSLT, Apimondia , & CAAS, 2021).

Honeybees' productive capacity, product quality and health can be affected by pollutants in the environment, so honeybees are highly environmentally influenced species. Although their flight distance is 3 km, it is necessary to examine the environment that honeybees will interact with at different levels, from local to regional level. What affects the functioning and survival of the colony in honeybees is the environment in which they interact, the regional climate in which the colonies are located, more importantly the microclimate in which the colonies are located, the topography and orientation of the land, the structure of the surrounding vegetation, the exposure of the colonies to sun, wind, humidity and frost.

Bees affect the environment not only through natural phenomena such as climate and vegetation, but also through the use of various types of chemicals such as pesticides, insecticides, acaricides, fungicides, herbicides and antibiotics as part of agricultural practices. Affected by the bees themselves or their progeny are directly or indirectly affected and exposed to acute intoxication, rapid death, chronic and fatal events that are difficult to measure. Although the unconscious use of chemicals has reduced in recent years. Intensive farming practices require the use of pesticides, leading to the use of new generation, more toxic pesticides such as neonicotinoids, leading to increased bee losses. Serious threats to the environment, ecosystems and human health are reflected in the decline of bees and other wild pollinators due to pesticides.

One of the environmental influences on honeybees is the richness of the surrounding vegetation for bees to find their vital activity and food sources (nectar, pollen, honeydew, water, etc.). Vegetation of sufficient diversity, quality and quantity is essential to ensure the survival and reproduction of honeybee colonies throughout the season (FAO, IZSLT, Apimondia , & CAAS, 2021).

While honeybees themselves are affected by the environment, they also affect the environment and the ecosystem. Many of the crops, food cultivated crops and wild plants species in crop production benefit from pollination, This is the main contribution of bees to the environment. It is estimated that about 80% of all flowering plant species are specialized for pollination by animals, mainly insects (FAO, IZSLT, Apimondia , & CAAS, 2021). Important pollinators of these plants and crops are wild bees and honeybees (Klein, et al., 2007; Brittain, et al., 2013). The diversity of honeybee and wild bee species is closely related to the pollination efficiency of different crops (Fontaine, et al., 2005; Garibaldi, Bartomeus, Bommarco, Klein, & aul A. Cunningham, 2015; Földesi, et al., 2016; Winfree, et al., 2018).

Animals (insects, birds, bats, etc.) pollinate approximately 87.5 percent of the world's flowering plants (Ollerton, Winfree, & Tarrant, 2011), up to 94 percent in the tropics (Klein, et al., 2007). Insects used in pollination, an important ecosystem service, contribute to human food and welfare (Zhang, Shyy, & Sastry, 2007). The contribution of wild and domesticated bees to pollination of a wide range of crops is now well recognized (Klein, et al., 2007; Kremen, Williams, & Thorp, 2007; Zhang, Shyy, & Sastry, 2007; Winfree, et al., 2018).

Research has shown that the decline of pollinators and honeybees can be attributed to intensive agricultural practices, reductions in crop diversity, the clearing of natural areas rich in flowering plants around or within agricultural landscapes to increase the size of agricultural landscapes that increase the availability of satisfactory resources for bees and reduce the availability of biodiversity; (Kremen, Williams, & Thorp, 2007; Senapathi, Goddard, Kunin,, & Baldock, 2017; Woodcock, et al., 2017; FAO, IZSLT, Apimondia , & CAAS, 2021). Climate change may affect the physiology and activities of bees and vegetation, leading to changes in the flowering time of plants and, as a result, the changes in the time it takes for bees to find nectar and pollen.

Natural and semi-natural forages with sufficient biodiversity and agricultural areas combined with the surrounding natural areas for ideal food source form a suitable environment and ecosystem for honeybees.

3. Sustainability and Beekeeping

FAO 2021; defines sustainable livelihoods as those that can withstand stresses and shocks and recover, maintaining or improving current and future skills and assets without depleting the natural resource base (FAO, IZSLT, Apimondia , & CAAS, 2021).

Much can be done to improve the productivity of many food and agricultural production systems by changing current practices. To ensure adequate supplies of nutrition and other agricultural products, productivity will need to continue to increase in the future. But this must be done while limiting the expansion of agricultural land and protecting and improving the environment. This is the essence of the transformation required for sustainability in food and agricultural systems. Efficiency in productivity has, in the past, mostly been expressed in terms of yield (kg per colony of production), but future productivity growth must consider more dimensions. Smart water and energy production systems are becoming increasingly important as water scarcity grows and agriculture needs to find ways to reduce greenhouse gas emissions. This also affects the use of fertilizers and other agricultural inputs (FAO & Hurst, 2007).

Food and agricultural production depend on natural resources and therefore the sustainability of production depends on the sustainability of the resources themselves. Much can be done to reduce negative impacts and improve the condition of natural resources. While intensification has positive impacts on the environment by reducing agricultural expansion and subsequently limiting encroachment on natural ecosystems, it also has potentially negative impacts on the environment. The most common pattern of agricultural intensification involves the intensive use of farm inputs, including water, fertilizers and pesticides. The same is true for animal production and aquaculture, with subsequent water pollution, destruction of freshwater habitats and degradation of soil properties. Intensification has also led to a significant reduction of crop and animal biodiversity. Such trends in agricultural intensification are not compatible with sustainable agriculture and are a threat to future production (FAO, Gemmill-Herren, Azzu, Bicksler, & Guidotti, 2020).

Ensuring that producers have adequate access and control productive resources and addressing gender inequality can make a significant contribution to reducing poverty and food insecurity in rural areas. Agriculture is the most labour-intensive of all economic activities. Directly and indirectly, it provides a livelihood for rural households totaling 2.5 billion people. Yet poverty is strongly associated with agriculture and agriculture is among the riskiest types of enterprise. Agriculture can only be sustainable if it provides its practitioners with decent employment conditions in an economically and physically safe and healthy environment (FAO & Hurst, 2007).

Beekeeping is sustainable when interactions between people and bees remain healthy. Beekeepers' apiaries benefit populations of locally adapted native bees, people in the wild and biodiversity. The production, profitability, sustainability and resilience of beekeeping systems as a source of income for rural and small-scale enterprises can be improved. Honeybees are highly affected by beekeeper management, climate change, intensive agricultural practices and resulting pollution, environmental conditions and quality, diseases and pests (September 2020). Beekeeping is a long-standing livestock production that faces various technical and economic challenges such as climate change, intensive agriculture, chemical use, shrinking and pollution of ecosystems, high colony losses and highly variable honey yields. It is important for both the beekeeper and the ecosystem that beekeeping can recover from difficult situations and be sustainable. Sustainable beekeeping depends on nectar sources, good beekeeping practices, a good environment, bee genetics, product diversity, success in disease control and new production models. While the ability of beekeepers to learn and integrate new knowledge into beekeeping management options is identified as the flexibility and diversity of the system, another important issue in the sustainability of beekeeping is the uncertainty of nectar sources. In farming systems other than beekeeping, flexibility and adaptability are essential for farms to achieve sustainability, given the dynamics and complexity of farming systems and the unpredictable changes they undergo. It seems that (Scoones, et al., 2007; Darnhofer, 2010).

As with all products, beekeeping products need to be differentiated to access markets and deliver economic value, but the high costs of product differentiation are often a barrier to market entry. Gaining market value for honeybee products can contribute to the sustainability of beekeeping through source registration and standardization of these products, especially honey. In order to offer consumers a specific, safe, nutritious or sustainable choice in the market, bee products need to be standardized and communicate their differentiable qualities in a verifiable way.

Standardization of bee products is an extremely difficult task due to the increasing uncertainty about the future of nectar sources for many reasons, including the lack of direct control over these sources, errors arising from bee breeding systems and disease control. However, the creation of bee farms in specific regions will ensure product standardization. Similar systems have been applied to other livestock.

Yield increase in beekeeping is carried out in some ways such as climate, the suitability of the region's vegetation and distribution conditions, and improving production methods. Honey quality will vary depending on the types of resources of pollen and nectar that honeys make use of (Bahşi, Yörük, & Budak, 2016). Access to nectar sources for beekeeping is based on mobility. This mobility is the main tool to optimize the use of nectar resources in the region, to adapt to the phenological stages of flowering plants and to manage environmental variability in these systems (Koocheki & Gliessman, 2003; Scoones, et al., 2007). The main component of transhumant bee keeping systems is the mobility of colonies. In order to get the best possible yield from the colonies, beekeepers need to know the nectar flow characteristics of the regions where they will place the colonies, which is an important criterion in determining a suitable location for the bees, while beekeepers need a sufficient number of available beehive spaces and a suitable transportation vehicle for the beehives. The availability and quality of nectar sources, the fact that nectar sources are a co-product of crop production and wild flowers, that beekeepers have no direct control over these sources, and agricultural practices and land management are the main factors as specific problems of bee breeding and crop standardization (Decourtye, AMader, & Desneux, 2010; Wrattena, et al., 2012). The use of pesticides in crop production can have consequences on the quality of floral resources, with an impact on colony losses (vanEngelsdorp,, Hayes Jr, Underw, & Pettis, 2009). The indirect exclusion of honeybees from some areas of crop production is caused by beekeepers adjusting their transportation schedules to limit exposure to certain pesticides and avoid areas of monoculture in order to provide honeybees with sufficient quality nectar (Allier & Gourrat, 2016).

The amount of nectar that honeybee colonies can access at a given location depends on the condition of the floral resources in the landscape, but also on colony density, which can be difficult to predict as many beekeepers share the same location without sharing location and number of colonies many beekeepers share the same space without sharing location and number. The optimum density for flower capacity at a nectar location has been documented (Ausseil, Dymond, & Newstr, 2018). Excessive colony placement at a location with a given nectar resource capacity has been reported to lead to competition for nectar resources, both between honeybee colonies and between honeybees and wild bees (Henry & Rodet , 2018). In this case, product standardization, which is important for the sustainability of beekeeping, which is necessary to prevent counterfeiting incidents, especially in honey, becomes difficult.

With food safety, which is a growing concern all over the world, especially among EU member states, it is aimed to prevent the presence of chemicals above acceptable limits that may threaten both quality and safety in food and food. This situation is evidenced by the fact that producers of beekeeping products prove the food safety of their products by documenting the disease prevention measures they apply in their locations and colonies in the name of sustainable beekeeping. At the same time, by documenting the quality, composition, origin and processing of products, beekeepers can prove that their products are safe, authentic, unaltered, nutritious and sustainable in the bee products market, which is highly vulnerable to fraudulent practices (FAO, Gemmill-Herren, Azzu, Bicksler, & Guidotti, 2020).

Precision beekeeping practices will be the phenomenon that will support beekeeping in issues such as bee presence and genetics, events affecting bee health, climate change, diversification of bee products, etc., which are essential for the sustainability of beekeeping. A sub-branch of precision agriculture, precision beekeeping is a beekeeping management strategy based on monitoring individual colonies to minimize resource consumption and maximize bee productivity. Although there are sufficient technical tools and industrial products to implement precision beekeeping in practice, the process is slowed down by the different stages of development of his three implementation phases of data collection, data analysis and implementation (FAO, Gemmill-Herren, Azzu, Bicksler, & Guidotti, 2020). In precision beekeeping applications, data that are important for beekeeping such as colony presence, colony individuals, weather conditions inside and outside the colony, colony weights are examined with smart hive system and data analysis methods, and problems that colonies may experience are tried to be predicted in advance.

Beekeeping has evolved from an old man’s hobby to a complex multi-stakeholder occupation involving women, youth and professionals, with colonies ranging from a few colonies to thousands of colonies in both rural and urban areas. Beekeeping is a resilient, sustainable and low-risk activity that is widely practised in poor rural communities, mostly on a subsistence basis, although it varies across the world. The existence of beekeeping and bees is largely limited by the environment from which they obtain food and, in turn, contribute to its function and health through pollination. Resources such as nectar, pollen, water, which are vital food sources for bees to ensure the survival of colonies, are hidden in the richness of the surrounding vegetation.

As a fundamental part of the ecosystem, bees have an important role in the survival of many plants, agricultural production, regeneration of forests, climate change and sustainability in agriculture. In addition, bees are also effective in pollination as an important supporter of plant production.

Beekeeping, defined as all activities related to the management of bee species, which is a social insect, “produces products such as honey, pollen, royal jelly, royal jelly, bee venom, beeswax, swarm bees, package bees, queen bees, and operates in the service sector with activities such as pollination and bee tourism (FAO & Hurst, 2007). However, in recent years, beekeeping has been facing various technical challenges such as economic difficulties, high colony losses and highly variable honey yields. The environment, climate change, changes in land use and habitat fragmentation, exposure to chemicals, diseases and biological agents and beekeeping practices can be cited as factors affecting the sustainability of honeybee colonies.

Beekeepers’ utilisation of the environment and the integration of bees with the environment will ensure the sustainability of beekeeping. Beekeepers are important stakeholders of the environment and can play an important role in landscape management. Through their regular observation of nature, their knowledge, their contact with other stakeholders, their legitimisation and awareness raising through the co-benefits from their bees and partnerships, they can improve the environment and convince others to contribute. Many different actors can help manage the landscape, including beekeepers, farmers, herders, foresters, local and indigenous knowledge holders, catchment managers and scientists. Because of all these factors, the environment should have sufficient biodiversity within natural and semi-natural areas, and agricultural landscapes should have diverse cultivation, ideally mixed with surrounding natural areas for nectar. The decline of honeybees and other pollinators due to pesticides poses serious threats to the environment, ecosystems and human health.

Climate change adversely affects both the natural and semi-natural habitats of honeybees and the honeybees themselves, which has a negative impact on the sustainability of honeybees. With the effect of climate change, shifts occur in the flowering period of plants. Beekeeping is effective by keeping a bee colony in the right place at the right flowering time.

The processes carried out by farmers engaged in crop production in land use either directly or indirectly affect beekeeping. The use of chemicals on the land causes intense bee deaths. Cleaning of wild plants in and around the land and mono-culture production is another factor affecting beekeeping.

Bee diseases and parasites are one of the factors that have a negative effect on honeybees. Today, diseases that can be transported rapidly from one place to another by transport affect almost all beekeeping. Failure to use the drugs used for bee diseases and parasites carefully and on time may leave residues in beekeeping products.

Today, many bee products such as honey, pollen, propolis etc. are produced by beekeeping. In order to increase the sustainability of beekeeping, it is necessary to standardise the beekeeping products produced. Since beekeeping products are easy to apply in terms of forgery, beekeepers need to prove the products they produce with documents. This is an indication that a registration system for beekeeping should be established. The production of geographically labelled products will increase the trust in beekeepers and ensure that the products are marketed at higher prices.

In order to make beekeeping sustainable, it is necessary to increase the confidence in products and beekeepers by using tracking prompts, which are new applications in beekeeping. Although the data monitoring system is initially costly, changes in the colony can be easily controlled and early measures can be taken with smart hives.

In order to ensure the sustainability of beekeeping, bees should be improved as well as beekeeping products. Today, the European honeybee Apis mellifferra is found in various parts of the world. However, new orientations to improve regional bee ecotypes will eliminate the adaptation problem in bees and increase productivity.

At the last point, on-site harvesting and bee tourism are on the way to become a new alternative source of income for beekeeping. On-site harvesting of bee products by consumers and accommodation and catering services can be used in this new trend. It can provide an alternative income source for the sustainability of beekeeping.

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