THE CAMRAS HANDBOOK ON AGRICULTURE

FOR LOCAL FARMERS, MIGRANTS AND REFUGEES

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INTRODUCTION

In 2023, the CAMRAS Project (Increase the Capacity of Migrants and Refugees in Agriculture Sector), a project co-funded by the Erasmus+ Programme of the European Union (Project Number: 2022-1-TR01-KA220-VET-000089931) was launched to provide a contribution to one of the major challenges of our times, that is the refugee migration, which is linked to political tensions and armed conflicts, economic crises and poverty, unsustainability and climate change. As a challenge at the global, regional and national level (United Nations, 2023), projects seeking practical solutions to this complex field need to consider its global dimension and operate at the local level.

Against this backdrop, the project partners

- Kahramanmaraş Sütçü İmam University (KSU), Türkiye
- Association Migration Solidarité et Echanges pour le Développement (AMSED), France
- Institute of Entrepreneurship Development (IED), Greece
- Inercia Digital S.L. (IDSL), Spain
- Internationale Arbeidsvereniging/International Labour Association (ILA), The Netherlands
- Kahramanmaraş Directorate of Provincial Agriculture and Forestry (KDPAF), Tükiye
- Trend Education NGO (TENGO), Türkiye

have developed an educational programme that attempts to prepare migrants and refugees (M/Rs) for their integration in the agricultural sector. Thus, the project contributes to M/Rs' capacity building so that they can work as a qualified workforce in agriculture and meet the demands of farmers in the host countries.

So far, the project has gone through various stages to prepare the *CAMRAS Handbook on Agriculture for Local Farmers, Migrants and Refugees*. Starting from a comprehensive needs analysis in the five European partner countries (İkikat Tümer et al., 2024a), a detailed picture of the situation of both M/Rs and the agricultural sector was revealed resulting in a guidebook entitled *The agricultural sector in five European countries: A guidebook for local farmers, migrants and refugees* (İkikat Tümer et al, 2024b). Informed by the views of M/Rs, local farmers and various stakeholders as well as based on the project partners' expertise, a vocational training programme was developed. An outcome of these efforts is this handbook, encompassing the content of the CAMRAS training programme. It is worth mentioning that the

training programme is strongly guided by the conviction that M/Rs can play an important role due to their, often accessible, previous knowledge of farming acquired in their home countries, that the views of local farmers are crucial to prepare tailored training programmes, and that only reflecting both groups' views and understanding can lead to a win-win situation. Thus, M/Rs can improve their living conditions by receiving vocational training, thereby supporting local economies in the host countries.

This handbook is organised in seven modules that cover important aspects of agriculture in the 21st century. Module 1 (Agriculture and Life) is an introductory module that offers trainees insights into the significance of agriculture in the globalised world. Module 2 and 3 embrace Crop Production and Animal Breeding as the two main fields of agricultural production. These modules inform trainees about distinct aspects that can be transferred to the specific local contexts they work in. Module 4 covers Innovations in Agriculture and Module 5 Sustainable Agriculture. These modules are conducive to arriving at an understanding that agriculture is exposed to constant change to meet the demands of the social and environmental challenges of our times. Module 6 (Worker Skills and Labour Issues) provides trainees with insights into the need to organise employment in the sector. The module also stresses the need for worker well-being as necessary components of 21st century skills to engage in effective farming. Finally, Module 7 (Problems of the Agricultural Sector) defines and specifies crucial aspects of today's agriculture that do not need to be neglected.

By nature, topics surrounding M//Rs and agriculture need to address problems and challenges in their field. However, the aim of this handbook is to provide solutions through vocational training. To serve this purpose, each chapter is enriched through case studies, in which M/Rs can see how to practically approach challenges they are likely to face.

As the handbook content is part of an educational training, it is integrated in an e-learning platform that additionally contains videos and assessment components to provide the CAMRAS project's target groups with a tailored opportunity to engage in the training. Trainees who successfully complete the training are granted with a certificate. Also, as the project is conducted in several European countries with a considerable number of target group members from Arabic speaking countries, all materials are multilingual covering the languages of Arabic, English, French, Dutch, Spanish and Turkish.

In sum, CAMRAS has generated a comprehensive needs analysis with an overview of M/Rs' working opportunities in the agricultural sector and a tailored training programme to serve vocational education purposes. It is our hope that M/Rs, local farmers, policy makers and other project designers benefit from the outcomes of the CAMRAS project.

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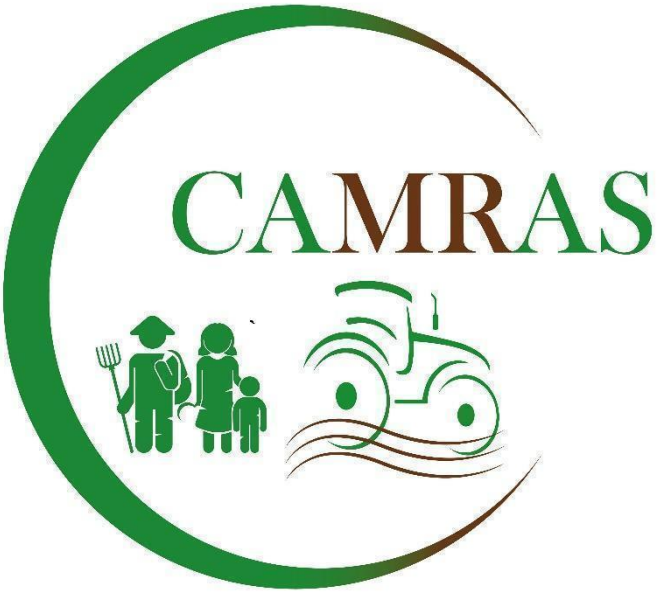


Module 1

Agriculture and Life (KSU)

Mürüvvet Ilgin

Emine İkikat Tümer

Stefan Rathert

In this module, you will

- learn about the role and importance of agriculture in the globalised world
- learn about current challenges agriculture faces
- be introduced to forms of agricultural enterprises and agricultural production
- raise an awareness of the importance of sustainable practices and technological innovation for successful farming
- get informed about issues like ownership structure, employment structure and supports in farming.

1. Agriculture in the world

Agriculture is one of the main sources for human life. It contributes to the economic growth and development in various areas such as production, employment, value added, export and environmental sustainability. Agricultural production varies greatly depending on various factors such as climate, soil, water resources, technological infrastructure and socio-economic conditions at hand.

As a vitally important sector, agriculture keeps the rural and urban population in balance. The agricultural sector, however, also faces challenges in developed, developing and underdeveloped countries given its growing strategic importance in the globalised world. Issues such as meeting the food needs of the growing world population, ensuring food security and protecting natural resources increase the importance of the agricultural sector.

Agricultural production has been characterised as an open factory that produces under the influence of natural factors (İkikat Tümer, 2011). Global warming, climate change, pandemics such as the COVID-19 pandemic, natural disasters such as earthquakes and floods, diseases and pests, civil unrest and war deeply affect the agriculture and food sector. All these events are risk factors for agricultural production.In recent years, the strategic importance of agriculture and food has increased, and self-sufficiency has emerged as one of the fundamental principles for countries. In 2008, the global food crisis caused by drought and the rapid increase in the number of M/Rs for various reasons made it necessary for many countries to revise their national agricultural policies. Additionally, food security has become an important part of national policies. For agricultural production purposes, countries have started to use soilless agriculture techniques and develop new agricultural land. In this context, the demand for purchasing or long-term leasing of agricultural land outside the borders of a country has started to become an issue.

A survey of various reports (Anonymous, 2022) highlights current challenges the agricultural sector is confronted with: A report published by the Organization for Economic Cooperation and Development (OECD) states that demand for agricultural products will increase by 15% between 2019 and 2028 due to population pressure. Considering that cultivated land is not increasing globally and is even decreasing in some countries, the projected 15% increase in production will have to be achieved through increased yields. According to the 2020 report of the Global Food Crises Network, which was established by the Food and Agriculture

Organization of the United Nations (FAO) and the World Food Program, 135 million people in 55 countries around the world are at crisis level or worse in terms of food security as of 2019.

The world's most vulnerable communities are experiencing some of the highest food prices of this century, and this trend is being expected to continue in the upcoming years. Families are being forced to reduce their diets as food price inflation impacts household budgets. Nutrition experts say they are already seeing the knock-on effects of malnutrition in children, with women and girls particularly at risk.

In many countries around the world, agricultural production takes place in rural areas far from settlements. Rural areas are classified as places or regions where demographically low population density is observed and production is based on agriculture and animal husbandry rather than industrial production.

In fact, the definition of rural may vary depending on the geography. Rural areas are the vast steppes in Turkey, giant breeding farms in the Netherlands, regions of poverty in India, rice fields in China, corn fields in the USA. If people in rural areas are not socially and economically comfortable and peaceful, migration to the city increases. This disrupts the urban balance. For this reason, on-site rural development plans have entered the agenda of countries and measures have been taken accordingly (İlter, 2019).

Leaving aside a limited group of producers and workers operating under favourable agricultural employment conditions, many contexts worldwide are constrained by conditions of poverty affected by a variety of factors. These include climatic conditions, uncertain economic prospects, the still undefined roles of women in agriculture, the alarmingly high rate of unprotected - precarious child labour, insufficient skills of workers and lack of qualified personnel, lack of protection of agricultural workers by law, low wages along with dangerous and difficult working conditions (Şenel, 2022).

1.1. Agricultural enterprises

The overall structure of agricultural enterprises across countries can vary greatly depending on such factors. However, in general, the structure of agricultural enterprises shows similar characteristics in many countries:

1-Dimension and Scale: Agribusinesses can range from small family farms to large industrial farms. In some countries, small-scale family farms are predominant, while in others large farms dominated by industrial agriculture are more common.

According to 2020 data, 4,772,427,627 hectares of land were used as agricultural land worldwide (FAO, 2023). This value corresponds to 1/3 of the world's land area. Of these 4.7 billion hectares, 1.6 billion hectares were agriculturally processed and the remaining 3.1 billion hectares were used as meadow or pastures. As a general observation, it can be stated that the global land distribution is highly unequal between land uses for livestock and agricultural products.

The three leading countries in the European Union in terms of cultivated agricultural area are France, Spain and Germany. These three countries account for more than 40% of the total cultivated agricultural land.

There are around 570 million agricultural enterprises worldwide. Nearly 90% of them are small family enterprises. About 60% of these small family businesses are located in China and India. Family businesses in the agricultural sector cultivate 75% of the world's agricultural area and account for 80% of the world food production.

In developing countries, family farming and small farms are more common. In most of these areas, crop and animal production are combined. These enterprises often provide food for their own families and may focus on local markets. In Türkiye and Greece, for example, small family farms are predominant, while in the Netherlands, Spain and Germany larger farms are more common.

One of the most important issues related to agricultural land is undoubtedly land fragmentation and the shrinkage of agricultural land through inheritance. This renders the enterprises uneconomic and gradually affects the local, regional and national economies negatively (Şahin, 2023).

2- Product Diversity: Agribusinesses usually focus on one or a few specific agricultural products. There are specialised enterprises for the production of various products such as cereals, vegetables, fruits, dairy products, meat products and agricultural services. There are many factors that affect the product diversity of agricultural enterprises. These factors may arise from various factors such as geographical location of the enterprise, climatic conditions, soil structure, market demands, technological infrastructure, costs, management capabilities and local economic conditions.

Agricultural technology and innovation allow businesses to offer a greater diversity of products. New agricultural techniques can increase crop diversity or enable the cultivation of lesser-known plant species.

Crop diversification can spread the costs and risks of the business. By growing more than one crop, the enterprise can be more resilient to risks such as fluctuations in the price of a particular crop or disease (İkikat Tümer et al., 2019).

The knowledge, experience and skills of business owners and managers can increase or limit crop diversity. Well-managed enterprises can successfully grow and market different crops.

Local economic conditions play an important role in how enterprises decide on which crops to grow and market. In addition, government policies supporting agriculture can also affect the product diversity of enterprises.

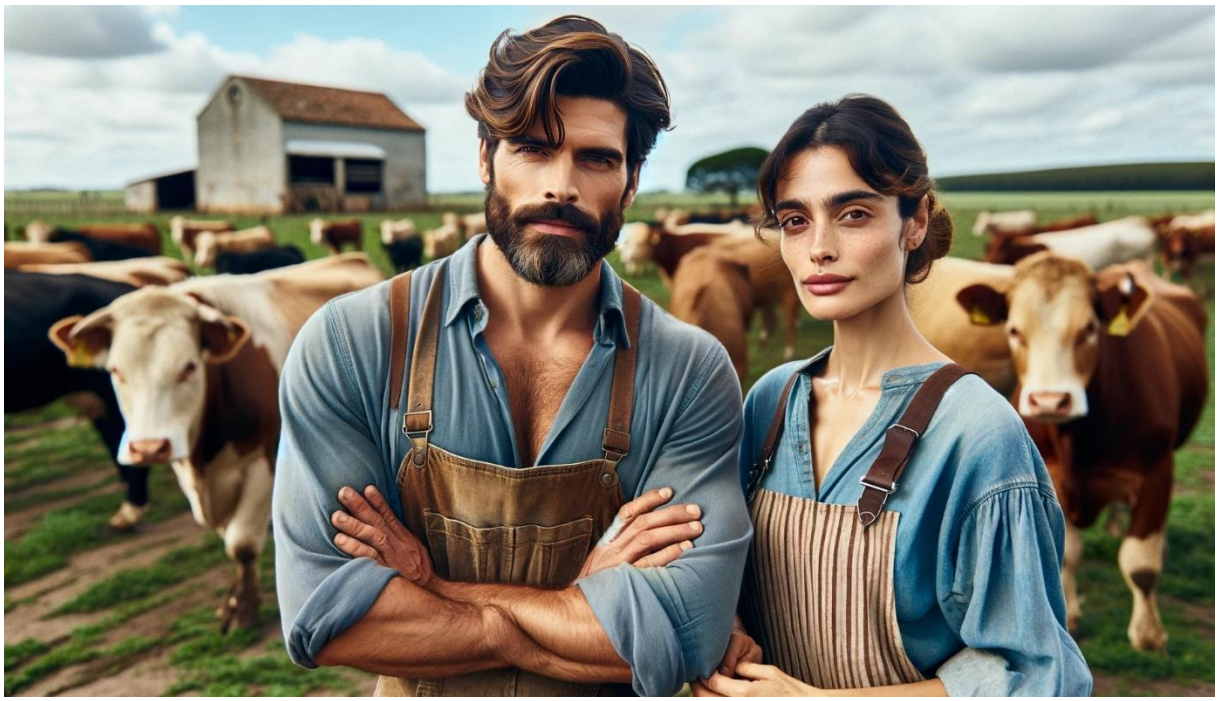
The richness of a country's water resources is also a factor affecting crop diversity. If you have limited water availability, your product diversity will be reduced accordingly. Many people,

especially small-scale farmers, lack access to clean and safe water. To illustrate this with an example: In Nigeria, around 78 million people live without this basic need. In some cases, farmers, especially those in remote rural areas, are unaware of water management and conservation practices, leading to wasteful depletion of this critical resource. The HortiNigeria (2021-2025) program, funded by the Embassy of the Netherlands in Nigeria, aims to facilitate the development of a sustainable and inclusive horticulture sector that contributes to food and nutrition security in Nigeria. With an unwavering commitment to improving food security and nutrition in Nigeria, the HortiNigeria program trains and empowers small and entrepreneurial farmers in water conservation practices through training on eco-efficiency and production practices. The program collaborates with various stakeholders to improve water availability and accessibility in the regions where it is active. In addition, farmers are equipped with knowledge and skills to ensure the economic use of water. For example, mulching and smart irrigation practices are carried out within the framework of the program (IFDC, 2023).

Soil fertility of countries is another factor affecting product diversity. Countries with rich fertile soils have the opportunity to grow a wide variety of products to the extent that climatic conditions allow. In countries with infertile soils, fertilizer use increases accordingly. Excessive fertilizer use causes both the deterioration of the soil structure and the pollution of drinking water resources. In addition, for countries dependent on foreign fertilizers, this situation is recorded as a loss to the country's economy.

In terms of their contribution to the product diversity of countries, M/Rs can contribute to the agricultural labour force and work in the agricultural sector, contributing to the production of various products. However, this impact is often more pronounced at the regional or local level and may not directly affect the diversity of agricultural products across the country.

Moreover, the contribution of migrants and refugees may not be limited to labour. Their cultural background and agricultural experience can also contribute to the adoption of different agricultural practices and the introduction of new agricultural products. The knowledge and experience of M/Rs can bring innovation to the local agricultural sector. This can contribute to growing new crops, improving farming techniques and increasing productivity.



1.2. Ownership structure

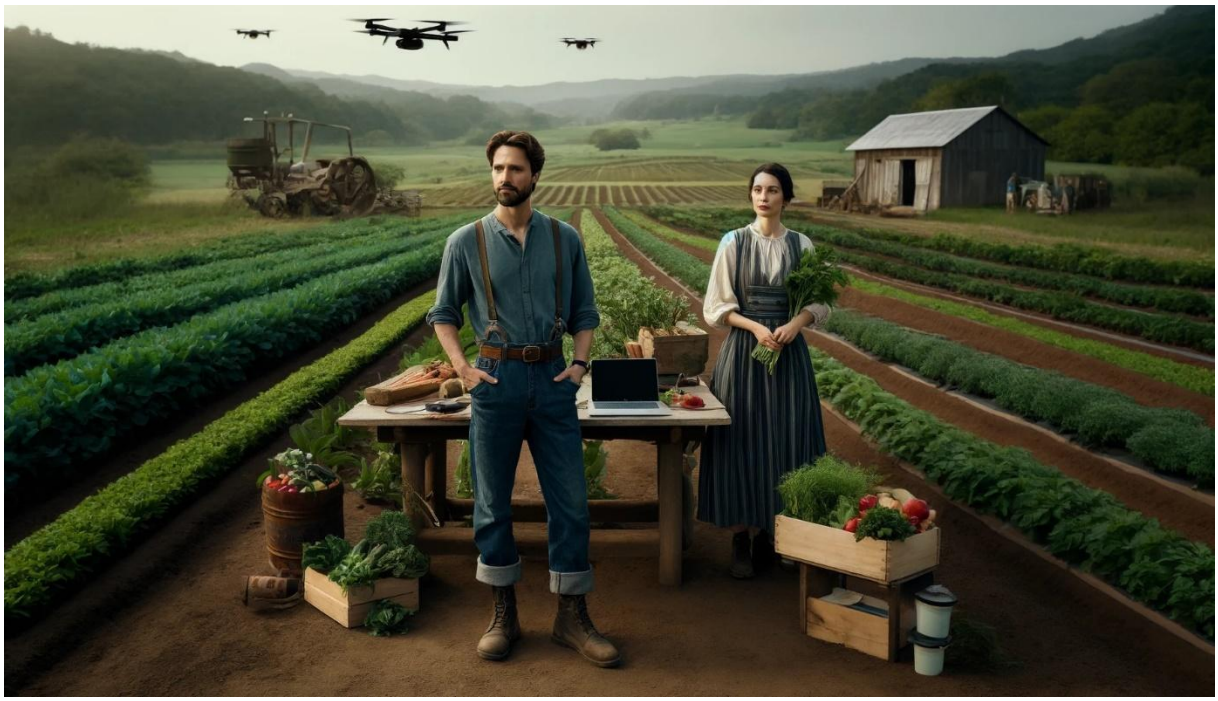
The ownership structure in agricultural enterprises may generally vary from country to country and from region to region. However, common ownership structures in agricultural enterprises are as follows:

a) Family Businesses: In many countries, agricultural enterprises are run by families and ownership is usually shared among family members. Family businesses manage small and medium-scale agricultural activities and are often based on traditional farming practices.

b) Cooperatives: Agricultural cooperatives enable farmers to come together to produce communally and share resources. Cooperatives allow members to market more effectively, reduce input costs and cooperate in production.

c) Companies and Sole Proprietorships: Some agribusinesses are owned and managed by private companies or individuals. These enterprises usually carry out large-scale farming activities and produce for commercial purposes using modern agricultural techniques.

d) State Enterprises: In some countries, agricultural land is owned by the state and operated by state enterprises. These enterprises usually operate in strategic agricultural areas and often carry out large-scale agricultural projects.



1.3. Use of technology

Modern agribusinesses increase productivity by using tractors, irrigation systems, pesticides, genetic modification technologies and other advanced agricultural innovations and technologies. However, traditional farming methods and tools are still widely used in developing and underdeveloped countries. The agricultural sector in Germany, the Netherlands and Spain has developed through modern agricultural techniques and technologies. Irrigation systems, greenhouse technologies and other modern agricultural practices are widely used to increase productivity, while Türkiye and Greece are slightly behind these countries in the use of technology in agriculture.

1.4. Employment structure

Agribusinesses may be operated by seasonal workers, family members and local communities. Some enterprises have permanent employees, while others are more likely to hire seasonal workers.

Although employment in agriculture has been declining year by year, it still accounts for more employment than industry. The International Labour Organization (ILO) estimates that by 2022, 891 million people in the world will be employed in agriculture, representing 26% of total employment of 3.43 billion. This ratio rises to approximately 63% in less developed countries and 3% in developed countries (ILO, 2023).

While large agribusinesses with a global influence are able to obtain more products in a shorter period of time with advanced technology (mechanization in agriculture, smart agriculture, digital agriculture, etc.), they, on the other hand, continue their intensive agricultural activities by renting land in countries where labour is cheap. For example, for cut flower cultivation, which requires intensive labour, many European countries, especially the Netherlands, rent land

in Kenya, Ecuador and Colombia for cut flower cultivation and benefit from the ecological advantages as well as cheap workforce. Similarly, countries such as Spain, Italy and the Netherlands grow crops such as cocoa, coffee, bananas and various spice plants, which cannot be grown economically in their own countries, on rented agricultural lands in South America and Africa (Şahin, 2023).

Informal employment opportunities that arise from structural features of the agricultural sector encompassing lack of supervision, organization and organization often provide easy employment opportunities for potential labour force with M/R status. Similarly, the dependence of the production period on climate and natural conditions time constraints in agricultural activities create the need for seasonal labour.

The ILO estimates that 1.3 billion people in the world are engaged in agricultural activities. Especially in developed countries and some regions, most of the labour force engaged in agricultural activities are migrants (Dedeoğlu, 2018). Although the agricultural sector is an important source of employment worldwide, there is a shortage of agricultural labour in many countries. This situation means that the number of workers working in the agricultural sector is decreasing and the sustainability of agricultural activities is jeopardized. In this context, the integration of M/Rs into the agricultural sector and their participation in employment is of great importance. The agricultural sector often requires low-skilled labour. M/Rs may often be willing to work in agriculture, and these jobs are often for entry-level or unskilled workers.

From the above, it is clear that M/Rs may be employed as agricultural workers, especially in seasonal agricultural work, during harvest times or peak work periods. Many countries use seasonal migration schemes to fill labour shortages in specific sectors, and this approach has proven to be mutually beneficial for M/Rs, source countries and destination countries in many contexts. For example, Spain and Morocco signed a bilateral agreement in 2001 allowing Moroccans to work in the agricultural sector in Spain for up to nine months. Spain has similar programs with Latin American countries such as Honduras, Colombia and Ecuador. Germany has similar agreements with Central Asian countries. M/Rs in Türkiye are also mostly employed in the agricultural sector.

M/R workers employed in the agricultural sector face a variety of challenges around the world, including low wages, violations of the right to rest, the right to organize and bargain collectively, the right to security, lack of social protection, discrimination and xenophobia. These conditions can result from unfair and fraudulent recruitment practices where M/Rs are not adequately informed about the terms and conditions of employment. Labour inspection often does not reach many agricultural workers, especially those working in the informal economy, in remote rural areas, in forests or at sea. M/R workers coming with their families are likely to find her children involved in child labour. The FAO should strengthen its advocacy for decent work opportunities for M/R workers in the agriculture, forestry and fisheries sectors in both countries of origin and destination. This requires strengthening the knowledge base on the employment conditions of migrant agricultural workers and their families, improving their

labour protections and, with partners, increasing their access to safe and regular migration channels.

Women have traditionally made a large contribution to employment in the agricultural sector, especially in underdeveloped and developing countries. Women have been the main source of agricultural labour force with a significant employment rate for centuries in such contexts. In developed countries, men outnumber women in agricultural employment. The proportion of women in agricultural employment is 22.7% in Türkiye, 2.1% in Spain, 1.4% in the Netherlands and France (ILO, 2023). According to official statistics, there are many small businesses in Greece and one-third of them are owned by women, but despite their contribution to family income, women are treated as an invisible force, household managers and mothers, not as real farmers. In Türkiye and Greece, for instance, it is still a widespread belief that agriculture is a male-dominated profession and that women are auxiliary staff, not true farm heads (Charatsari, 2014; Kazakopoulos & Gidarakou, 2003).

1.5. Agricultural sustainability

Today, many agribusinesses are paying more and more attention to the principles of environmental sustainability and organic farming practices. Issues such as soil conservation, water management and biodiversity protection have become important for the operations of modern agribusinesses. The integration of M/Rs into the agricultural sector faces a number of challenges. Factors such as language barriers, cultural differences, level of education and technical skills can complicate the integration process. However, the participation of M/Rs in agricultural employment also offers significant opportunities.

1.6. Providing raw materials to agriculture-based industry

Agriculture-based industry is a sector where agricultural products are processed into industrial products and economic added value is increased. This branch of industry supports various industries by providing raw materials from agricultural products and contributes to economic growth. The agriculture-based industry includes a range of activities related to the processing and value addition of agricultural products. These activities include the processing of agricultural products into raw materials used in food, textiles, chemicals, pharmaceuticals, biofuels and other industries. For example, cereals can be used in the production of flour and starch, cotton in the textile industry, sugar beet in the production of sugar and biofuels. The sustainability of agriculture, productivity, quality and diversity of agricultural products affect the competitiveness of the agro-based industry.

Agricultural productivity is an important factor for the agro-based industry. Technological advances and innovative agricultural practices can increase the productivity of agricultural products and help provide raw materials more efficiently. Innovations such as irrigation systems, plant breeding, fertilization techniques and harvesting technologies can increase agricultural production and provide more raw materials to industry.

The agriculture-based industry is often linked to global supply chains. Agricultural products and raw materials are a highly traded sector around the world. Trade agreements between countries promote the free movement of agricultural products and raw materials, while also playing an important role in the reliability and sustainability of supply chains.

1.7. Marketing and trade

Agribusinesses use various channels to market and sell the products they produce. These channels include wholesale, retail, direct sales, exports and local markets.

Global agriculture is characterized by increased international trade in food products. Increased trade allows agricultural products to reach wider markets, which in turn allows producers to earn higher incomes. Especially in recent years, worldwide trade in agricultural products has accelerated with the increase in international trade agreements and free trade policies.

One of the main positive impacts of the agricultural sector on economic development is the inflow of foreign exchange to the country through foreign trade. In 2022, world agricultural exports amounted to 2 trillion dollars, while world agricultural imports amounted to 2.1 trillion dollars (Ministry of Türkiye Ministry of Trade, 2023).

Very few countries shape the world agricultural sector. The USA is at the forefront of these countries. When evaluated as a whole, the European Union (Germany, the Netherlands and France), China, India and Brazil are ranked as important countries. They are followed by Indonesia, Türkiye, Canada and Russia. Naturally, some of the major players in the world market in agriculture are on the supply side of the market and some on the demand side.

The USA, the Netherlands, Germany, Brazil and China are the world's largest exporters of agricultural products. The share of these five countries in total world agricultural exports exceeds 30%. The world's largest importers of agricultural products are China, the USA, Germany, Japan and France. These five countries account for about 40% of the total world agricultural imports.

1.8. Supports

The fact that agriculture is a very valuable resource but also has a very fragile structure makes it clear that the sector should be constantly protected and monitored (Aydın & Güner, 2020).

Changing climatic conditions, efforts to adapt to competitive conditions and increasing input costs are among the factors that have a high impact on agricultural production. Farmers and large business owners, who are the most important actors in the agricultural sector with its natural, social, economic, internal and external risks, are supported by the state with various supports.

The objectives of agricultural support policies are as follows: raising the income level of the agricultural sector, protecting consumers against price increases, directing production and prices and making income distribution fair, increasing productivity and quality, growing highly

competitive agricultural products, reducing foreign dependency by producing fertilizers and reducing production costs (Comaktekin, 2009; Oğul, 2022).

Today, many countries, irrespective of whether their economies depend on agriculture or not, provide significant amounts of physical and financial support to the agricultural sector. The state intervenes in the market with support policies aimed at reducing price fluctuations in the market (Kıymaz, 2008).

Agricultural support can be considered as policies carried out in order to direct production and maintain economic balances, to encourage producers to continue production, to increase production and to encourage the introduction of new products into production. In this respect, agricultural supports can be categorized into four groups: market price support, direct income support, input-based supports, output-based supports (Boz, 2003):

Market price supports are practices that involve the state's intervention in agricultural product prices with the aim of raising the income level of the agricultural sector, ensuring self-sufficiency in agricultural products and increasing productivity.

Direct income support is defined by the World Trade Organization as a policy instrument that utilises public resources in order to exert positive effects on the income level of agricultural producers (Babacan, 1999).

Unlike other subsidies, **input-based subsidies** are subsidies for inputs that do not directly affect the product but have an impact on the quantity and quality of production. They are in the form of tax reductions, debt and interest write-offs, fertilizer, medicine, seed, irrigation and energy support provided by the state for crop production in certain periods (Aktaş et al., 2013).

Output-based subsidies are a set of subsidies given in return for agricultural or animal products produced.

Agricultural support policies are policies pursued by the state to direct the agricultural sector in line with general economic objectives. Especially in developing countries such as Türkiye, a significant part of the population is still employed in the agricultural sector and the production of basic consumer goods needed by the country's population is met through the agricultural sector. Intervention and agricultural support policies remain inevitable in order to stabilize the sector (Karakaya, 2023).

1.9. Conclusion and recommendations

This handbook section provided an introduction to key issues in agricultural production from a European and global perspective. Agricultural production has an enormous impact on various factors such as food security, economic growth, employment and environmental sustainability.

Food security is becoming increasingly important worldwide. Population growth and changing dietary habits are putting pressure on the sustainability and efficiency of agricultural

production. Inequities in food production and distribution bring problems such as hunger and malnutrition.

In conclusion, agricultural production in the world is a complex and multifaceted issue. The challenges faced in this area are important issues that need to be addressed at the global level. Promoting sustainable agricultural practices, reducing environmental impacts, ensuring global food security and increasing farmers' incomes are critical for the future of agricultural production.

Understanding the importance of agricultural production for sustainability and human food security and taking appropriate measures has become a priority on a global scale. Against this backdrop, training or M/Rs to facilitate employment in the agricultural sector needs to deal with the following issues:

M/Rs are generally employed in the agricultural sector and play an important role in filling the labour shortage. This is important in terms of increasing the production capacity of agricultural enterprises and ensuring the sustainability of agricultural activities. M/Rs can bring different cultures, knowledge and experiences to the agricultural sector. This can increase the diversity of agricultural products, diversity of agricultural methods and practices, and encourage agricultural communities to work together.

M/R agricultural workers often work for low wages and in poor working conditions in many countries. This can lead to violations of workers' rights and inadequate social protection. It is therefore important that policies and programs for the employment of M/Rs in the agricultural sector are well-designed and implemented thoroughly. This will improve both the sustainability of the agricultural sector and the well-being of M/R communities.

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Module 2

Crop Production (KDPAF)

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This chapter gives information about crop production as an essential area of the agricultural sector. Selection of plants and cultivation techniques are essential knowledge bases for farmers to base their practice on.

In this module, you will be informed about

- field crops,
- horticultural crops,
- greenhouse techniques,
- and vineyard cultivation systems,
- learn about good agricultural practices.

2. Crop production

2.1. Field crop cultivation

Field crops are plants that are usually cultivated by humans for commercial purposes and have a wide diversity. They are usually grown for a variety of purposes such as food, feed, oil, fiber and industrial raw materials. Field crops are often grown on a large scale in agricultural areas and are an important source of food worldwide.

Cultivation of field crops requires expertise in many areas such as plant cultivation techniques, disease and pest control, and harvesting methods. Agricultural machinery and technologies used in this production area are also constantly evolving, which increases productivity. In addition, sustainable agricultural practices are becoming increasingly important, as they are critical for conserving natural resources and maintaining productivity.

Field crops are the main source of food for humans and animals. Maize, alfalfa, clover, damson, sainfoin, vetch, vetch, vetch, vetch, clover, forage peas, sorghum, sudan grass, legumes and wheatgrass, forage crops directly and other field crops indirectly meet the needs of the feed industry. Meadows and pastures are of great importance as natural resources that meet the roughage needs of animals used especially in meat and milk production (Baydar, 2021).

Oil and industrial crops play an important role for humanity and are used for a variety of purposes in many different industries. They are usually grown for oil, fibre, biofuels or other industrial purposes.

Field crops can be categorised into four groups according to their product groups: cereals, edible legumes, industrial crops and forage crops. Meadows and pastures, which are widely used in animal nutrition, are also included in field crops (Baydar 2021).

In relation to migrants and refugees (M/Rs), there are several important points regarding field crops. First, M/Rs are often found among workers in the agricultural sector. They contribute to the cultivation of field crops by working in various jobs in agricultural areas. In addition, M/Rs can often work as seasonal workers in the agricultural sector, which makes them play an important role in the processes such as planting, maintenance and harvesting of field crops.

2.2. Field agriculture systems

Field farming systems are a concept that includes various technologies used in open fields where agriculture is practised. These systems have been developed to increase productivity in agricultural production, reduce labour force, ensure more efficient use of natural resources and support environmental sustainability. Some of the Field Agricultural Systems are as follows:

Traditional Agriculture: In this system, agricultural operations are carried out manually or using simple agricultural tools. For example, tillage, sowing, irrigation and harvesting are carried out using traditional methods.

Modern Agriculture: By using modern agricultural machinery such as tractors, harvesters, driverless tractors, farming operations are automated and become less dependent on manpower. These machines speed up farming operations and increase productivity.

Precision Agriculture Technologies: Precision agriculture applications, supported by technologies such as GPS, sensors and imaging systems, enable more efficient use of resources in agricultural areas. These systems increase productivity and reduce environmental impact by applying different amounts of fertiliser, water and pesticides to specific areas of the fields.

Integrated Pest Management: This is an approach that includes alternative methods such as biological control, cultural control and physical control in addition to chemical control methods and is used in field agriculture to control pests. This method aims to keep pest populations under control while minimising environmental impact.

Organic Agriculture: Organic (ecological) agriculture is a form of agricultural production that is carried out with the use of permitted inputs within the framework of regulations without using chemical inputs and pesticides in production, and every stage from production to consumption is under control and certified (Gülbağ & Ilgın, 2016).

The aim of organic agriculture is to protect the environment, plant, animal and human health to the maximum extent without polluting soil and water resources and air (Michelson et al., 1958).

Issues to be considered in field crops cultivation

Soil Analysis and Preparation: Soil, which is the basis of plant cultivation, has a great influence on the growth and productivity of plants. Regular soil analysis should be carried out to determine soil properties and necessary arrangements should be made according to the results of the analysis.

Tillage in the cultivation of field crops is one of the basic steps for efficient production. Good tillage includes aeration of the soil, drainage of water, supporting the development of plant roots and controlling harmful organisms in the soil.

Tillage methods include various tools such as harrow, plow, disc harrow, hoeing. However, which method to use depends on the crop type, soil conditions and farming practice. For example, direct sowing minimises tillage, while conventional sowing may require more intensive tillage. Choosing the right tillage method is important to ensure high crop yields.

Sowing and Planting: Sowing can be described as sowing the seed in the soil at a certain time, depth, frequency and amount. Planting can be described as planting production materials such

as tubers, onions, rhizomes, cuttings, seedlings and saplings into the soil at a certain time, depth and frequency (Baydar, 2021).

Crops such as cotton, barley, wheat, maize, chickpeas and lentils are planted with seeds as production material. Field crops whose production material is seedlings (such as tobacco and thyme), saplings (such as oil rose and hops), tubers (such as potatoes and orchids), bulbs (such as saffron and snowdrops) and cuttings (such as lavender and rosemary) are planted.

There is an optimum sowing or planting time for each plant species. This timing should be observed and suitable conditions should be provided.

The most suitable planting method in field crops cultivation is sowing in rows. Planting plants in rows facilitates maintenance work, helps plants to benefit equally from water, nutrients and light, allows maintenance work such as hoeing, fertilising, spraying and harvesting to be done by machine (Baydar 2021).

Water Management: Ensuring that plants receive the right amount of water is critical for healthy growth and efficient crop yields. Irrigation systems and irrigation timing should be carefully planned. Some common irrigation methods can be listed as follows:

Drip Irrigation: In this method, water is dripped directly into the root zone of the plant. This ensures that the water reaches directly to the area where the plant needs it and minimises water waste. It is also easier to control the moisture level on the soil surface when irrigating with this method.

Sprinkler Irrigation: In this method of irrigation, we spray water under high pressure to deliver it to the plants. This is often used in large field areas and is ideal for providing plants with an even amount of water. However, this method has the disadvantage that the water evaporates and is scattered by the wind.

Surface Irrigation: In this method, we spread water over the surface of the field to reach the plants. These include simple irrigation canals or irrigation ponds. This method is preferable because of its low cost and simple implementation. However, it has disadvantages such as water evaporation and soil erosion.

Fertilisation: Fertilisation is important to provide the nutrients plants need. However, the right amount and type of fertiliser should be determined according to the needs of the soil and the plant. Fertilisation after soil analysis is very important in terms of preventing waste of resources. The most commonly used fertiliser types in field crop production are NPK fertilisers, which generally contain nitrogen (N), phosphorus (P), and potassium (K). These are used to meet the basic nutrient needs of plants. The timing of fertilisation depends on the type of plant, growing conditions and regional factors. However, in general, the following timings are important:

Disease and Pest Control: Field crops are susceptible to various diseases and pests. Therefore, it is important to use appropriate methods to recognize, prevent and control diseases and pests. Methods of controlling diseases and pests in field crops are generally applied within the framework of integrated control approach. This approach considers chemical control methods as a last resort and prioritises biological, cultural and physical control methods. Some of the methods used in the control of diseases and pests in field crops can be listed as follows:

Cultural Control: It is the suppression of harmful organisms through agricultural practices, preventing them from causing damage or reducing their damage.

Plant diversity and rotation: Growing different plant species in sequence on the same field land prevents the spread of pests and diseases.

Correct planting time: Selecting appropriate planting times that can be effective in pest control.

Drainage: Proper drainage of field water prevents the spread of diseases and pests.

Field cleaning: Removing crop residues and weeds reduces the spread of pests and diseases.

Organic matter application: Increasing the organic matter content of the soil can increase plant resistance to disease.

Physical barriers: The use of physical barriers to keep pests and diseases away from plants, e.g. traps, barricades, etc.

Temperature control: The spread of pests can be controlled by controlling temperature and humidity in greenhouse environments.

Use of predators and parasites: Use of natural enemies of pests, e.g. beneficial insects.

Use of pesticides: The use of pesticides to control pests and diseases. However, this method should be considered as a last resort in integrated control and must be applied correctly.

Harvest, Threshing and Storage of Field Crops: Harvesting plants at the right time and in the right way increases product quality and durability. Harvesting methods for field crops may vary depending on the type of plant, growth period and quality of the product. In general, agricultural products are harvested when the product reaches maturity and the highest quality and yield can be achieved. We can explain the harvesting methods commonly used in some field crops as follows:

Cereals (Wheat, Barley, Corn, etc.): Cereals are harvested after ripening. Harvesting is usually done using mowers (harvesters). The mower cuts the stem of the plant and collects the grains.

Legumes (Beans, Peas, Lentils, etc.): Legumes are usually harvested by hand or with mechanical harvesters. Ripe legume fruits are picked by hand or cut by machine.

Potatoes: Potatoes are allowed to dry completely before harvesting. Potatoes are then harvested by hand or mechanically. Mechanical harvesters dig the soil to remove the potatoes and clean them with a conveyor system.

Cotton: The cotton plant is harvested using mechanical harvesters. Harvesters pick cotton fibres from the fields with cotton pickers. The cotton seeds are then separated and the fibres are extracted.

Sugar Beet: Sugar beet harvesting is done after the roots have matured. Harvesting is usually done with machines. The machines pull the beets out from under the soil and clean the leaves.

Post-harvest storage conditions also affect the quality of the product. Grain crops, especially oilseeds, are difficult to store for long periods. On the other hand, it is possible to store cereals,

pulses and seeds of fodder crops for a long time since they have less water and oil content (Baydar, 2021). Storage of field crops is important to maintain the quality and durability of the products. The issues to be considered in storage are as follows:

Humidity control: Moisture can cause spoilage and mould growth in crops during storage. Therefore, the humidity level of the storage environment should be checked regularly and adjusted accordingly.

Ventilation: Storage areas should be well ventilated. This reduces the risk of spoilage by removing hot air and moisture that accumulates on the products.

Temperature control: The appropriate temperature range for storing field crops should be determined and maintained within this range. Excessive heat or cold can adversely affect the quality of the produce.

Pest control: It is important to control pests and insects in storage areas. For this purpose, appropriate insecticides or other control methods should be used.

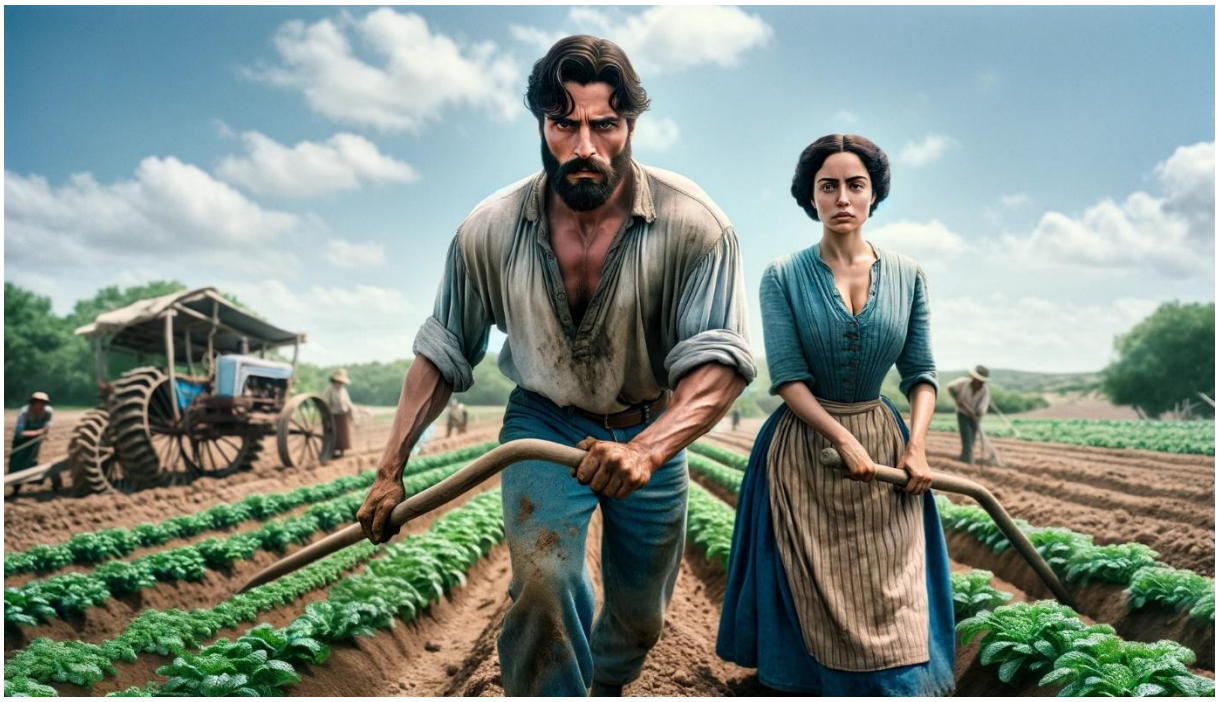
Storage duration: The storage period of products should be kept as short as possible. Long-term storage may reduce the quality and nutritional value of the products.

Storage procedures that pay attention to these issues can increase productivity and minimise crop losses by ensuring long-term preservation of field crops.

Marketing in Field Crops: Marketing of the products grown is important for the sustainability of the enterprises. Research on market demands and prices should be conducted and products should be offered to the market with the right marketing strategies. The main purpose of marketing is to ensure consumer satisfaction and consumer confidence in the product in the long term. Today's understanding and concept of marketing aims to serve the demands of the society and the customer by moving away from a sales concept alone. For this purpose, the supply of goods, pricing, sales development and distribution planning should be carried out programmatically (Anonymous 2015).

Marketing is as important as cultivation in field crops. Producers should have information about the market situation before they start growing their crops and they should choose the seed of a product that is sought after in the market. Thus, they will have the opportunity to get more profit share from their products. Marketing methods for field crops can include wholesale and retail sale of products. The methods used to market field crops may vary according to local market conditions, crop type and the farmer's marketing strategies.

Case Study 1: Maria and Juan



Introduction: Maria and Juan rented a field in the country where they were refugees. They wanted to grow field crops. But they found it difficult to decide what to grow and how to grow it. This could affect the productivity and profitability of their farm and a wrong decision could lead to financial losses.

Challenge: For Maria and Juan to decide to start growing field crops, it is important that they follow some basic steps at the beginning. What will be easy to market in their country? What equipment do they need and how to grow the crop?

Solution: Maria and Juan researched the market in the area where their farm is located. It is important to identify which varieties are in high demand, the competition and prices. They then commissioned a soil analysis. This analysis helped them to determine whether the soil was suitable for the crop to be produced. It is important to consider factors such as planting, irrigation, fertilisation and labour costs. They decided which planting system to use according to the climate and sun exposure of the cultivation location. However, they also conducted a risk analysis as every production involves certain risks. Factors such as diseases, pests, and weather conditions can affect the success of production. These risks should be assessed and appropriate measures should be taken. Finally, they decided to get information from experts on field crop cultivation (sowing, disease and pest control, spraying, fertilisation, marketing, etc.). After the information they received from the experts, they decided to grow pepper, which is consumed as a spice, which is cultivated in the region and which they learned that they would earn high income from the unit area. Then they decided to rent the necessary tools and equipment for cultivation. To realise this, they sought financing. They decided to do contract farming with a pepper factory that would turn the pepper into a spice. As a result of the contract, the managers of the pepper factory, and Maria and Juan agreed on a price and signed a contract before production that they would bring all of the product they grew to the factory. In return, Maria and Juan received the necessary financing from the pepper factory for their cultivation. Through contract farming, they were able to market their products.

Impact: Maria and Juan, who grow spicy peppers and have improved themselves in this field, have increased their income by choosing a product with high added value by getting more product per unit area. Seeing that Maria and Juan had secured financing through contract farming, the refugees decided to start producing in the same way. They made a contract farming agreement with a spice factory. Thus, the owner of the spice factory determined the amount of product he would buy in advance. He made a sales plan for his products. The refugees also gained access to finance through the contract farming agreement.

Conclusion: Maria and Juan's decision to grow spicy peppers and contract farming on their farm, following steps such as market research, cost analysis, and risk analysis, allowed them to increase their income. They also set an example for other refugees. This simple but effective system enabled them to make informed decisions, leading to sustainable growth and increased profitability of their agricultural enterprises.

2.3. Horticulture crop cultivation

The horticulture sector includes the production and marketing of fresh fruits, vegetables, vineyards and ornamental plants, as well as their utilisation as raw materials for industry. Horticultural crops contribute to the consumption of fresh fruit and vegetables as well as processed food products. It is also a rich and important sector for countries with ornamental plants that decorate and beautify the places we live in.

Horticultural crops, which are important for the national economy and are a source of livelihood for the people, cover a significant part of the agricultural lands in the world (Turhan et al., 2019).

The Importance of Horticultural Agriculture

Horticultural crops are an important part of both our daily lives and our economy. They play a critical role in food safety by meeting our need for fresh fruit and vegetables, supporting our healthy diet and providing raw materials for the processed food sector. In addition, ornamental plants aesthetically enrich the spaces we live in, beautify the environment and provide psychological relief to people. Horticultural plants have an important place in agriculture and landscaping and are of great economic and social value.

Plants grown for horticulture are generally vegetables for human consumption (tomato, pepper, cucumber, lettuce, leek, carrot), fruits (apple, pear, peach, plum, cherry, raspberry, mulberry, strawberry, pomegranate, grape), medicinal aromatic plants (mint, parsley, basil, thyme, dill, basil, sage) and some ornamental plants (rose, lavender, lily, honeysuckle, geranium, begonia, violet, orchid).

These plants are widely preferred plants for garden cultivation. Depending on factors such as climatic conditions, soil structure and individual preferences, different plants may be preferred.

Horticulture requires a large labour force. Those working in the agricultural sector can take part in many stages from seed planting to harvest time. This increases employment opportunities.

Although the agricultural sector is an important source of employment worldwide, many countries are experiencing labour shortages. This situation leads to a decrease in the number of agricultural workers and jeopardises the sustainability of agricultural activities. In this context,

the integration of M/Rs into the agricultural sector and their participation in employment is of great importance.

M/Rs form an important part of the labour market in host countries, contributing to economic growth. They often work in a variety of sectors, meeting the need for labour and increasing the dynamism of the labour market. The employment of M/Rs often provides employers with diversity and access to different skill sets, increasing the competitiveness of their workplaces. Moreover, the employment of M/Rs stimulates social and economic development by bringing new ideas, cultural diversity and innovation to local economies. Thus, the employment of M/Rs not only improves individuals' own well-being, but also has a positive impact on the economic and social development of host countries.

Horticulture has the potential to effectively utilise natural resources and promote sustainable agricultural practices. When the right farming methods are used, soil quality can be maintained, water resources can be managed effectively and biodiversity can be supported. Horticultural crops are packed with various vitamins, minerals and antioxidants that are essential for humans to maintain a healthy diet (Ilgın, 2019). Therefore, horticulture plays an important role in supporting a healthy lifestyle of societies.

The fresh fruits and vegetables produced in the world are a source of raw materials for the agricultural industry in large quantities. The processed fruits and vegetables produced provide high amounts of added value to the economy of countries in terms of both domestic consumption and exports. Fruit and vegetable processing industry consists of various sub-industry branches. These are fruit juice industry, canned fruit and vegetable industry, frozen fruit and vegetable industry and fruit and vegetable drying industry. For example, dried fruits are one of the traditional export products in Turkey and Turkey ranks first in the world in dried fig, apricot and grape exports (Ilgın, 2017).

Horticulture is an important economic activity for many countries. Those working in this sector earn income through the production, sale and marketing of products. At the same time, agricultural products can be exported to contribute to the national economy.

According to the Food and Agriculture Organisation of the United Nations (FAO) data for 2021; 747.8 million tonnes of fresh fruit production on 56.3 million hectares, 1.1 billion tonnes of fresh vegetable production on 58 million hectares, 162 million tonnes of citrus fruits on 10.2 hectares, a total of approximately 2 billion tonnes of fresh fruits and vegetables were produced on 124.5 million hectares in total.

As of 2021, China was the country producing the highest amount of fresh fruits and vegetables in the world with 853.9 million tonnes of production. China has a 41% share in the world fresh fruit and vegetable production. This country is followed by India (245.8 million tonnes), Turkey (51.6 million tonnes), USA (50.7 million tonnes) and Brazil (48.3 million tonnes) (Meyve Sebze İhracatçıları Birliği, 2023).

If we look at the situation of ornamental plants, which are other important cultivation branches of Horticulture; 77% of the world's ornamental plants production areas (580.000 ha.) are located in the Asia/Pacific region. The most important producers among Asian countries are China and India. Central and South American countries account for 11 per cent of the world ornamental plant production. Mexico, Colombia and Ecuador in Central America and Brazil in South America are important producer countries.

The most important advantages of these countries are favourable climatic conditions and low land and labour costs. European Union countries provide 8% of the world's ornamental plants production. The most important producer countries among these countries are Italy, the Netherlands, Germany and Spain. The European Union is the region with the highest productivity per hectare in the world (Turkish Flowers, n.d.).

Systems Applied in Horticulture

Horticulture can be carried out using various systems and methods. Some of the systems commonly used in horticulture are as follows:

Traditional Soil Farming: This is the traditional farming system where horticultural crops are sown and grown directly in the soil. Soil cultivation is usually carried out in open fields and is used in areas with suitable soil conditions for various plants.

Greenhouse Farming: Greenhouses allow plants to be grown in a controlled environment. Greenhouse agriculture enables year-round production regardless of climatic conditions. Greenhouses are particularly used in areas with seasonal or climatic challenges.

Soilless Agriculture: Soilless agriculture: It can be defined as an advanced production technique in which plant nutrients and water necessary for the development of plants are used in the root zone, using different solid or liquid media other than soil.

Production directly in nutrient solution is defined as water culture, while production in solid media irrigated with nutrient solution is defined as solid media culture. Solid media culture is the most widely used soilless farming method commercially in the world. Plants are grown in media enriched with nutrient solutions such as peat, coconut waste (cocopite), rice husk, mushroom compost and bark.

Aquaculture, on the other hand, is a system in which plants are grown directly in nutrient solution and is applied in three ways: stagnant water culture, flowing water culture and aerophonic.

Organic Agriculture: Organic farming is the process of growing plants using natural methods without the use of chemical fertilisers, pesticides or herbicides. Organic agriculture aims to obtain healthier products for human health while protecting soil and environmental health.

Good Agricultural Practices (GAP): Refers to an approach based on certain standards and practices to ensure the environmental, social and economic sustainability of agriculture and to improve food safety and quality. Good Agricultural practices include a set of guidelines and principles for farmers, producers and agribusinesses and focus on food safety, environmental protection, worker health and safety, and the social and economic well-being of society.

Issues to be considered in horticulture

It is necessary to know the characteristics of the plants to be grown. How often a plant needs irrigation, its need for shade or sun, its resistance to wind or the benefits it provides from the wind are important issues to be emphasised. In addition, knowing how a plant relates to other plants allows you to grow consciously in a mixed garden. There is a benefit/harm balance in the relationship between plants. It is based on this balance that you should decide whether to plant them together or separately. Doing detailed research on each of these issues and evaluating

the negative/positive effects they may have on the plant will also be useful for your design. For example, in areas with light winds, wind improves photosynthesis by increasing plant respiration and transpiration, and increases pollination and therefore fruit set. However, high wind speeds (10m/s and above) can be damaging to plants, increasing transpiration, disrupting the plant's water balance and causing scorching of the leaves. It is very important to determine the wind prevailing points and plant your plants accordingly to ensure the right conditions, especially for perennial plants. You can determine the appropriate conditions by examining the life cycle of the plants you are going to grow: germination, young plant formation, flowering, pollination and re-fertilization. This helps you to recognize the individual processes for each plant and to intervene correctly. The most important issues to be considered in horticulture are the following:

Location and orientation: In order for horticultural crops to grow healthily, to facilitate maintenance and to increase productivity, careful attention should be paid to the choice of location and orientation.

Location refers to the geographical position of the area to be cultivated and orientation refers to the direction in which a sloping land faces. Whether a place is a mountainous region, hill, plain or valley is very important in the formation of the unique climatic characteristics of that place. For example, plains and valleys are the most favourable places both because they have fertile soils and because their climatic conditions are suitable for the cultivation of horticultural crops. Especially in fruits and vineyards, the characteristics of the location are very effective in the formation of the variety's distinctive taste, aroma and colour. For example, the coloration of fruits is more beautiful in high altitude plateau areas.

The effect of direction in horticulture varies according to the location of the vineyard-garden and the type of plant. This is based on the fact that each direction does not have the same potential for insolation and illumination and air movement, and this situation affects the plants differently according to their growing periods. Therefore, each direction has positive and negative effects in terms of cultivation. For example, since the south and south-west directions receive more sunlight, the air and soil warm up earlier in the fields facing this direction, resulting in early flowering and early ripening of the fruits. Areas facing this direction are important in terms of earliness. However, in regions where late spring frosts are effective, there may be danger in terms of frost damage during the flowering period, especially in early flowering fruit species such as almonds, plums, peaches and apricots, and during the young shoot periods in fruits and vineyards (Ağaoğlu et al., 2013).

Soil Selection and Soil Preparation:

Soil is important for plants in two ways. The first is that it is a support environment where plants can grow and develop by holding on with their roots; the second is that it provides water and nutrients for plants to take up with their roots. Factors such as the physical structure of the soil, ground water level, pH, salinity and nutrient content are effective in the fulfilment of these tasks for plants.

When the physical structure of the soil is mentioned, the size of the particles in the soil and the proportions of stones, sand, gravel and clay are taken into consideration and soils are named according to the proportions of these contents. Soils containing about 10 per cent organic matter are called ‘mineral soils’ and those containing more organic matter are called ‘organic soils’.

The soil in which horticultural crops will be cultivated is required to be deep, permeable, moist, loamy in terms of structure and rich in nutrients. However, horticultural crops may also have special soil requirements according to the plant species or even variety.

Loamy soils are the most preferred soil group for horticultural crops. While the sand in loamy soils makes the soil structure permeable and breathable; clay causes the soil to be tight, moist and impermeable. Therefore, it is preferred to grow deep-rooted plants such as almonds, apricots and vegetables whose tubers and roots are consumed such as potatoes, radishes and carrots in sandy-loamy soils, while it is recommended to grow more shallow-rooted fruits and vegetables such as plums and plants that like high soil moisture in clay-loamy soils.

Sandy soils are loosely structured due to the presence of more than 60% sand, have good aeration but low water holding capacity and are poor in nutrients due to easy washing. However, this type of soil can be made suitable for the cultivation of some garden plants by adding nutrients and establishing a good irrigation system. Especially herbaceous plants with shallow roots such as strawberries and vegetables whose roots are eaten such as carrots can be grown well in these soils and they are also suitable for seedlings and nursery.

Clay soils contain more than 50% clay, therefore these types of soils are heavy textured soils. Clay soils are poorly aerated, compact, have high water and nutrient retention capacity and poor drainage. These types of soils are defined as cold soils and do not pose a risk of frost while causing lateness in fruit growing. In places where the groundwater is high, this type of soil is not suitable for the cultivation of plants with deep roots, as the aeration of these soils is not good. When fruit growing is planned on such heavy textured soils, attention should be paid to the choice of rootstock; for example, for fruit species such as almonds and apricots, it is recommended to use plum rootstocks with relatively shallow roots.

Apart from these soils, stony and gravelly soils, which contain about 50% soil, can be used especially in early vegetable cultivation because they have a permeable structure and increase soil temperature.

Organic soils other than mineral soils are not directly used in horticultural crops since they contain up to 80% pure organic matter. However, they can be used in various mixtures in seedling and soilless culture cultivation and in the improvement of infertile soils.

In the soil preparation phase, the soil is loosened to a depth of 60 cm to enrich it and help improve the soil structure. The ideal soil structure has both spaces for air and water to move freely and soil particles that are tightly packed together. Air supports plant roots and the soil organisms that give life to the soil and increases the availability of nutrients for plants. Aerated soil retains water better and requires less watering than compacted soil. It also promotes healthier plant growth by aiding root spread and minimises erosion.

Soil pH refers to the acidity and alkalinity of the soil and directly affects the usefulness and uptake of plant nutrients in the soil. pH 7 indicates that the soil reaction is neutral, below this value the soil is acidic and above this value the soil is alkaline (basic). Mostly ideal pH limits for horticultural crops are between 5.5 and 7.5. However, plant species and even varieties have different sensitivity to soil pH in terms of their growth and development.

For example, blueberry (lychee) plants can be grown in acidic soils with a very low pH of 3.5-4.0, while on the contrary, almonds and olives can be grown in highly alkaline soils with a high pH of 8.0-8.5 without toxic effects.

Soil salinity, which can occur due to excessive and incorrect fertilisation, excessive irrigation, irrigation with salty groundwater and poor drainage, is another soil factor affecting the cultivation of horticultural crops (Turhan et al., 2019).

Plant Selection: In the establishment of gardens, care should be taken to select species and varieties that can be sold at high prices in domestic or foreign markets and that will bring the highest income, taking into account the economic return as well as ecological factors.

Fruit and vineyard gardens should be established with early maturing varieties in warm regions and late maturing varieties for high altitude areas. When selecting varieties, the evaluation of the variety for table, drying, wine, must, fruit juice and canning industry, etc. should be taken into consideration.

Pollination and fertilisation of species and varieties within horticultural crops is another issue to be considered before establishing a garden. While some of the varieties within these species are self-fertile, that is, when pollinated with their own flower powder, some of them require foreign pollination for sufficient fruit set. This situation should be taken into account in the selection of varieties and distribution of varieties in the garden and it should be ensured that there are enough pollinator varieties in the garden in sufficient number and in the appropriate place (Eti et al., 1996; Eti et al., 1998; Ilgın et al., 2007; Çalışkan et al., 2017).

Pest and Disease Control: Preventive measures should be taken to prevent pest organisms and diseases from damaging the garden. This may include regular checks, the use of natural enemies and, where necessary, the use of organic pesticides.

Fertilisation: It is well known that plant nutrients are essential for the physiological and metabolic activities of plants and thus affect yield and crop quality. In this sense, the amount and content of nutrients in the soil should be determined by various analyses before starting cultivation and according to the results obtained, the soil should be improved in line with the request of the plant species to be grown.

The nutrients in the soil are present in the solid, liquid and gaseous parts of the soil and the solid part is the source of plant nutrients. Inorganic particles of the solid part are the source of potassium, sodium, calcium, magnesium, iron, manganese, zinc and cobalt.

Nitrogen, phosphorus and sulphur in the soil are composed of organic particles. The liquid phase of the soil is called soil solution and forms the form used by plants as it contains nutrients in a dissolved form (Ilgın and Dikici, 2015).

Irrigation: The importance of irrigation in fruit trees can be summarised as follows:

Irrigation provides the water needed for the healthy growth of fruit trees, flowering and fruit ripening. Without sufficient water, fruit trees cannot achieve adequate growth and fruit development and productivity decreases.

Adequate irrigation makes fruits bigger, juicier and tastier. It also improves their quality by preventing them from cracking or drying out.

Adequate irrigation makes fruit trees more resistant to diseases and pests. Trees under drought stress often become more susceptible to diseases and pests, while well-watered trees are healthier and have the ability to fight diseases.

Irrigation supports the development of the root systems of fruit trees. Fruit trees with a strong root system are able to take up more water and nutrients, which allows for healthier and hardier plants to grow.

Mulching: All materials used to cover the soil are called mulch. Stalks and straw of cereals, leaves, sawdust and shells of trees, ground pruning residues, paper scraps, stones and pebbles, plastic covers such as polyethylene or PVC in different colours can be used as mulch materials. The benefits of mulching can be summarised as follows: Mulching

- prevents moisture loss, increases the diversity of above- and below-ground microbiological habitats (bacteria, fungi, arthropods, nematodes and protozoa),
- prevents weeds as it blocks light,
- the mulch particles placed on the soil are continuously transformed on the surface in contact with the soil and continue to nourish the soil during decomposition,
- reduces the effect of erosion during heavy rainfall,
- prevents soil compaction.

Pruning: Pruning and training are cultural practices carried out during the active development (summer period) and resting (winter period) periods in order to give fruit trees a smooth and solid structure, to ensure that the trees reach the yield age in a shorter time and to provide quality and abundant products for a long time. The benefits of pruning can be summarised as follows:

- done correctly, pruning can increase the fruit yield of the fruit tree. Pruning creates a healthier and more balanced fruit set by removing unnecessary branches and leaves to focus the tree's energy on fruit production,
- pruning can make the fruits on the fruit tree bigger, healthier and tastier. A tree with fewer branches gives the fruit better exposure to sunlight and can improve fruit quality,
- pruning diseased or pest-affected branches can prevent the spread of diseases and pests. Also, ventilating the interior of the tree and allowing sunlight to reach the interior can prevent diseases and pests from establishing,
- pruning allows the fruit tree to reach the desired shape and size. By shaping the branches and trunk of the tree, it improves the aesthetic appearance of the tree and makes it easier to care for,
- proper pruning can make it easier to maintain the tree. A tree with fewer branches can make spraying, watering and other maintenance more effective and efficient.

Harvesting: Achieving healthy and tasty fruit is critical to increase crop productivity and maintain crop quality. Fruit should be harvested at full maturity. This ensures that the fruit is tasty, nutritious and at optimum ripeness. Harvest time varies depending on the type and variety of fruit. Colour, changes in textures and smells can help determine the right time to harvest. When fruit harvesting is carried out with careful planning and correct practices, positive results can be achieved in terms of both plant health and product quality. These factors play an important role in achieving success in the fruit growing process. The points to be considered when harvesting fruit can be summarised as follows:

- products destined for near markets are usually harvested at a more mature stage, while produce destined for distant markets can be picked at an earlier stage of maturity. This ensures that the produce will hold up better during transportation,
- the time of harvest is also important. Especially in hot weather conditions, it is preferable to harvest early in the morning. This preserves the freshness of the products and prevents them from being adversely affected by hot weather conditions,
- the weather conditions on the day of harvest should also be taken into account. For example, a rainy day may delay the picking of fruits or vegetables or adversely affect the picking process,
- during harvesting, there are several situations that workers should be aware of. These include being careful when harvesting produce, not damaging fruit or vegetables when harvesting, maintaining hygienic conditions and using appropriate protective equipment,
- packaging and wrapping of harvested products is also important. Appropriate packaging materials should be used and hygienic conditions should be considered to ensure that produce is protected during transportation and storage,
- it is important to keep track of which field the harvested products came from and when they were harvested. This is important to ensure the quality and safety of the products and is necessary to meet traceability requirements.

Storage

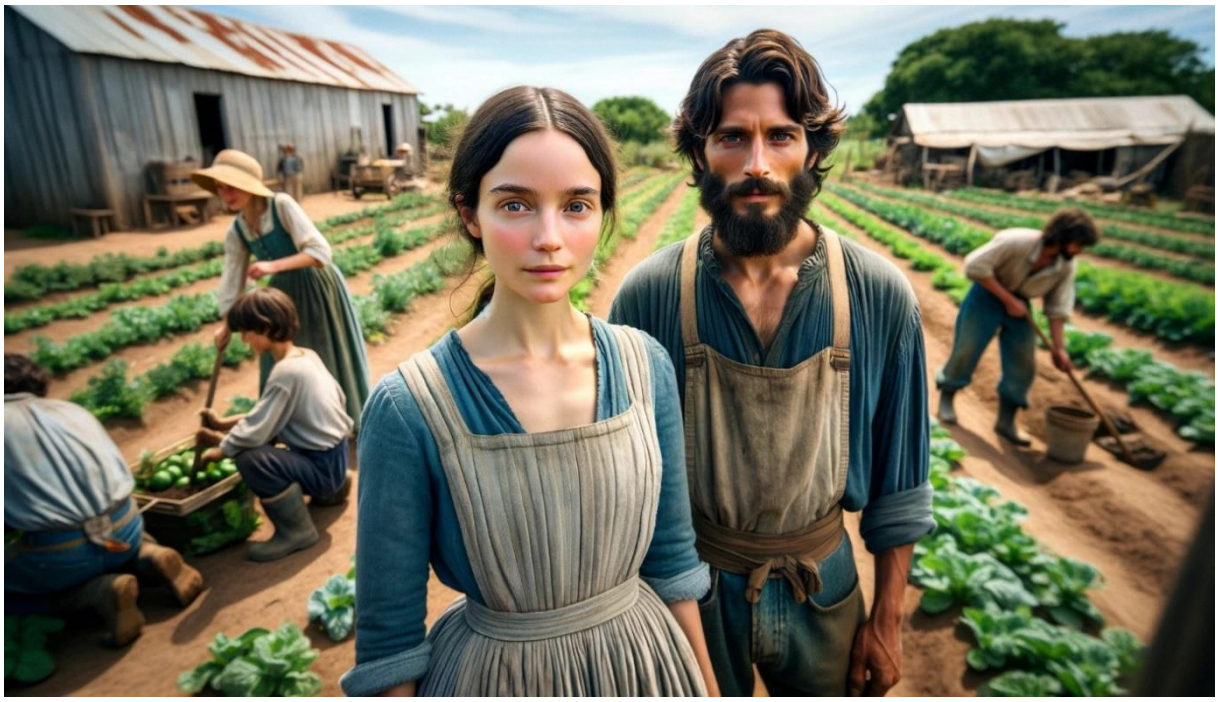
Preservation in horticulture is a very important factor in maintaining the freshness and quality of harvested fruits and vegetables. The importance of preservation in horticulture is based on the following factors:

- preservation ensures that harvested fruit is brought to market fresh and of good quality. This results in a more satisfying and attractive product presentation to consumers,
- preservation techniques improve the marketing and sales process by extending the shelf life of fruits. Fruits that stay fresh longer can reach wider markets and stay on the shelves longer,
- preservation helps reduce fruit loss. Well-preserved fruit is less damaged and less spoiled during storage and transportation, which reduces crop loss,
- preservation techniques preserve the freshness, nutritional value and flavour of fruit. This provides consumers with better quality and nutritious fruit,
- preservation techniques can be applied to suit different market needs. For example, techniques such as cold storage or atmosphere-controlled storage can be used for fruit to be transported long distances,
- preservation stabilises fruit supply. Even if there is a surplus at harvest, preservation techniques can be used to store the surplus and make it available for sale later,
- preservation provides economic benefits for fruit farms. Fruits that stay fresh for a long time can be sold at higher prices and increase the income of the enterprises,
- preservation ensures sustainability of fruit harvest and consumption. Well-preserved fruit helps to produce less waste and use resources more efficiently.

Marketing and Sales

If the cultivated fruits and vegetables are not standardised in a good way and are not placed in containers consisting of suitable materials, the expected benefit from that product will not be realised. In order to obtain the expected income from the product produced, the first condition is to classify the product within itself by making a good grading and then to use a good packaging container that protects the product from adverse conditions and positively affects the consumer preference with its attractiveness. Poor marketing organisation leads to serious losses in quality due to the long waiting time of the products in retail outlets. It is important to identify effective strategies for marketing and selling harvested fruit. Pricing, promotion and customer relationship management are important elements of a successful marketing strategy.

Case Study 2: Maria and Juan



Introduction: Maria and Juan grow horticultural crops. They grew vegetables on their farm, but they could not make enough profit. In order to increase their earnings, Maria and Juan decided to grow vegetables according to principles of organic farming. However, they found it difficult to decide whether it was right to grow vegetables organically on their farm. This could affect the productivity and profitability of their farm and a wrong decision could result in financial losses for their business.

Challenge: In order to decide to start organic farming, it is important that they follow some basic steps at the beginning. Where will they sell their products when they grow vegetables in their country using organic farming methods? How will they grow their produce, what equipment do they need?

Solution: Maria and Juan carried out market research in the area where their farms are located. They investigated which varieties were in high demand, the competition and prices. Then they had the soil analysed. This analysis helped them to determine whether the soil was suitable for the crops to be produced and how to follow a path for organic farming. They researched factors such as planting, irrigation, fertilisation and labour costs. They decided which planting system they would use according to the climate and sunshine of the place to be cultivated. However, they had to be aware that every production involves certain risks and they needed a risk analysis done. Factors such as diseases, pests, and weather conditions can affect the success of production. They assessed these risks and took appropriate measures. Finally, they received training on organic agriculture cultivation (planting, disease and pest control, spraying, fertilisation, marketing). After this training, they chose the place for cultivation, procured the necessary tools and equipment and obtained financing for the realisation of these processes.

Impact: Maria and Juan, who decided to grow vegetables with organic farming method, had their products certified by accreditation institutions. Thanks to this certificate, they sold their products at high prices. Seeing that Maria and Juan earned high income from organic farming, neighbouring farm owners decided to start organic farming themselves. Thus, a marketing

network was formed in their region. The increase in the amount of products grown in the same region with the organic farming system caused the traders to send their refrigerated vehicles directly to the region and Maria and Juan were able to sell their products much more easily and at high prices.

Conclusion: By following steps such as market research, soil analysis, cost analysis and risk analysis, Maria and Juan were able to decide which crops to grow on their farm and in which system. When the right decisions were made, they ensured the successful, profitable operation and sustainability of their farm.

2.4. Greenhouse cultivation

Under-cover cultivation refers to low and high systems used for plant production in a controlled manner by partially or completely eliminating the negative effects of environmental conditions. Under-cover cultivation is the name given to the realisation of production in a protected structure consisting of glass or plastic. Greenhouse cultivation, which has been preferred by many producers in recent years, is a widely used method in vegetable and ornamental plant production.

Unlike outdoor cultivation, the desired temperature range should be maintained in greenhouses with heating and cooling systems. In addition, shading measures should be taken to protect from the excessive effect of the sun.

The importance of greenhouse cultivation

In greenhouse cultivation, especially in greenhouse cultivation, the number of plants grown during the year increases by extending the cultivation period, and several crops can be obtained from the same place. It is possible to produce continuous products to the market. In this way, the profit obtained from unit area increases. Climatic conditions are the most important factor limiting greenhouse agriculture. The cost increases as the heating costs increase depending on the outdoor temperature. One of the important factors determining whether greenhouse farming will be economical in a region is heating costs.

Greenhouse systems

Greenhouse cultivation has a wide range of applications in the agricultural sector with its different varieties. It supports the growth of plants by creating a controllable environment in structures covered with glass or polycarbonate materials. In this way, weather conditions, temperature, humidity and harmful organisms can be controlled more effectively.

Tunnels are open areas generally covered with plastic or special fabric materials. These structures ensure the protection of plants, especially those affected by seasonal changes. Tunnels are a lower-cost option and are widely used, especially in vegetable and fruit cultivation.

Shades constitute another type of greenhouse cultivation. These structures, which are used to prevent plants from being damaged by excessive sunlight, offer an effective solution especially in hot climates.

Issues to be considered in greenhouse cultivation

Enterprises can be grouped as those using low, medium and high technology. Greenhouses using low technology are simple structures and have no heating system. Practices similar to open cultivation are observed. Since the heating system in medium-scale greenhouses is more efficient than those using low technology, the climatic conditions inside the greenhouse are relatively different from the outside weather conditions. More advanced technology, including soilless agriculture, can be used and applications can be partially or fully automated. Although soilless farming is considered to be a more costly form of production compared to traditional soil cultivation, costs vary depending on the technique used (Bayar, 2012). In general, investment costs are high in greenhouses using high technology (Pardossi et al. 2004).

Greenhouses using low technology are simple structures and there is no real heating. Heating system is more effective in medium-sized greenhouses. In modern greenhouses using high technology, investment cost is high and all kinds of climatic factors, irrigation and fertilisation systems are under control. Especially in high-tech greenhouses, in-greenhouse automation systems consist of heating, cooling, ventilation, lighting, shading, carbon dioxide enrichment, irrigation and fertilisation systems that provide climate control.

In greenhouses using high technology, automation and remote monitoring systems are widely used. These systems can continuously monitor and adjust environmental conditions such as temperature, humidity, light, irrigation and fertilisation. This provides a significant advantage to optimise plant growth and improve operational efficiency. In addition, in high-tech greenhouses, soilless farming is used to grow the roots of plants in water or air, providing a more controlled environment. These systems can optimise the use of water and fertiliser, while also providing advantages in the fight against plant diseases. Advanced agricultural technologies such as artificial intelligence can be used in high-tech greenhouses. These technologies can help business owners in areas such as identifying plant diseases, making productivity predictions and improving product quality.

These differences allow high-tech greenhouses to achieve higher crop yields and quality, often providing a more efficient, more sustainable and more controlled environment. However, the cost and complexity of these technologies may be a reason to favour medium and low technology greenhouses.

Since greenhouses are structures that allow plants to be grown outside of their seasons, the climatic conditions in the location where greenhouse cultivation will be carried out and the regulation of factors such as temperature, CO2, light and humidity affecting plant growth in the greenhouse in a way to meet plant requirements have a direct effect on yield (Tüzel et al., 2015).

The registration of pesticide use, pesticide analyses in the products offered for sale, rising pesticide prices and increasing sensitivity of consumers necessarily reduce the chemical struggle of the producers. In addition, the support provided by authorities for biological and biotechnological control is an important step towards reducing the use of chemical pesticides by producers.

However, in recent years, consumers' preferences for more varieties, more reliable, packaged and packaged quality products that are sensitive to the environment and human health have revealed the need for marketing to operate in a wider and more controlled area (Özkan et al., 1999).

The factors that make greenhouse cultivation under-cover advantageous are summarised below:

Temperature Control: Greenhouses are used to control the indoor temperature. This is important to ensure temperature stability in cold climates or out of season,

Humidity Control: Greenhouses are used to regulate humidity levels. Especially in humid or dry climates, this control is important,

Light Management: Greenhouse cultivation ensures that plants get the maximum benefit from natural sunlight. It also allows plants to receive more light by extending daylight hours, especially in winter,

Pest Organism Control: Greenhouses protect plants from pests, diseases and other external factors.

These factors ensure that greenhouse cultivation is efficient and sustainable, offering farmers a more controlled and profitable agricultural method.

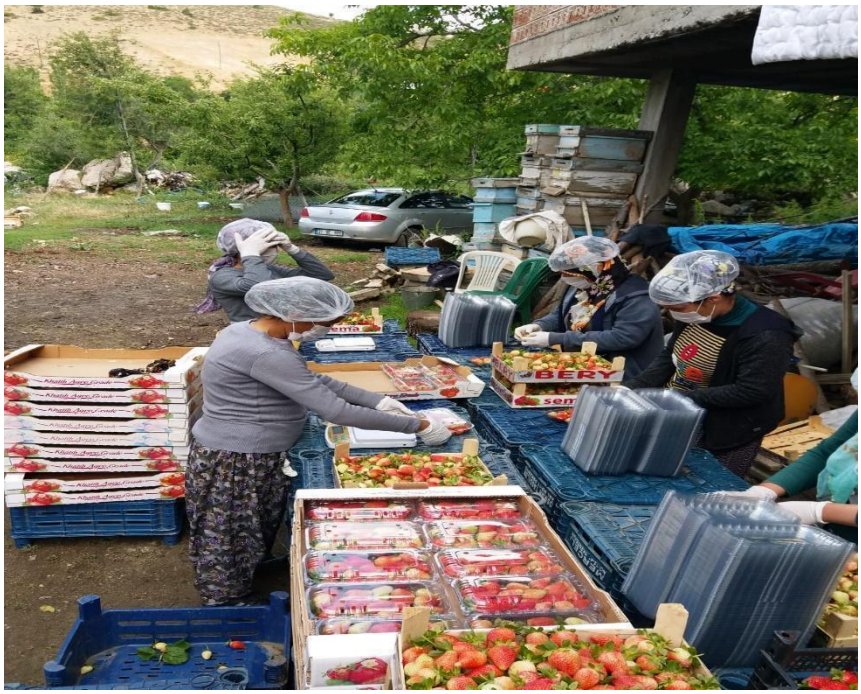
Case Study 3: Maria and Juan

Introduction: Maria and Juan wanted to do greenhouse cultivation and rented a greenhouse. However, they had difficulties in deciding which crops to grow and how to grow them in the rented greenhouse. This could affect the productivity and profitability of their business and a wrong decision could result in financial losses for their business.

Solution: Maria and Juan decided to research the market in the area where their farm is located. It is important to determine which greenhouse products are in high demand, the competition and prices. As a result of their research, they decided to grow strawberries in their greenhouse. They learnt that the infrastructure of the greenhouse they rented was suitable for soilless agriculture. For this reason, they decided to cultivate in the greenhouse with a soilless agriculture method. They learnt that the yield of strawberries grown with soilless farming methods is about 3-4 times higher when compared with the classical method. At the same time, they decided to use coconut shells instead of soil in soilless cultivation. They took into account factors such as seedlings, irrigation, fertilisation and labour costs. Taking into account that each production involves certain risks, they had a risk analysis. Factors such as diseases, pests, weather conditions can affect the success of production. These risks should be assessed and appropriate measures should be taken. Finally, they decided to receive training on hydroponic strawberry cultivation (planting, disease and pest control, spraying, fertilisation, marketing). After this training, they decided to obtain the necessary tools and equipment and to obtain financing for the realisation of these processes. They decided to negotiate with banks and use loans.

Impact: Maria and Juan, who cultivated strawberries with the soilless agriculture method under-cover and gained experience in this field, obtained 3-4 times more products from the unit area than with the classical method, and since their greenhouses were located on the roadside, they sold the products they produced directly to the producers on the roadside. Maria and Juan increased their income by getting more product from the unit area and selling the products they produced on the roadside.

Conclusion: Maria and Juan decided to grow strawberries with a soilless farming method in their farm by following the steps such as market research, cost analysis and risk analysis, which enabled them to increase their income.



2.5. Viticulture

Viticulture is actually the cultivation of grapes in vineyards carried out by a viticulturist. Viticulture is a complex agricultural work, including cultural operations and the application of grape growing techniques until the harvest day.

Importance of Viticulture:

Grape, which is one of the most produced fruit types in the world, constitutes the source of livelihood of some of the producers. There is a rich variety of grapes (Ünal, 2021). Viticulture is an important branch of agriculture that covers the process of growing grapes and processing the products obtained from vineyards such as wine, thereby establishing an important agricultural and economic sector:

Food Production: Viticulture is the basis for many food products through the cultivation and processing of grapes. These include fresh grapes, raisins, grape juice and wine, the latter being the most common.

Economic Contribution: Viticulture is an important source of economic income for many countries. Grape and wine production contributes to the agricultural sector as well as other sectors such as tourism and gastronomy.

Employment Opportunities: This branch of production offers employment opportunities to many people. Grape cultivation, vineyard care, harvesting and wine production provide jobs for many workers.

Protection of Cultural Heritage: Viticulture is considered an important heritage element for many cultures. In some regions, viticulture and wine production are part of a centuries-old tradition.

Environmental Impacts: Viticulture, which affects wildlife as part of agricultural activities, when properly managed, can protect biodiversity, prevent soil erosion and help promote sustainable agricultural practices.

Tourism and Tasting Experiences: Vineyards can be an important attraction for tourism. Activities such as vineyard trips, wine tasting tours and accommodation in vineyard houses can contribute to tourism income.

Dressing Systems in Vineyards

In vineyards, the way of training is the shape given to the trunk, annual branches and shoots of the vine. The training system is the combination of this form of training and the support systems in which the vines are located.

Vines grown in the appropriate trunk height and training system for the variety and the climate and soil conditions of the region form more clusters and reach the desired quality with higher trunk volume and leaf area. The choice of cultivation system and the form of cultivation should be made by taking into account the growth power of the cultivar, eye productivity, as well as the climate and soil conditions of the region. Support systems in vineyard are as follows:

Herek System
Simple Wire System
Single Wire system
Multi-wire system
High Wire System
V and Y system
Pergola system

Issues to be considered in viticulture

Viticulture involves a range of agricultural activities usually carried out in vineyards. Vineyards differ depending on the grape varieties and the region of cultivation. This branch of cultivation usually consists of planting, maintenance, pruning, disease control, irrigation and harvesting. All stages of cultivation should be followed meticulously. It is very important for the producers who want to do viticulture to decide which grape varieties to grow. They should investigate the market needs and climatic conditions in their region and decide on the variety selection accordingly. The most commonly grown grape varieties in viticulture include table grapes, wine grapes and dried grapes. While table grapes are used for fresh consumption, wine grapes are generally used for the production of grape juice or wine. Dried grapes are used in the production of raisins or raisin molasses. Viticulture involves various methods varying according to climate, soil structure, and grape variety and production purpose. Nowadays, with modern technology and scientific developments, it is important to follow and use various innovative techniques to increase productivity and improve grape quality in viticulture.

Among the factors influencing the widespread cultivation of grape varieties are climatic conditions, soil structure, water resources and regional preferences. Each variety develops better under certain climatic and soil conditions, which allows farmers to choose grape varieties

that are suitable for regional characteristics. Furthermore, grape diversity is also important in terms of adapting to different market demands and obtaining a variety of grape products. Vineyard establishment is one of the basic steps in viticulture, and after a successful vineyard establishment, correct cultural maintenance is necessary. Cultural maintenance procedures to be applied in vineyard establishment and established vineyards are as follows:

Site Selection: Choosing a suitable location for the vineyard plant is very important. Generally, areas with plenty of sunlight, good drainage, wind and suitable soil structure should be preferred. Soil analysis should be made and the nutrient content, pH level and drainage properties of the soil should be taken into consideration.

Variety Selection: Varieties resistant to diseases and pests should be selected by paying attention to the climate and soil characteristics of the place where the vineyard will be established.

Planting System Selection and Dressing Style: The development power of the cultivated variety should be selected by taking into consideration the climate and soil conditions of the region together with the eye productivity.

Planting Process: Planting should usually be done in autumn or spring. It is necessary to pay attention to the planting depth.

Irrigation: Providing sufficient water by selecting an irrigation system suitable for soil structure and climatic conditions is one of the most important factors affecting yield.

Fertilisation: Fertilisers to be given for nutrient deficiencies in the plant should be given by evaluating the results of soil and leaf analysis.

Disease and Pest Control: Common diseases and pests in the vineyard should be taken under control. Chemical and biological control methods can be used

Pruning: Old, dry or damaged shoots should be pruned regularly with the appropriate pruning method. The various pruning methods used in grape growing are designed to control the shape, growth and fruit yield of the plants. Appropriate pruning methods should be selected according to the location of the vineyard.

Harvest: Harvesting is an issue that requires different sensitivities according to the type of cultivation, especially in table grape cultivation, care should be taken to collect the clusters without damaging them during harvesting.

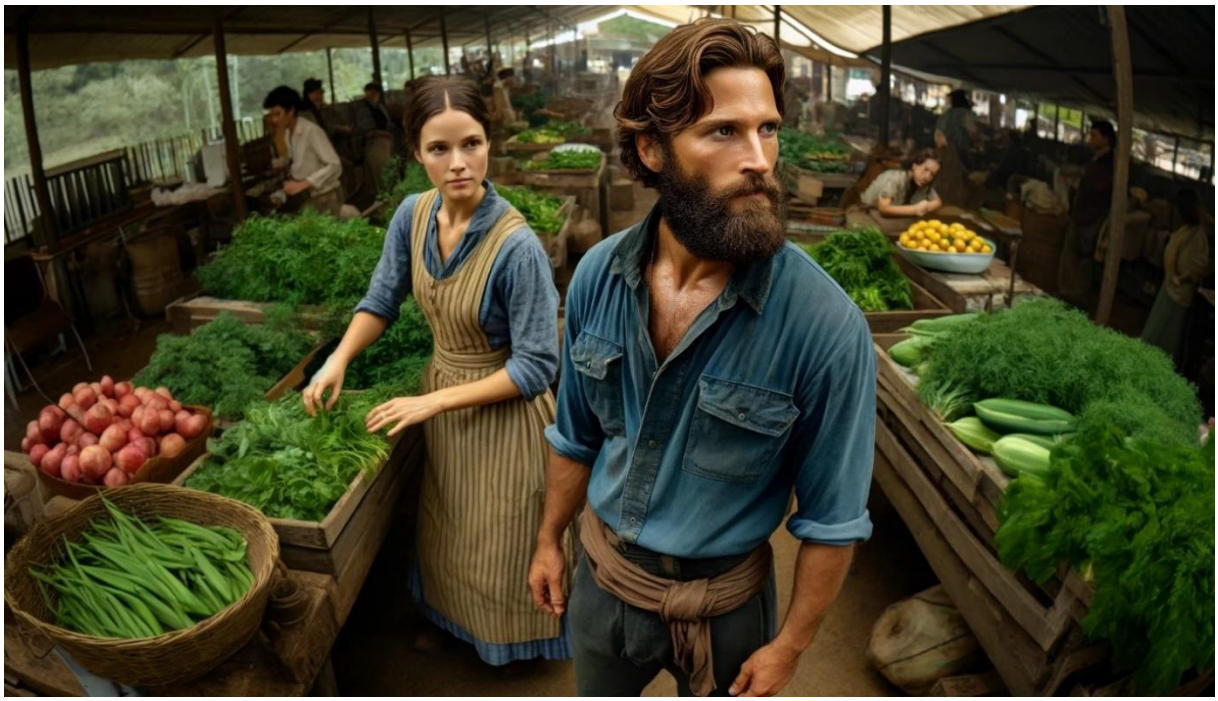
Production Permits and Legal Regulations: It is important to obtain the necessary permits for viticulture activities. Necessary permits should be obtained by contacting the Ministry of Agriculture and Forestry or relevant institutions.

Water Resources: In viticulture, irrigation is necessary for table production, but irrigation is also possible for dry and must varieties, but the effective use of water resources by establishing irrigation systems is one of the most important factors that increase yield. Therefore, it is important to have sufficient water resources for viticulture.

Education and Knowledge: Having basic knowledge about viticulture and continuously following the developments in the sector are important for a successful viticulture business.

Market Research and Trade Relations: In order to market the products produced, it is important to research local and national markets, understand customer needs and establish trade relations.

Case Study 4: Maria and Juan



Maria and Juan wanted to practise viticulture on their farm, but they found it difficult to decide how to grow which variety in which system. This could affect the productivity and profitability of their farm and a wrong decision could result in financial losses for their business.

Challenge: For Maria and Juan to decide to start viticulture, it is important to follow some basic steps at the beginning. They should grow whichever grape variety in the country they are in, if they did not have problems with sales. They needed to investigate which cultivation system is suitable for their region.

Solution: Maria and Juan decided to research the market in the area where their farm is located. They identified which varieties were in high demand, the competition and prices. They then commissioned a soil analysis. This analysis helped them to determine if the soil is suitable for viticulture. They learned that they should consider factors such as planting, irrigation, fertilisation and labour costs. They should decide which planting system to establish the vineyard according to the climate and sun intake of the place where the vineyard will be planted. They decided to use the high wire T support system according to the solar irradiation. They decided to irrigate with drip irrigation method and to grow a table grape variety with market value in the region. Finally, they decided to receive training on vineyard cultivation (planting, disease and pest control, spraying, fertilisation, marketing). After this training, they decided to obtain financing by taking out a loan to buy the necessary materials and equipment for production.

Impact: Maria and Juan, who cultivated table grapes with a drip irrigation system in the wired system, made their business more profitable by getting about 3 times more product from the unit area compared to the classical cultivation method.

Conclusion: Maria and Juan have increased their income by following steps such as market research, cost analysis and risk analysis soil analysis, establishing a viticulture business with wire system.

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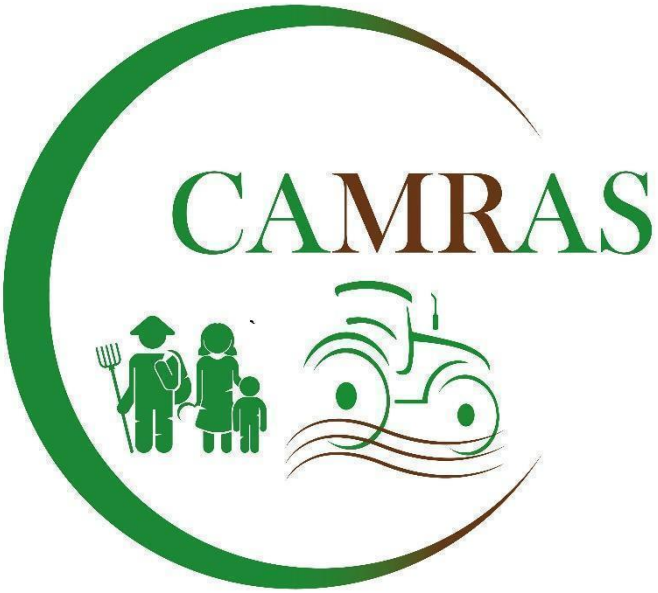


Module 3

Animal breeding (AMSED)

Moïse Nelson Haoumou

This chapter, dedicated to familiarising migrants and refugees (M/Rs) with animal breeding in the EU, covers key areas such as cattle, small ruminants (sheep, goats and pigs), poultry and aquaculture. The various sections will contribute to knowledge of existing farm types, understanding of the regulatory framework and essential practices for increasing M/R skills. Particular emphasis is placed on sustainability, animal welfare and productivity.

- Livestock production plays a crucial role in the global economy, not only providing essential sources of protein, milk, eggs and fibre to billions of people, but also supporting the livelihoods of millions of farmers and players in agri-food value chains. However, the industry is facing major challenges in the current context. Environmental issues, such as greenhouse gas emissions, deforestation and water consumption, highlight the urgent need for more sustainable production practices. In addition, growing concerns about animal welfare and health require a reassessment of farming methods and health management.

- So, while animal production is essential to global food security, it needs to be transformed into more ethical and environmentally sustainable practices to meet the challenges of today's world.
- In this module, you will learn about:
- the most common cattle breeding, small ruminants, poultry and aquaculture
- feeding and nutrition principles in animal farming
- animal health and welfare
- marketing of animal products.

3. Animal breeding

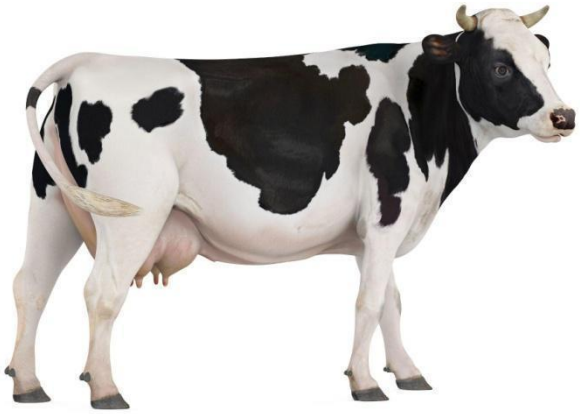
3.1. Cattle breeding

Types and characteristics of cattle

The European Union (EU) is home to a rich diversity of cattle breeds, each with its own unique characteristics adapted to a variety of purposes, such as milk and meat production, or even mixed uses. These factors are obviously good to know for M/Rs looking for work in this production sector.

Dairy cattle

Holstein-Friesian:

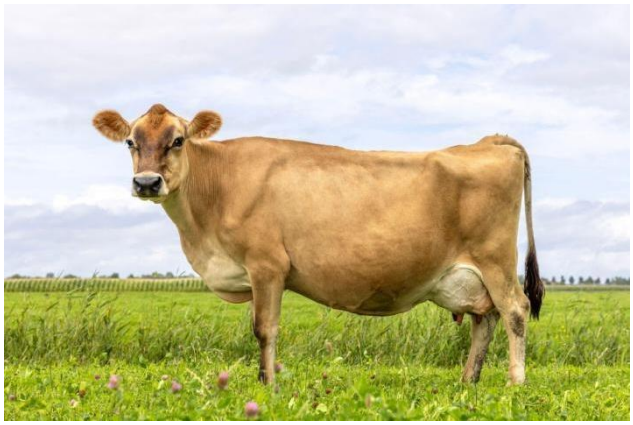


Source: shutterstock

Jersey: This small, fawn-coloured breed originates from the island of Jersey. This dairy breed knows how to stand up to difficult soils with short, salty grass.

Jersey is suitable for all climatic conditions. Easily adapting to its environment, this breed attracts attention with its small size. It is often preferred for its low maintenance cost and docile structure. Although its weight is less than other cows, it gives an average of 15-18 litres of milk per day.

The Jersey breed has many qualities. In particular, it leads the way among dairy breeds for the protein content of its milk, which makes it suitable for the production of butter and related products.

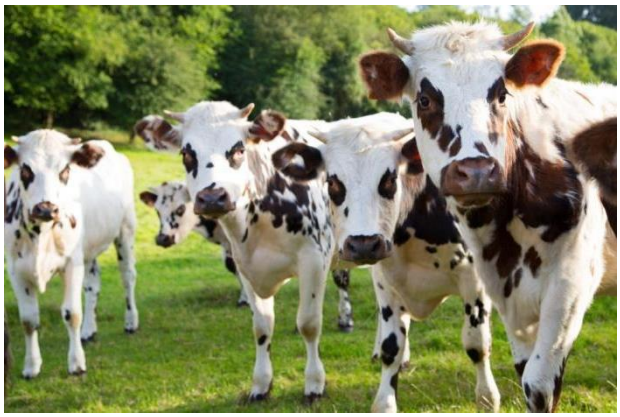


Source: shutterstock

Normande: Native to France, this breed is bred for its meat and milk yields, with 6 million pure-blooded Normande bred in the world. The breed is particularly renowned for its ability to produce high quality milk, making it suitable for cheese processing.

It is known for its ease of calving, adapts well to outdoor breeding and is the best mixed breed in temperate regions. It is white with mixed brown, black and red spots.

They have high feed conversion rate, strong mothering ability, lifelong span and adapt quickly to all climatic conditions.



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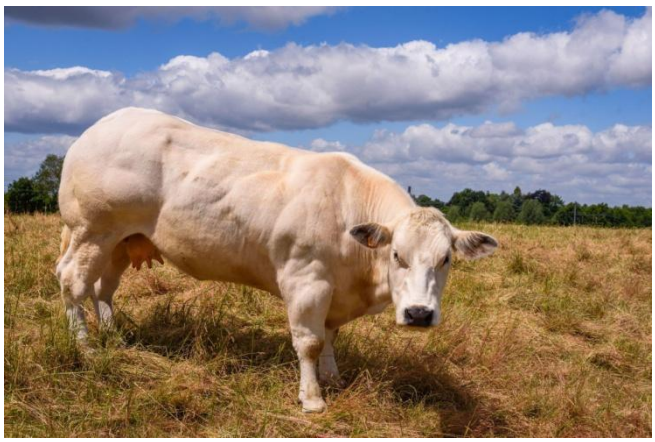
Beef cattle

Piemontese: Originating from Piedmont, Italy, this cattle breed is characterised by its white to light grey coat with darker coloration on the head and breeches. This breed is renowned for producing high-quality meat, due to its well-developed musculature and low fat content. Piemontese cattle are generally slaughtered between 18 and 24 months of age to ensure optimal muscle growth and proper maturation of the meat. This guarantees its tenderness and flavour. Males can reach an average slaughter weight of 700 to 900 kilograms, while females generally weigh between 500 and 700 kilograms. These features make them profitable animals for meat production.

Source: shutterstock

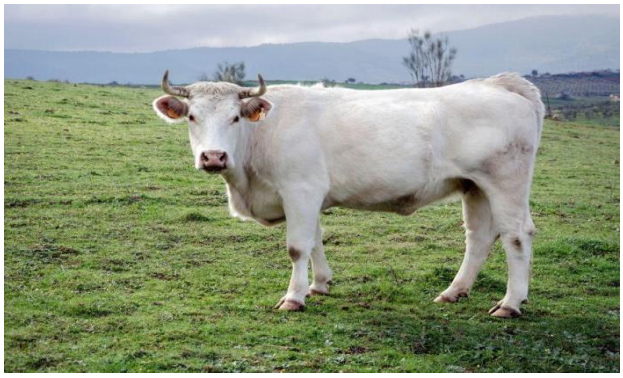
Belgian Blue: Renowned for its exceptionally well-developed musculature, the Belgian Blue is a cattle breed highly valued for its high-quality meat production. Originating in Belgium, this breed stands out for its ability to efficiently convert feed into muscle mass, resulting in well above-average meat yields, with low fat and high muscle content. Males of this breed can reach an impressive weight of 1100 to 1250 kg, while females generally weigh between 700 and 800 kg. In terms of reproduction, the Belgian Blue has a moderate birth rate, with the emphasis on quality rather than quantity of calves produced, with each calf benefiting from the genetic potential for rapid growth and significant muscle development. The meat yield of these animals

is exceptional, with carcasses providing up to 80% premium quality meat, well above the average for beef breeds. Although their life expectancy may be shorter compared with other breeds, due in part to their massive size and selection for rapid muscle growth, Belgian Blues are generally bred to around 5 years of age, during which time they can provide a significant amount of high-value meat.



Source: shutterstock

Charolais: Originating in France, the Charolais, with its characteristic white coat and imposing stature, is world-renowned for its exceptional contribution to beef production. Capable of reaching remarkable weights, with males weighing between 1000 and 1200 kg and females in the 700 to 900 kg range, this breed enjoys global popularity due to its satisfactory birth rate and rapid growth, optimising return on investment for breeders. In terms of meat yield, the Charolais dominates, thanks to a high percentage of premium lean meat and a feed efficiency that surpasses that of many other breeds, transforming feed into muscle with remarkable efficiency that translates into a meat yield of 60-70% of live weight. These qualities make the Charolais a mainstay of the beef industry, offering tender, flavorful, high-value meat that is highly sought after by butchers and consumers alike.



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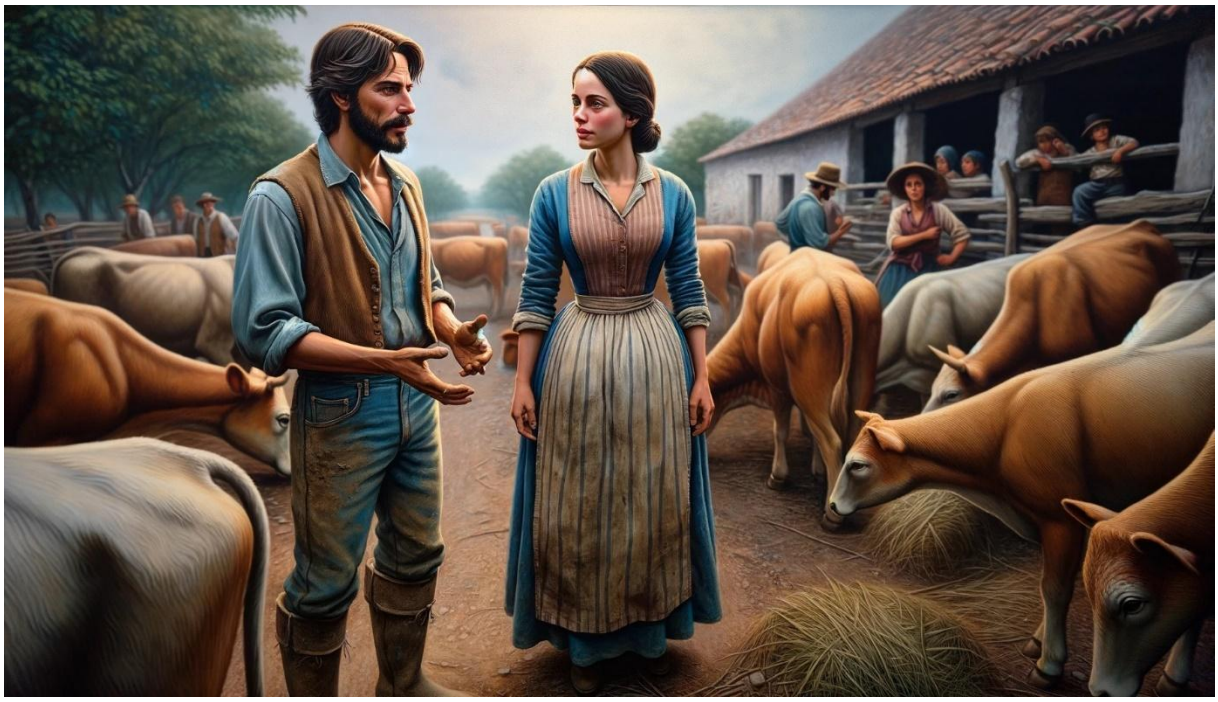
Case study: Maria and Juan



Maria and Juan own a farm that produces both crops and livestock. They are interested in diversifying their livestock production by including both dairy and beef cattle but are facing challenges in breed selection and effective management practices for both.

Challenge: The main challenge for Maria and Juan was selecting the right breeds and management strategies for dairy and beef cattle that suited their farm's conditions. They needed to consider various factors including climate adaptability, disease resistance, productivity levels (milk yield for dairy and meat yield for beef), and environmental sustainability.

Solution: Maria and Juan have a range of options and considerations for successfully raising both dairy and beef cattle on their farm. They should start by thoroughly researching to choose the most suitable breeds that match the unique characteristics of their farm, such as climate, soil, and water resources. Different breeds have varying tolerances to climatic conditions and environmental factors, with some better suited for cold climates and others for warmer ones. Alongside breed selection, Maria and Juan need to ensure they provide proper housing, nutrition, and veterinary care, which includes regular check-ups and vaccinations to maintain the health and welfare of the cattle.

To make informed decisions, consulting with a seasoned cattle breeding consultant could be invaluable. This expert can help Maria and Juan assess the advantages and disadvantages of each breed, guiding them in choosing the ones that best fit their farm’s needs and establishing an effective breeding program. Additionally, Maria and Juan might benefit from specialised training to enhance their skills in cattle management and breeding, thereby boosting the efficiency and profitability of their farm. By integrating professional advice and continuous learning, they can optimise their cattle operations for both milk and meat production, ensuring the long-term success and sustainability of their business.

Different breeds of dairy cattle offer different milk yields. Maria and Juan should choose the breed with the milk yield that best suits the needs of their farm. Some breeds of dairy cattle are

more resistant to certain diseases. Maria and Juan should choose a breed that is resistant to diseases, taking into account the diseases that are common in the region where their farm is located. In addition, different dairy cattle breeds have different nutritional requirements. Maria and Juan should choose a breed that suits the available resources of their farm.

Impact: By making informed decisions about raising both dairy and beef cattle, Maria and Juan can significantly enhance the income, productivity, and profitability of their farm. Selecting appropriate breeds and implementing effective breeding programs tailored to their specific requirements can yield higher milk and meat outputs, while simultaneously reducing the risk of diseases. This strategic approach not only supports the farm's economic goals but also plays a crucial role in promoting environmental sustainability and animal welfare. The benefits of choosing suitable breeds and adhering to robust breeding practices extend beyond immediate productivity gains, fostering long-term sustainability and resilience of their farming operations.

Conclusion: Maria and Juan have the potential to enhance the productivity and profitability of their farm by making informed decisions in cattle breed selection and by implementing structured breeding and management programs. This comprehensive approach not only supports the growth of their farm but also contributes to sustainable farming practices.

Nutrition and feeding principles for cattle

Plant-based diet as a base for cattle breeding

Each day, the animal must consume the quantity of feed required to cover its needs: this quantity is called the ration. It varies according to the animal species, age, main type of production (meat, milk or mixed), season and region. This is particularly important for M/Rs who are interested in entering the cattle breeding industry, as understanding the specific nutritional requirements of their livestock is essential for successful farming practices.

Cattle feed ration

The aim of rationing is to calculate the quantities of feed to be distributed to an animal to cover its maintenance and production requirements in terms of energy, nitrogen, minerals, trace elements and vitamins. Feed must provide animals with the components they need for their vital functions and growth. These are the nutrients: water, carbohydrates, proteins, lipids, minerals and vitamins.

Cattle rations are mainly based on a variety of forages. These forages differ in the way they are stored. Some, such as grass, alfalfa and rapeseed, are grazed directly by the animals during the summer season. Others are harvested and stored for later use in winter, including hay, straw, corn, grass, sorghum or beet pulp silage, and grass or legume wraps. Grass plays a central role in the diet of cattle, representing on average 60% of their diet. Whether grazed or harvested from vast permanent grasslands, grass plays a crucial role in ecological regulation, the preservation of landscapes and biodiversity, risk prevention and regional planning (İkikat Tümer & Birinci, 2011).

Forage does not always cover all the needs of cattle. Farmers who know their animals and how to assess their needs will regularly adapt the ration distributed. In particular, they will supplement it with concentrated plant and mineral feeds. Most of the plant-based supplements are produced on the farm, particularly cereals.

The average composition of an adult bovine's feed ration is 80% forage, 2% minerals and vitamins, 18% concentrated feed and unlimited drinking water (up to 100 litres per day for an adult bovine, depending on its ration).

Strict food regulations

At every stage in the chain, professionals are committed to guaranteeing consumers high-quality beef. To this end, breeders adhere to exacting standards, particularly when it comes to the feed they distribute to their animals. The addition of feed supplements to fodder is governed by strict national and European regulations. The regulations require precise labelling of all products purchased by the farmer and intended for animal feed. The exact composition of the feed must be indicated on the label.

Safe power supply

To avoid any risk of contamination of cattle by the Bovine Spongiform Encephalopathy (BSE) agent, the use of animal meal in cattle feed is prohibited. Also, the addition of anabolic or antibiotic additives to cattle feed is prohibited. As part of animal product health monitoring plans, these substances are regularly tested in meat and other animal products, to check compliance with regulatory bans.

The controlled use of genetically modified (GM) plants

The cultivation, import and use of genetically modified plants for animal feed are subject to very strict regulations: only certain varieties are authorised after evaluation on a case-by-case basis by the European Food Safety Authority (EFSA). Their use is then subject to precise traceability and labelling rules, and rigorous control by the public authorities.

Cattle health and disease control

Cattle health and disease control are major concerns in the European Union (EU), where strict standards are in place to ensure the health and welfare of farm animals. A tightly regulated veterinary surveillance system is in place to detect and control infectious diseases such as foot-and-mouth disease, bovine tuberculosis, brucellosis and bluetongue, as well as other emerging diseases.

Awareness and training programmes are also offered to farmers, including M/Rs employees, to inform them of best practice in animal health and disease management. EU legislation requires farmers to comply with high standards of animal health, biosecurity and animal traceability, including preventive practices such as vaccination, health risk management, animal movement control and regular disease testing. Farmers are obliged to report any suspected cases of animal disease to the competent health authorities, who can then take measures to contain the spread of the disease and protect public health, in particular by establishing restriction zones and quarantine measures.

In addition, the EU actively supports research and the development of new technologies and strategies to improve the prevention, diagnosis and treatment of animal diseases. Awareness-raising and training programs are also offered to farmers to inform them of best practices in animal health and disease management.

Overall, cattle health and disease control are key priorities for the EU, not only to protect the health of farm animals, but also to guarantee food safety, maintain the competitiveness of the farming industry and preserve consumer confidence in the quality of beef products.

Animal welfare and environmental factors

Cattle welfare is a major concern in the EU, where strict standards are in place to ensure optimal living conditions for these animals. Breeders are required to comply with rules concerning housing, feeding, veterinary care, transport and slaughter of cattle, in order to meet their physiological and behavioural needs.

As far as housing is concerned, cattle must have access to sufficient space to move around, lie down and rest comfortably. Stalls must be well-ventilated, well-lit and equipped with clean, dry bedding. In addition, animals must have access to sufficient fresh water and a balanced diet that meets their nutritional requirements (Keskin et al., 2010).

Environmental factors also play an important role in cattle welfare. Extreme weather conditions, such as summer heat or winter cold, can have an impact on animal comfort. Breeders must therefore take steps to protect cattle from adverse weather conditions, for example by providing shade, shelter or heating.

Furthermore, cattle must be treated with respect and compassion at all stages of their lives, including transport and slaughter. Measures are in place to minimise the stress and suffering of animals during these processes, ensuring that they are handled with care and respect for their welfare.

Marketing of live animals, meat and dairy products

The marketing of live animals, meat and dairy products in the EU is subject to strict regulations designed to guarantee food safety, product traceability and animal welfare. Trade in live animals, such as cattle, pigs and poultry, is governed by strict health and welfare standards, including rules on animal identification, vaccination and transport. For meat products, such as beef, pork and poultry, as well as dairy products like milk, cheese and butter, strict quality and hygiene standards are imposed at every stage of the supply chain, from production to distribution (Özer & İkikat Tümer, 2021). Farmers, processors and distributors must comply with these standards to obtain the certifications and approvals required to sell their products on the European market. In addition, meat and dairy products imported from third countries are subject to similar quality and safety controls before being allowed onto the EU market. Overall, the marketing of live animals, meat and dairy products in the EU aims to ensure consumer protection, respect for high animal welfare and public health standards, and the promotion of fair competition on the internal and international markets.

Cooperatives and their advantages in cattle breeding

Cooperatives enable breeders to benefit from greater bargaining power and collaboration, pooling their resources and efforts to access larger markets and more diversified commercial opportunities. This gives them better access to the infrastructure, equipment and services needed to produce, process and market cattle and cattle products.

In addition, cooperatives often offer advice, training and technical support services to breeders, helping them to improve their breeding practices, optimise their productivity and strengthen

their competitiveness on the market (İkikat Tümer & Kumbasaroğlu, 2008). They can also play a role in the research and development of new breeding techniques, as well as in the implementation of high quality and animal welfare standards, thus contributing to the continuous improvement of the beef industry in the EU.

In addition, cooperatives can provide a platform for collaboration on risk management, particularly with regard to price management, market fluctuations and health crises. By organising themselves collectively, breeders can better cope with economic challenges and market hazards, strengthening the resilience of the beef industry as a whole.

In short, cooperatives offer cattle farmers in the EU an effective organisational structure to collaborate, share resources, access support services and face industry challenges, thus contributing to a stronger, more sustainable and more competitive cattle industry (Section Bovine, 2023).

3.2. Small ruminants (sheep, goats and pigs)

Types and characteristics

Sheep farming

Sheep farming is practised in many EU countries, with major production areas in Spain, France, the UK, Ireland, Türkiye, Greece and other regions. Sheep flocks in the EU are raised for meat, wool, skin or milk, depending on breed and local farming practices. EU support programs aim to promote the sustainability and competitiveness of sheep farming, notably through agricultural subsidies and measures to protect flocks against disease. Some of the breeds most in demand for breeding are surveyed below.

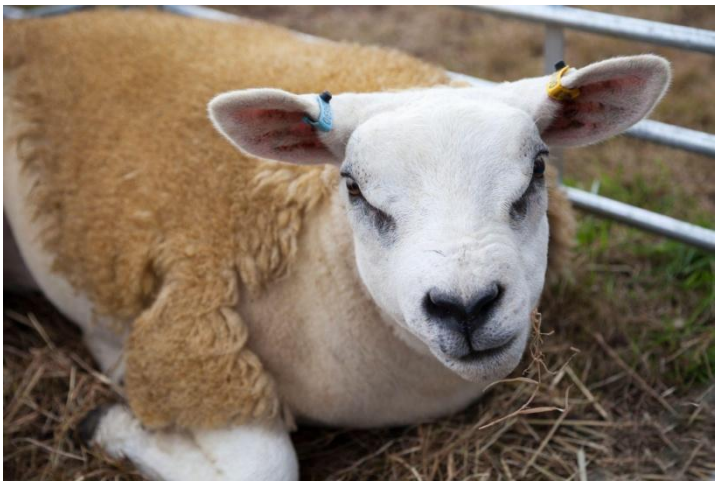
Merinos: Known for their fine, high-quality wool, Merinos are in great demand in regions where wool production is important. Merino is the most common sheep breed in the world. It is a breed with high adaptability to different environmental conditions, high resistance to diseases and high survival power. Fertility is quite good and lambs have high yield and growth rate. The twinning rate is 30-60%. Their live weight varies between 60-90 kg and they have high meat and milk yield. The milk yield during the lactation period (average 140 days) varies between 70 and 80 litres.

Source: shutterstock

Suffolk: originated in England, and more specifically in Suffolk, as a result of cross-breeding Norfolk Horn sheep and Southdown rams in the early 19th century, and is renowned for the superior quality of its meat. Recognisable by their appearance, with black heads and legs contrasting with their white wool, Suffolks are large, robust animals. Although their wool is of good quality, they are valued primarily for their meat, thanks to their rapid growth and excellent feed conversion capacity. These characteristics make Suffolks a preferred choice for improving meat yields, contributing to their popularity with breeders around the world. Suffolk sheep are high breeders and have a high rate of twins. They can lamb three times a year. The daily weight gain of their offspring is 500 gr. The live weight of this breed varies between 80-160. The average wool yield is 3 kg.

Source: shutterstock

Texel: It's a sheep breed renowned for its quality meat, originating on the Texel islands in the Netherlands. Texels are known for their well-developed musculature, high meat yield and ability to adapt to different environments. They have good quality white wool, although this is often secondary to their value as meat animals. Texel lambs grow quickly and generally reach higher market weights than other breeds. Because of their favourable characteristics for meat production, Texels are popular in many countries around the world, for both small and large farms. They are tailless, and display a high feed conversion rate, making them a meat sheep breed. Live weights vary between 65-120 kg. The meat yield is 55% on average and the meat is lean. The annual fleece yield is 4 kg on average. Resistance against diseases is high.

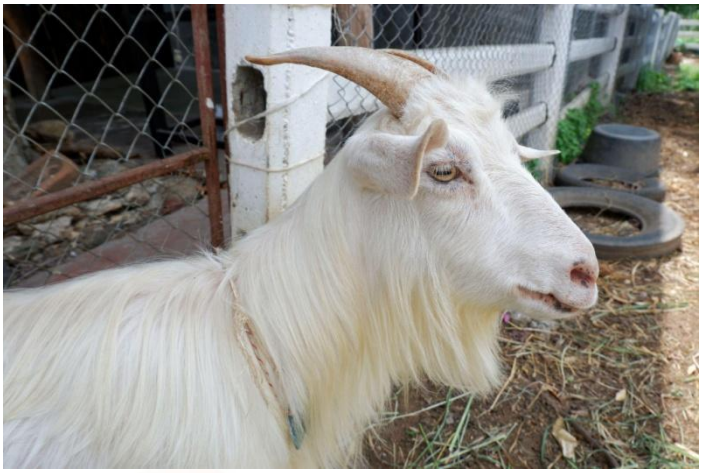


Source: shutterstock

Goat farming

Goat farming is also widespread in several EU countries, including France, Greece, Italy and Portugal. Goat farmers generally produce goat's milk for cheese and other dairy products, although goat meat is also consumed in some regions. EU rural development programs support initiatives to improve the productivity and quality of goat herds, as well as the promotion of goat products on local and international markets. Some of the breeds most in demand for breeding are surveyed below.

Saanen: The Saanen breed is a goat breed originating from the Saanen valley in Switzerland. It is renowned for its milk production, being one of the main breeds used in the dairy industry throughout the world. Saanen goats have a characteristic white coat and straight or no horns. They are renowned for their ability to produce large quantities of high-quality milk with a high protein and fat content (average 3.5%). They can give 750-1000 litres of milk in a lactation period of 280-300 days. Saanen goats are also appreciated for their docile temperament, making them easy animals to manage in dairy herds. Because of their exceptional milk performance and docile nature, Saanen goats are widely bred in many parts of the world for commercial milk production. Their live weight varies between 50-70 kg. Their fertility is high and they can adapt to different climatic conditions very quickly.

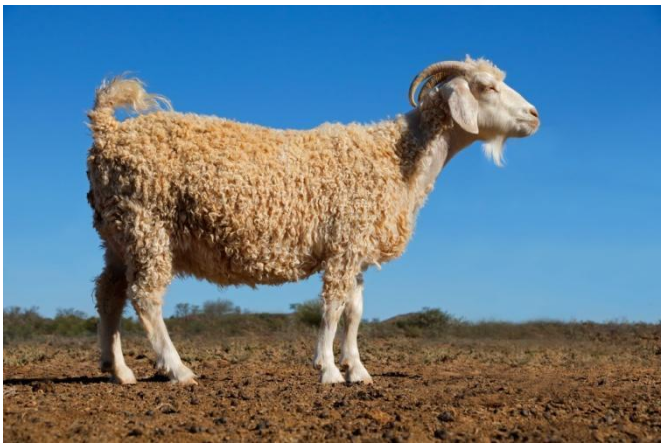


Source: shutterstock

Boer: This breed is a type of goat originating from South Africa. It is specifically bred for meat production and is known for its fast growth rate, high fertility, and good meat quality. Boer goats typically have a white body with a red head and some may have other red markings. They are well adapted to hot, dry climates and are often raised in extensive grazing systems. Boer goats have gained popularity worldwide due to their excellent meat yield and adaptability to various environments, making them a valuable breed for meat production in many regions. Their live weight varies between 90-135 kg.

Source: shutterstock

Angora: The Angora breed of domestic goats, originating from Ankara, Turkey, is renowned for its long, soft, and silky fleece known as mohair. These goats, selectively bred for centuries, produce luxurious fibre ranging in colour from white to various shades of grey and brown. Valued for its warmth, sheen, and durability, mohair is sought after in the textile industry for items such as sweaters and blankets. Angora goats are raised primarily for mohair production, which is sheared from the animals twice a year. Adapted to semi-arid climates, they are also utilised for meat and brush control. However, their primary significance lies in their role as producers of high-quality mohair, contributing to the global textile market. Their live weight varies between 22-62 kg. Shearing is done twice a year and mohair yield varies between 1.5-6.5 kg with an average mohair yield of 76%.

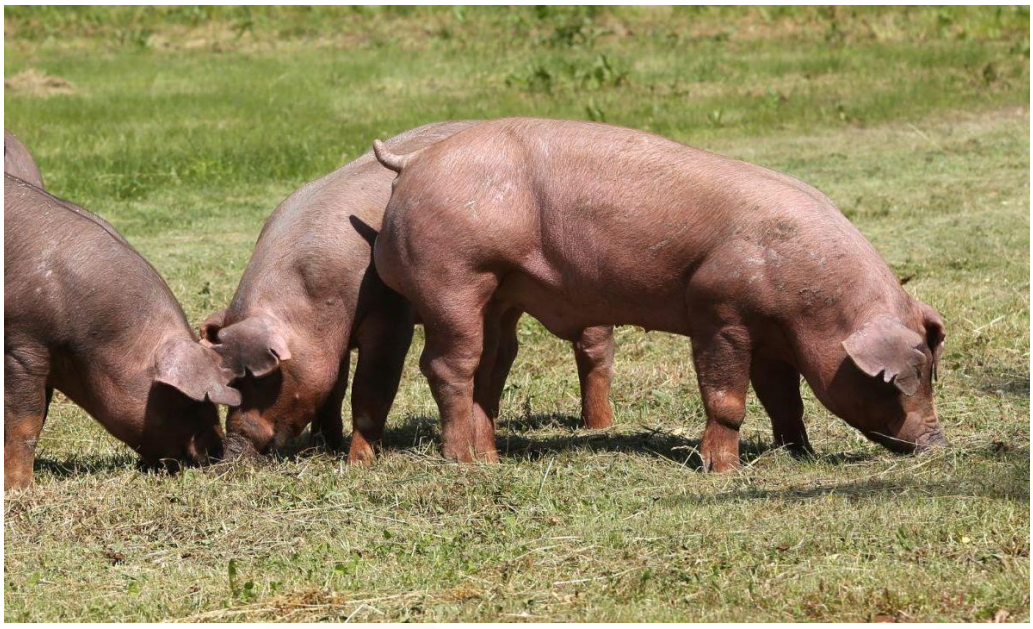


Source: shutterstock

Pig farming

Pig farming is one of the main livestock industries in the EU, with major producers in Spain, Germany, Denmark, the Netherlands and France. Pigs are bred primarily for their meat, which is widely consumed throughout the EU and exported to other parts of the world. The EU strictly regulates animal welfare and food safety standards in pig farming, including animal living conditions, waste management and the use of antibiotics. Some of the most popular breeds used in pig farming are surveyed below.

Duroc: The Duroc breed is a type of domestic pig renowned for its excellent meat quality, fast growth rate, and efficient feed conversion. Originating from the United States, Duroc pigs are prized for their distinctive reddish-brown colour, well-marbled meat, and desirable carcass traits. They are known for their adaptability to various climates and management systems, making them popular among pork producers worldwide. Duroc pigs are often used in crossbreeding programs to improve meat quality and production efficiency in commercial swine operations. With their robust constitution and superior meat characteristics, Duroc pigs play a significant role in meeting the demand for high-quality pork in the global market.

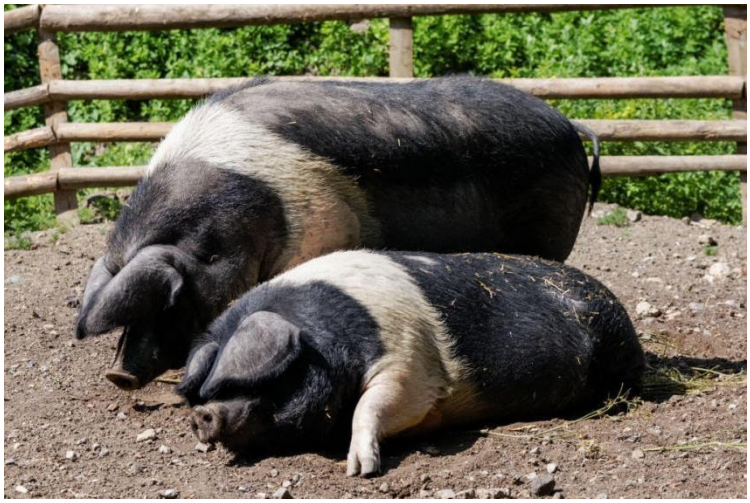


Source: shutterstock

Large White: The Large White breed, also known as the Yorkshire pig in some regions, is a highly regarded domestic swine breed prized for its prolificacy, fast growth rate, and excellent maternal instincts. Originating from England, the Large White is characterised by its large size, erect ears, and distinctive white coloration. This breed is renowned for its lean meat, efficient feed conversion, and adaptability to various climates and management systems, making it a preferred choice for commercial pork production worldwide. Large White pigs are often used in crossbreeding programs to improve carcass quality and production efficiency.

Source: shutterstock

Hampshire: The Hampshire breed, a domestic swine originating from the United States, is highly esteemed for its excellent meat quality, efficient feed conversion, and remarkable growth rate. Recognized by its distinctively black body with a white belt encircling the front legs and shoulders, Hampshire pigs are renowned for their muscular build and meaty carcasses. With a reputation for hardiness and adaptability to various climates and management systems, Hampshire pigs are favoured among pork producers worldwide. This breed's superior meat traits, coupled with its strong maternal instincts and good mothering abilities, make it a popular choice for both purebred and crossbreeding programs, contributing significantly to the global pork industry's productivity and quality standards.



Source: shutterstock

Case study: Maria and Juan

Maria and Juan want to raise sheep, goats and pigs to increase the profitability of their farm, but they do not have enough information about which breed to choose, how to raise them and how to market their products.

Challenge: For each animal species, knowledge about different breeds and their characteristics was required. Each breed had different characteristics, nutritional requirements, and health needs. Likewise, it was important to know about the appropriate feeds and feeding programs for sheep, goats, and pigs. In particular, suitable shelter and housing conditions needed to be provided for each animal species. Regular veterinary check-ups and necessary vaccinations and treatments were important for sheep, goats, and pigs. It was important to be informed about the demands and prices of the market for sheep, goat, and pig meat. The farmer needed different information for different animal species and had to research and obtain this information.

Solution: Maria and Juan need to do research to choose the animal breed that best suits the needs of their business. They need to gather information about different breeds and evaluate the advantages and disadvantages of different breeds. They could enlist the help of a consultant experienced in the animal breeding process. A consultant can help them choose the breed that best suits the needs of their farm and create an effective breeding program. Maria and Juan could receive training to gain the necessary skills in the animal breeding process. A staff trained in animal husbandry can increase the productivity and profitability of their business.

As it is necessary to design a suitable corral for sheep, a suitable barn for goats, a suitable shelter for pigs, they should find cost-effective solutions to ensure proper shelter and feeding conditions for different types of animals. They can get technical support on the sale of animals, marketing techniques.

Impact: Maria and Juan can increase the productivity and profitability of their business by choosing the right breed of animals and implementing a correct breeding program. Choosing the right breed can bring benefits such as higher meat and milk yields and less risk of disease. In addition, a correct breeding program can improve the environmental sustainability of the farm.

Conclusion: By selecting the right breeds and implementing appropriate breeding programs, the farmer can increase the productivity and profitability of his farm. This means that choosing the right breed and implementing a correct breeding program can influence the long-term success of the farm.

Nutrition and feeding principles for sheep, goats and pigs

Sheep feed

Plant-based diet as a base for sheep breeding

Grass plays a predominant role in sheep diets (60% on average). Essentially made up of forages, there are several types of forage, distinguished by their method of preservation:

- Green forage directly grazed by the animals during the summer months: grass, alfalfa, rapeseed, etc.
- Forages harvested and stored for winter consumption, including:
- Dry forages such as hay (grass mown and then dried on the meadow before harvesting), or straw;
- Silage fodder, stored after grinding in a silo and preserved by acidification in the absence of oxygen (corn silage, grass silage, or occasionally sorghum or beet pulp);
- More or less dried fodder, kept protected from the air in plastic film, which breeders call grass or legume wrapping. It is an intermediate product between hay and silage.

Feeding goats

Goat feed is carefully adapted to meet their unique nutritional requirements, promoting healthy growth, reproduction and efficient milk or meat production. This balanced diet judiciously blends forages, concentrates and mineral and vitamin supplements to ensure a complete ration. Goats benefit from a wide variety of forages, including grass, hay and silage, making efficient use of land through their ability to exploit hard-to-reach areas, which contributes to their digestive health and the ecological management of spaces. Concentrated feed, necessary during the critical phases of growth, lactation and gestation, provides a dense source of energy and protein, thanks to ingredients such as cereals and oilseed cakes (İkikat Tümer et al., 2020). Mineral and vitamin supplements are included to prevent any deficiencies, thus guaranteeing optimal goat breeding in compliance with the welfare and performance standards dictated by European regulations.

Feeding pigs

Pigs are omnivorous mammals, which means that their bodies assimilate products of both animal and plant origin. In the European Union they consume a variety of feed ingredients to meet their nutritional requirements at different stages of growth and production. The composition of pig diets typically includes a mixture of cereals, protein sources, vitamins, minerals, and additives. His feeding process meets strict quality and health requirements. Pigs have small stomachs, so they need to eat several meals a day. Pig breeders ensure that their animals are fed a diet adapted to their needs. To do this, they refer to feeding tables that correspond to each physiological stage of the animal and its particular needs.

To feed his pigs, farmers turn to feed manufacturers who supply them with ready-made fodder perfectly calibrated according to the age or nature of his animals.

Some farmers have chosen to manufacture their own feed. This is the case for over 35% of breeders, who either grow their own feed or buy the raw materials directly, mainly cereals and oilseeds. They then adjust their own dosages to meet the physiological needs of their animals (La-Viande.fr, "L'alimentation des porcins", n.d.).

Small ruminant (sheep, goat and pig) health and disease control

From the very first animal, and whether for professional or private purposes, sanitary obligations are the crucial as stated by national authorities. This encompasses identification of animals (allocation of identification tags to dedicated services) and notification of their movements. A livestock register must be kept, and presented to the veterinary surgeon at each visit and to inspection officers.

Prophylaxis is mandatory. Regulations typically include:

> Smallholders with five (or more) small ruminants over six months of age are not subject to the brucellosis qualification requirement, and are therefore not included in the mandatory screening.
>
> Ovine and caprine brucellosis prophylaxis is compulsory in sheep, goats and mixed flocks every five years.

In goat and sheep flocks whose milk or milk products are intended for human consumption in the raw state, prophylaxis is carried out annually (Préfète de la Mayenne, n. d.)

Welfare of small ruminants (sheep, goats and pigs) and environmental factors

Ensuring the health safety of small ruminants means first and foremost planning and designing the living areas for the animals, guaranteeing their comfort, as well as the cleanliness and atmosphere of the buildings (temperature, air quality, hygrometry, light).

The layout of the building and its immediate surroundings must be taken into account in preventing contamination risks. The area around the building must be kept clean and tidy (no garbage stored along the walls) to avoid the presence of pests (rodents, birds, insects).

In order to ensure optimum health safety for the herd, small ruminant breeding includes:

A quarantine zone: this is the area in which animals coming from outside are isolated from the rest of the farm for at least 30 days. This isolation allows new animals to adapt to the

environment and prevents the spread of disease. Particular attention should be paid to animals coming from other production sites.

An infirmary: this is where sick animals are isolated. This enables them to be treated appropriately, thus preventing transmission of the disease to the rest of the herd.

A loading and unloading dock: located outside the rearing area to prevent the driver from coming into contact with the herd.

A sanitary lock: this is the area dedicated to washing hands and changing clothes before entering the sheep or goat farm.

Water intended for the watering of small ruminants is not subject to any regulations setting quality standards, unlike water intended for human consumption, which must meet potability criteria. The only regulatory requirement is that it be of adequate quality, and to meet this requirement, a number of criteria have been defined.

Finally, it is important to ensure that pipes, spaces and equipment are properly cleaned and disinfected (Lanxess, n.d.).

Marketing of live small ruminants, meat products, dairy products, etc.

Live small ruminants are often sold on local, national and international markets for breeding, rearing or slaughter. Breeders may choose to sell directly to consumers, at livestock markets, or to specialised traders. Meat products, such as lamb, mutton, goat and pork, are sold via butchers, supermarkets, restaurants and markets. Dairy products, such as goat's and sheep's milk, cheese and yoghurt, are also sold through a variety of distribution channels, from small artisanal farms to large retail chains. The marketing of these products is regulated by strict quality and food safety standards, in line with EU legislation. Farmers must also comply with traceability rules to guarantee product safety and consumer confidence. Furthermore, the marketing of small ruminants and their products often depends on the seasons, market trends and consumer preferences, requiring producers and processors to constantly adapt their marketing strategies.

Cooperatives and their advantages in small ruminant farming (sheep, goats and pigs)

Cooperatives are a crucial pillar of small ruminant farming, offering a range of benefits to their members. They facilitate market access by enabling group sales of products, opening up export opportunities and the development of collective brands. In addition, these structures encourage the sharing of resources and knowledge, reducing costs and improving efficiency through access to advanced farming equipment and practices. By pooling risks, cooperatives offer financial stability in the face of market fluctuations and climatic hazards, while facilitating access to financing and strengthening members' bargaining power vis-à-vis buyers and suppliers.

In addition, cooperatives often engage in sustainable development and social responsibility practices, contributing to the preservation of the environment and the well-being of local communities. In this way, they play a crucial role in promoting the sustainability of the agricultural industry and improving the living conditions of farmers and their families. By offering a collaborative and supportive framework, cooperatives strengthen farmers' resilience and contribute to the sustainability of small ruminant farming operations.

3.3. Poultry farming

Poultry refers to the animals that belong to the farmyard, and game birds born and raised in captivity are included in this group (e.g., quail, pigeons, ducks). Poultry meat is the second most produced and consumed type of meat in the European Union, after pork. The poultry sector is known as one of the most intensive livestock farming systems in the European Union. Some farms have more than 100,000 birds.

Poultry types and characteristics

Poultry are classified according to the colour of their flesh, which is either white or red.

White-fleshed poultry:

- Chicks, cockerels: weight less than or equal to 0.800kg
- Chickens and pullets (before sexual maturity) weighing over 0.800kg
- Roasting roosters and capons
- Chickens and roosters
- Turkeys and poults

Brown-fleshed poultry:

- Ducks
- Geese
- Guinea fowl
- Pigeons
- Farm-raised quail

Breeding types are exemplified below showing distinction made in the French agricultural sector:

Industrial (confinement): fast-growing strain, generally slaughtered at 41 days of age, with up to 20,000 individuals per building.

Label rouge (confinement): slow-growing strain, generally slaughtered at 81 days of age, with up to 6,000 animals per building.

Label rouge (semi-free-range): slow-growing strain, generally slaughtered at 81 days of age, with up to 4,000 animals per building.

Appellation d'origine contrôlée (total freedom): slow-growing stock, generally slaughtered at 110 days of age, with numbers ranging from 500 to 1,000 per wooden shelter (Appellation d'origine controlee (2024).

Poultry feed (rations, concentrates), nutrition and feeding principles

Thinking about/implementing a balanced poultry feed and its components is the best way to ensure good animal health, optimal growth, effective control of feed costs, which account for nearly 70% of production costs, and final product quality (meat or eggs).

A breeder can make several choices:

- manufacture feed on the farm,
- buy a complete feed from professional feed suppliers,
- buy a supplement from professional feed suppliers to mix with your own raw materials.

This is standard practice for our standard chicken farms. Farm-grown wheat is mixed with a specific, nutritionally-adapted supplement.

Essential nutrients

A precise knowledge of poultry requirements is an essential prerequisite for a balanced diet. These requirements vary according to species and rearing phase (start-up, growth, finishing). They are scientifically defined and mastered by nutritionists.

Proteins are essential for muscle growth and egg production. They generally come from sources such as soy, corn, peas, beans and oilseeds.

Lipids provide energy and essential fatty acids for poultry. They are found in foods such as oilseeds, vegetable oils and animal fats.

Carbohydrates are an important source of energy for poultry, and are found in feeds such as corn, wheat, barley and other cereals.

Vitamins, including A, D, E, K and B-complex vitamins, are essential for poultry health and reproduction. They are often added to feed in the form of vitamin supplements.

Minerals such as calcium, phosphorus, magnesium, potassium and sodium are necessary for bone development, muscle and nerve function, and other biological processes. They are supplied through the diet or in the form of mineral supplements.

Finally, water is a crucial nutrient for poultry, necessary for many biological functions, including digestion, body temperature regulation and waste elimination. Poultry must have constant access to clean, fresh water.

The balance and quality of these nutrients in feed are essential to ensure the health, growth and productivity of poultry in the European Union. EU feed regulations ensure that poultry feed meets the highest nutritional and safety standards (Cellule d'Information Agriculture, 2021)

Poultry health and disease control

Diseases with multifactorial origins can sometimes occur on livestock farms. To cope with the development of these diseases, livestock farmers need to be technically skilled and integrate a number of factors into their operations. As a result, there is a strong demand for preventive references, particularly in organic farming where conventional treatment options are virtually non-existent.

Foundation

Organic livestock farming must meet high animal welfare standards addressing the behavioural needs of specific animal species with the aim of disease prevention. Preventive measurements include housing conditions, breeding practices and stocking densities. In addition, the choice of breeds must take into account the animals' ability to adapt to local conditions.

Organic farming regulations make disease prevention a priority in a context where the use of drugs is restricted. Prevention is based on actions on the external environment (soil, housing), on feed, on the animal itself (behaviour, handling, well-being, etc.), on preventive practices to stimulate disease resistance, on breeding practices and on stocking density. For veterinary treatments, alternative methods such as phytotherapy, homoeopathy, trace elements should be considered

Poultry pathogens include:

Bacteria: In poultry, we can find coronaviruses (infectious bronchitis), metapneumoviruses (RTI, SIGT), paramyxoviruses (Newcastle disease), orthomyxoviruses (avian influenza).

Viruses: Poultry can contain endoparasites such as nematodes (worms), single-celled organisms (coccidia) or ectoparasites such as lice, ticks or mange mites.

Fungi: In poultry, Aspergillus fumigatus (responsible for aspergillosis), or Candida albicans (responsible for candidiasis) are found.

Disease prevention

To prevent the development of diseases linked to pathogens, sanitary measures on farms refer to suitable levels of biosecurity (e.g., sanitary airlock for people entering, delimited breeding zone, definition of production units), a good level of biosecurity (e.g., sanitary airlock for people entering, delimited breeding zone, definition of production units), site hygiene (e.g. cleaning and disinfection of buildings between each batch, rodent and insect control), complete periodic sanitary vacuum of the site, good water and feed quality. In addition, certification stating organic farming alongside with alternative medical treatments such as phytotherapy (a frequently used method based on the use of plants) or aromatherapy (based on the use of aromatic plant extracts known as essential oils) are preferable.

Vaccines are preventive tools frequently used in poultry farming. They are most often administered to prevent viral diseases, but some vaccines have also been developed against bacterial and parasitic diseases (Institut technique de l’Agriculture Biologique, n. d.).

Poultry welfare and environmental factors

Whatever the type of poultry and the techniques used, buildings are subject to rules designed to guarantee the comfort and good health of the animals. Well-ventilated, well-heated and well-cleaned, modern poultry houses, like those of yesteryear, provide a safe haven for birds that fear the elements and predators. They also need to be lit for the right length of time and at the right intensity - poultry need periods of darkness at night. What's more, their ventilation and heating systems must ensure air renewal, the right level of humidity and the right temperature.

Indoors, chickens, turkeys and guinea fowl are kept on a litter of chopped straw or shavings that covers the floor. The litter is kept dry and comfortable to ensure a healthy atmosphere and excellent hygiene in the henhouse at all times.

All buildings and equipment are thoroughly cleaned and disinfected before any new chicks arrive, and the hygiene rules for entering them are particularly strict, in line with the health charters drawn up by the industry in conjunction with the public authorities.

In addition to chicken coops, when it comes to free-range poultry (Organic, Label Rouge, PDO), the animals have access to outdoor areas to explore, peck, roll in the dirt, and enrich their diet. If they are labelled "Free-range", the outdoor area is fenced with a space of at least 2 m^2 per bird. If they are "Raised in freedom", their range is unlimited, without fencing (Info, 2023).

Poultry marketing

Poultry marketing in the EU is a dynamic and diverse process, with a range of players and channels involved in the sale and distribution of poultry products. Poultry, whether fresh, frozen or processed, is marketed through a variety of channels, including wholesale markets, supermarkets, butchers, restaurants, canteens, local markets and producers' direct outlets. Large retailers play a major role in poultry marketing, purchasing large quantities from producers and distributing them through their store networks. At the same time, many small-scale producers sell their products directly to consumers via farmers' markets, farm stores, local produce baskets and online platforms. Poultry marketing in the EU is regulated by strict food safety, hygiene and animal welfare standards, ensuring product quality and safety for consumers.

European chicken and egg producers are financially supported by the Common Market Organization under the Common Agricultural Policy (CAP), which regulates trade, marketing standards and exceptional support measures in the event of epidemics.

Cooperatives and their advantages in poultry farming

Poultry cooperatives jointly market the animals and/or eggs of their member farmers. With the aim of achieving better remuneration for breeders, they are particularly involved in setting up quality chains. In addition to this marketing mission, they advise their member breeders on various aspects such as optimising technical and economic performance, health monitoring, animal welfare and reducing environmental impact.

3.4. Aquaculture

Aquaculture is the rearing or cultivation of aquatic organisms (at sea, in coastal or inland areas), in particular fish, molluscs, crustaceans and aquatic plants. The term "culture" implies some form of intervention in the rearing process to improve production, such as regular stocking,

feeding and protection from predators. It also covers individual or legal ownership of farmed stock, the planning, development and operation of aquaculture systems, sites, structures, practices, production and transport.

Animal types and characteristics in aquaculture

Aquaculture encompasses several types of farming, such as pisciculture (fish farming), conchyliculture (shellfish farming: oysters, mussels, clams, cockles, etc.), algoculture (seaweed farming) and carcinoculture (shellfish farming, mainly shrimp and crayfish). It can be both marine (seawater) and continental (freshwater).

Here are some of the types of animal commonly farmed in the EU:

Fish: The most common species farmed in the EU include salmon, trout, carp, sea bass, turbot, sea bream and sole, among others.

Crustaceans: Shrimps are among the most important crustaceans raised in fish farms.

Molluscs: mussels, oysters and clams are just some of the molluscs.

Feeding (rations and concentrates), nutrition and feeding principles

An adequate feed ration in aquaculture must provide a balance of proteins, lipids, carbohydrates, vitamins and minerals, in precise quantities to optimise growth and minimise production costs while reducing environmental impact.

Concentrated feeds in aquaculture are formulated to concentrate a large quantity of nutrients in a small volume, making them effective for feeding large numbers of fish or other aquatic species in confined spaces. These feeds can be presented in a variety of forms, such as pellets, floating pellets or sinking pellets, and are designed to be easily ingested and digested by the animals. The formulation of these feeds takes into account the digestibility of the ingredients, the stability of the feed in water, and the ability to provide a balanced diet that meets the nutritional requirements of the target species.

Feeding principles

EU aquaculture feeding principles emphasise sustainability, feed efficiency and reduced environmental impact. This includes using alternative and sustainable protein and lipid sources, reducing feed waste through precise and controlled feeding, and adapting diets to improve animal health and disease resistance. EU regulations on aquatic feed are also strict, with high standards of food safety and quality to protect both human health and the environment (Gouvello & Simard, 2017).

Animal health and disease control

In the European Union, several directives govern disease control and animal health in aquaculture.

Scope of application

The directive does not apply to fish or shellfish used for decorative purposes, caught in their natural environment or intended for processing into fishmeal, fish feed, fish oil or similar products.

Approval

National authorities in EU countries must ensure that all fish farms are approved.

To receive approval, farms must:

- keep a register of all fish and shellfish entering and leaving their premises;
- demonstrate high levels of hygiene;
- implement an animal health surveillance program based on risk analysis to detect the presence of any disease and any increase in mortality.

National authorities must draw up, keep up to date and make public a register of approved fish farms.

Disease prevention

- The directive establishes a list of diseases and the species susceptible to them.
- Disease prevention measures must be applied when transporting aquaculture animals.
- Farmed fish and shellfish must be in good health. They must be accompanied by an animal health certificate when intended for sale.
- Imported fish and shellfish must meet EU health requirements.
- The EU may decide to carry out inspections of the farms from which they originate.

Notification

- Farm owners and veterinarians must report any increase in mortality or suspected disease to the relevant authorities.
- Within 24 hours of confirmation of the presence of a disease, national authorities must notify other EU countries and the European Commission, as well as Iceland, Liechtenstein, Norway and Switzerland.

Disease control

- If the presence of a disease is suspected, control measures such as laboratory testing and farm quarantine are taken.
- When the presence of a disease is confirmed, the authorities:
    - officially declare the farm infected;
    - establish a containment zone, with protection and surveillance perimeters;
    - prohibit the restocking and movement of fish and shellfish.

- EU countries must meet specific requirements before being granted "disease-free" status.

Commission specialists accompanied by representatives of national authorities can carry out on-site inspections. If they wish, national authorities can take more stringent measures (EUR-Lex, 2020).

Animal welfare and environmental factors

Animal welfare: a new priority for European aquaculture

The strategic guidelines for more sustainable and competitive aquaculture in the European Union for the period 2021-2030 will be used to guide subsidies from the European Maritime Affairs and Fisheries Fund.

The animal welfare section includes:

- the development of good breeding, transport and slaughter practices;
- defining species-specific welfare indicators throughout the production chain;
- continued research and innovation, particularly on species-specific welfare parameters;
- fish welfare training for fish farmers and other operators handling farmed fish.

Other animal welfare measures are listed:

- identify good breeding practices, in particular environmental enrichment ;
- better prevent disease and parasitic infestations ;
- develop research into fish microbiomes, the possible effects of climate change on their health and the impact of stress on their immune systems;
- promote the exploitation of herbivorous fish species, mollusks and other invertebrates, as well as algae;
- guarantee sustainable food systems, including by limiting dependence on fishmeal and fish oil from wild stocks;
- improve breeding practices to reduce the use of veterinary products and other chemical substances (La Fondation Droit Animal, 2021)

Marketing of aquaculture animals

Marketing aquaculture animals is a crucial process involving several stages to ensure efficient distribution of aquatic products to markets. Here are the main steps involved in marketing aquaculture animals:

Production and breeding: It all starts with the breeding of aquatic animals in specialised facilities such as fish farms, ponds, sea cages or shellfish beds. The animals are fed, monitored and cared for to ensure their growth and health.

Harvesting: Once aquatic animals have reached an appropriate size or stage of maturity, they are harvested. The harvesting method depends on the type of animal and the specific practices of each species. For example, for fish, this may involve fishing, netting, or vacuum harvesting

from ponds, while for molluscs such as oysters and mussels, it usually involves scraping from shellfish beds.

Transformation: After harvesting, animals may undergo a transformation process that may include cleaning, sorting, evisceration, skinning, filleting or other processes depending on the type of animal and market requirements.

Packaging: Aquatic products are then packaged appropriately for transport and sale. This may include vacuum packing, packing on ice, or using special containers to maintain product freshness.

Distribution: Aquatic products are distributed to local, regional, national or international markets according to demand and availability. Distribution channels may include direct sales to consumers, wholesale to retailers or restaurants, or even export to other countries.

Marketing and sales: Finally, aquatic products are marketed and sold to consumers. This can be done through a variety of sales channels, including fish markets, supermarkets, fishmongers, restaurants, local markets, food fairs, e-commerce sites, and other outlets.

Successful marketing of aquaculture animals requires careful planning, effective supply chain management, and attention to quality, food safety and environmental sustainability.

Cooperatives and their advantages in aquaculture

The main reasons for individual producers to create new cooperatives or join existing producer organisations are as follows:

- **Strengthen breeders' market position through increased market access**
- Provide technical assistance to members to improve end-product quality and/or production efficiency (notably through better access to technical knowledge and risk management mechanisms).
- Improve aquaculture governance (including participation in policy-making, reducing the administrative burden, promoting spatial planning for aquaculture, ensuring food supply and safety, and guaranteeing supervision and data collection in the aquaculture sector).
- Create the conditions for sustainable growth in aquaculture through optimised environmental performance (in particular through assessment and control of the environmental impact of aquaculture activities, promotion of good practices to improve animal health and welfare, promotion of sustainable exploitation of fisheries resources and improvement of the carbon footprint).
- Promote the competitiveness of EU aquaculture production (in particular through better knowledge of the market to align supply and demand, and involvement in research and development activities to make the aquaculture sector highly efficient).
- Promote a level playing field, in particular with imports from third countries (notably through the application of sustainability, production and social standards equivalent to those applied to EU products).
- Improve the social acceptability of the sector (notably by raising public awareness of aquaculture and its products, and improving consumer information through notification and labelling) (Conseil consultatif de l'aquaculture, 2021)

3.5. Conclusions and recommendations

This chapter on animal husbandry in the European Union provides an overview of the practices, standards and regulations that govern this crucial sector. Providing information on the different species of farm animals and best practices.

For M/Rs wishing to enter this field, specialised training in EU breeding practices is obligatory to familiarise them with current standards and regulations. Participation in mentoring programs and professional networks can also be beneficial for acquiring practical skills and establishing industry contacts. In addition, it is crucial for M/Rs to understand societal expectations in terms of sustainability, animal welfare and food safety, and to integrate them into their farming practices.

Finally, a proactive attitude, an openness to continuous learning and a commitment to environmental and social best practices are key to success in the European livestock sector. By following these recommendations and committing themselves fully to the EU's livestock standards and values, M/Rs can find rewarding and sustainable opportunities in this dynamic and essential sector of the European economy.

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Module 4

Innovations in Agricultural Production (ILA)

Mehmet Altunbaş

Sefer Demirci

In this chapter, you will focus on training migrants and refugees (M/Rs) in the agricultural sector, covering key areas such as agricultural accounting, insurance, agricultural supports, and modernisation in tools and machinery, emphasising drone technology. You will also delve into cooperatives and marketing strategies. Each section is tailored to improve your understanding of modern agriculture's financial, technological, and marketing facets and equip you with vital skills for active participation in the agricultural workforce. This chapter aims not only to develop your personal skills but also to contribute to the sustainable growth of the agricultural sector, benefiting both the host and home countries of M/Rs.

4. Innovations in agricultural production

4.1. Agricultural accounting

This chapter is designed for those new to the agricultural sector, especially migrants and refugees who are looking to build a career in agriculture. Our focus is on introducing you to the basics of agricultural accounting, an essential skill for anyone involved in farming.

In this section, you will learn on how to:

- Keep track of your expenses and income
- Make informed decisions about your farming activities
- Plan for the future and ensure your farm remains sustainable

Agricultural accounting is a type of accounting that's specifically tailored to the needs of farms and agricultural businesses. Like any business, a farm needs to keep track of its income and expenses. However, farming has unique accounting needs, such as tracking crop cycles, livestock management, and equipment costs.

Understanding agricultural accounting helps you manage your farm's finances effectively. Here is a set of key concepts in agricultural accounting.

Recording Transactions

Recording transactions is a vital part of managing your farm’s finances. It involves keeping a record of every amount of money you spend or receive. For instance, when you buy seeds or fertiliser or when you sell your crops or dairy products, each of these actions should be recorded. You can use a simple notebook or a basic spreadsheet on a computer or smartphone. In your records, make sure to note down the date of the transaction, a brief description (like “bought tomato seeds” or “sold milk”), the amount spent or earned, and the method of payment (cash, bank transfer, etc.). It is like keeping a diary but for your farm’s money.

Keeping track of these details helps you see where your money is going and where it is coming from. This is essential for understanding how well your farm is doing financially. You don't need to be an expert in accounting; just be consistent in writing down every transaction. At the end of each week or month, take some time to look over your records. This will help you make smart decisions about spending and selling in the future. Remember, the key is to be regular and accurate in your record-keeping.

Understanding Assets and Liabilities

In farming, understanding your assets and liabilities is like knowing what you have in your pocket and what you owe to others. Assets are everything your farm owns that has value, like your land, animals, machinery, and crops growing in your fields. On the other hand, liabilities are like the promises you have made to pay someone back. This could be money you borrowed to buy seeds or a loan for a new tractor. It is important to keep track of these because knowing your assets and liabilities helps you see the true picture of your farm's financial health.

To manage your assets and liabilities, start by making a list. For assets, write down everything you own on the farm and estimate how much each item is worth. This could include the value of your land, the number of animals you have, and the price of any equipment or buildings. (Kontsevoy et al., 2020) For liabilities, list all the money you owe, like loans or bills that need to be paid. Keep this list updated regularly, especially when you buy new things or pay off debts. By comparing what you own to what you owe, you can clearly understand how well your farm is doing financially and make better decisions for the future.

Budgeting and Planning

Budgeting and planning are crucial for managing your farm's finances effectively. It is all about predicting your future expenses and income so you can make smart decisions about your farm. Imagine it like planning your household budget but for your farm. First, you list all the money you expect to spend in the coming months – this includes buying seeds, fertilisers, paying for labour, and maintaining your equipment. Then, you estimate how much money you will make from selling your crops or livestock. (Argilés & Slof, 2001)

To do this, start with a simple notebook or a spreadsheet if you can access a computer. Write down all the expenses you can think of for the next planting season. Remember to include small things like transportation or utility bills. Then, think about how much you might earn from your farm products. Be realistic – it is better to underestimate income and overestimate expenses. This planning helps you see if you have enough money to cover all costs and where you can save money. If your expenses are more than your income, you might need to find ways to reduce costs or increase your farm's production. This way, you keep your farm running smoothly and avoid financial surprises.

Inventory Management

Inventory Management is all about keeping track of what you have on your farm. It means knowing how many seeds, fertilisers, animal feeds, and other supplies you have at any time. This is important because it helps you understand what you need to buy and what you can use for your next crop or livestock, and it prevents you from wasting things or running out unexpectedly. Regular updates prevent your shortages and overstocking, ensuring operational efficiency (Korobeynikova et al., 2021).

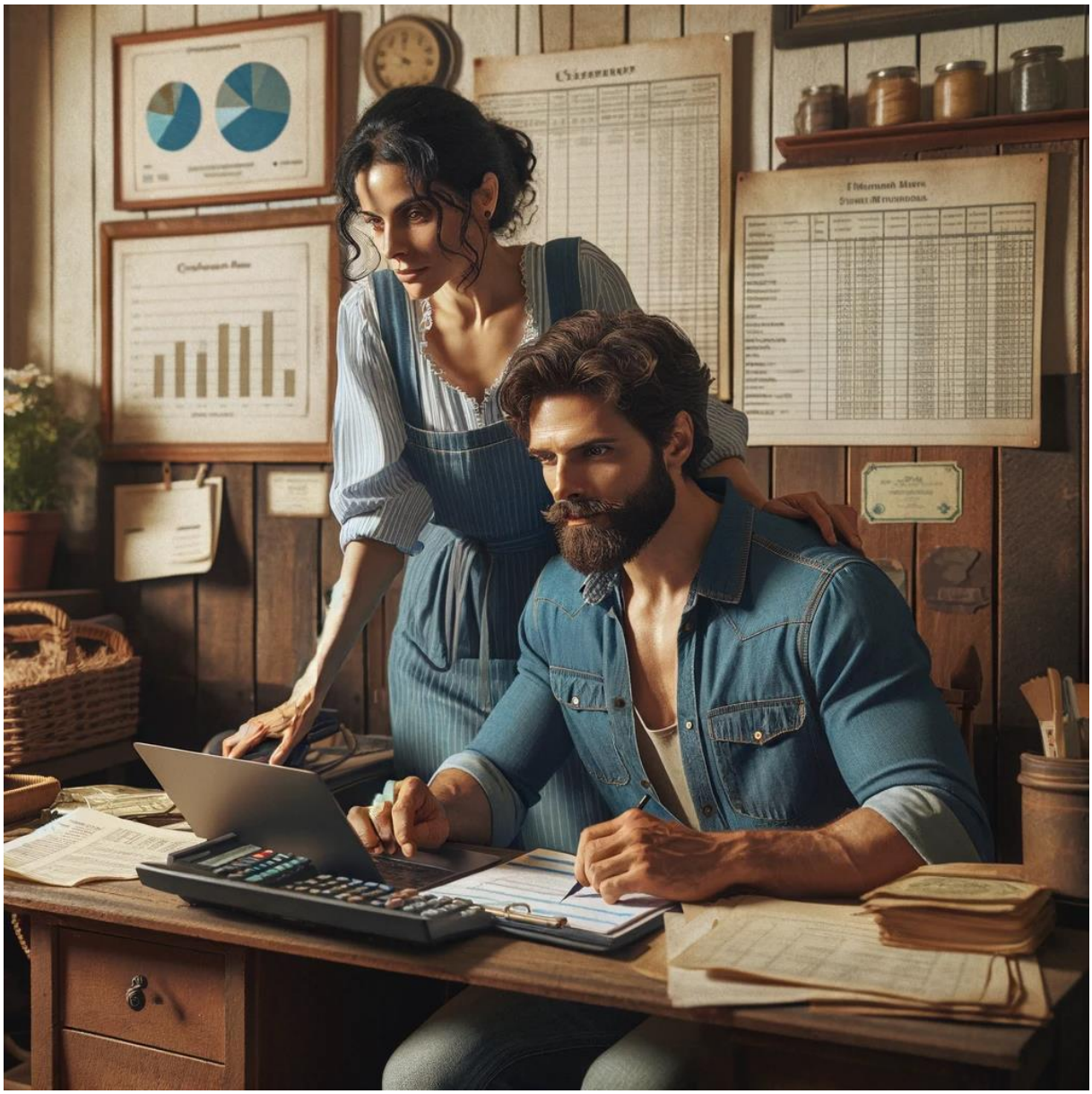
To do inventory management, start by making a simple list of everything you have – like a shopping list. Every time you buy something new, add it to the list with the date and how much it costs. When you use seeds for planting or animal feed, write down how much you used. This way, you always know what is left. You can do this on paper, in a notebook, or use a basic spreadsheet on a computer or smartphone if you are comfortable with that. Checking and updating your list regularly, like once a week, will help you stay organised and make better decisions for your farm.

Analysing Farm Performance

Understanding how well your farm is doing is important. This is called "Analysing Farm Performance," and it is like giving your farm a health check. To do this, you need to compare the money you spend (expenses) with the money you earn (income). First, add up all the money you spend on things like seeds, tools, and animal feed. This is your total expense. Then, add up the money you got from selling crops or livestock. This is your total income. If your income is more than your expenses, your farm is doing well. But if it is less, it means you are spending more than you are earning, and you might need to find ways to cut costs or increase sales. (Cowie et al., 2012)

Another way to check your farm's performance is by looking at the number of crops you grow or animals you raise and how much you sell them for. If you are growing more crops or raising more animals than before, and you are selling them for a good price, it means your farm is improving. Keeping simple records of these numbers regularly, like in a notebook or a basic computer spreadsheet, can help you see how your farm is doing over time. This way, you can make better decisions, like what crops to plant next season or how to improve your farming methods. Remember, the key is to keep track regularly and use this information to help your farm grow.

Case Study: Maria and Juan



Introduction: Imagine a small family-owned farm located in a rural area, primarily focusing on organic vegetable production. The farm is run by Maria and Juan, migrants who have successfully run their own small-scale organic farm for five years. Despite having rich agricultural knowledge and producing high-quality vegetables, they struggled with managing their finances effectively.

Challenge: Maria and Juan faced difficulties in tracking their expenses and revenues. They often mixed personal finances with their business finances, leading to confusion about the farm's actual profitability. Additionally, they had no clear records of their input costs (like seeds, fertilisers, labour) and output sales, making it hard to plan for future investments or expansions.

Solution: To address these challenges, Maria and Juan decided to implement a simple yet effective agricultural accounting system. They started by separating their personal finances from their business finances, opening a new bank account exclusively for the farm.

They then began recording all financial transactions related to the farm. They tracked expenses such as seed purchases, equipment maintenance, labour costs, and other operational costs. They also recorded all income from selling their produce, whether at local markets, to restaurants, or through community-supported agriculture (CSA) memberships. Maria and Juan used a basic spreadsheet to organise their financial data. They categorised each transaction and updated the spreadsheet regularly. This practice helped them to see clear patterns in their finances, like which crops were most profitable and when their expenses were highest.

Impact: After years of diligent agricultural accounting, Maria and Juan gained valuable insights into their farm's financial health. They could identify cost-effective crops and eliminate or reduce less profitable ones. They also better understood their seasonal cash flow, allowing them to plan for lean periods and invest wisely during more profitable times. Furthermore, with clear financial records, they could apply for a small business loan to expand their operations. They added a new greenhouse, increasing their capacity to grow vegetables year-round, thus boosting their income.

Conclusion: Maria and Juan's case illustrates the importance of agricultural accounting in running a successful farming business. They gained control over their farm's financial health by keeping accurate financial records and separating their personal and business finances. This simple yet effective approach enabled them to make informed decisions, leading to sustainable growth and increased profitability for their small farm.

4.2. Agricultural insurance

Insurance in agriculture plays a critical role in protecting farmers from unexpected events that can impact their crops and income. Agricultural insurance is like a safety net. It is a way for farmers to protect themselves from losses caused by things they cannot control, like bad weather, diseases, or pests. When you buy insurance, you pay a small amount of money (called a premium) to an insurance company (Ikikat Tümer, 2011). In return, if something terrible happens to your crops or livestock, the company will help cover your losses.

In this section, you will learn:

- Types and benefits of agricultural insurance
- How to choose the right insurance plan
- Steps to buy and use farm insurance
- How insurance stabilises farming income

There are different types of agricultural insurance, and it is important to know which one is right for you. Crop Insurance protects against the loss of your crops due to natural disasters like floods, drought, and pests (Ikikat Tümer et al., 2019). Livestock Insurance covers your farm animals if they get sick, injured, or die due to unforeseen events. If your tools or machinery break down unexpectedly, Farm Equipment Insurance helps cover the cost of repair or replacement (Meuwissen et al., 2003).

Agricultural insurance is like a protective shield for your farm. It helps you in two big ways. First, it gives you security. Imagine you have a field full of crops, and a big storm comes and destroys them. Without insurance, you might lose all the money you spent on planting those crops. But if you have insurance, the company you bought it from will pay you some money to help cover your losses. This means you will not lose everything and can keep farming. Second, insurance brings stability. Farming can be uncertain – some years are good, others not so much. Insurance ensures that even in bad years, when your crops don't grow well or your animals get

sick, you still have some income. This helps you plan for the future without worrying too much about what will happen if things go wrong (Birinci & Ikikat Tümer, 2006; İkikat Tümer, 2011).

To get agricultural insurance, start by looking at what risks your farm faces. Do you need protection against floods, or are insects and diseases a bigger problem for your crops? Once you know what you need, compare different insurance plans. Look at what they cover and how much they cost. The cost of insurance, called a premium, is a small amount you pay regularly to the insurance company. It is important to find a balance – choose a plan that gives you enough protection but is also affordable. When you decide on a plan, you'll need to sign up for it, usually through an insurance agent or directly with an insurance company (Ikikat Tumer & Birinci, 2020). After that, if something bad happens to your farm, you can file a claim with the insurance company, and they will help cover your losses as per the agreement. Remember, having insurance means you are better prepared for the ups and downs of farming, and it helps keep your farming business strong and steady.

Case Study: Maria and Juan

Introduction: Maria and Juan's small family farm had flourished with the help of efficient accounting. The next step in securing their farm's future was to explore agricultural insurance, a crucial aspect they had previously overlooked.

Challenge: Despite their success, Maria and Juan's farm was vulnerable to unforeseen events like extreme weather, pests, and diseases. These uncertainties posed significant risks to their income and long-term sustainability. They realised the need for a safety net to protect against potential losses but were uncertain about the types of agricultural insurance available and suitable for their specific needs.

Solution: To tackle this challenge, Maria and Juan conducted research and sought advice from insurance experts and other farmers. They learned about different insurance options, including crop insurance that covers losses due to natural disasters and liability insurance for any accidents that could occur on their farm. They decided to opt for a comprehensive insurance plan that covered both crop damage and liability. This plan was particularly suited to their farm's size and

the nature of their organic vegetable production. They made sure the insurance policy was tailored to cover the most common risks in their region, such as drought and pest infestations. Maria and Juan also ensured that the insurance premiums were affordable and justified by the coverage benefits. They used their improved financial records to accurately assess their farm's value and potential risks, helping them choose an insurance plan that provided adequate coverage without straining their budget.

Impact: With agricultural insurance in place, Maria and Juan gained peace of mind, knowing they were better prepared for uncertainties. In the following year, when their region faced an unexpected pest outbreak, their insurance policy covered a significant portion of their crop losses, preventing a major financial setback. This security allowed them to continue investing in their farm without the fear of losing everything to unforeseen events. It also demonstrated to their workers and community their commitment to a stable and sustainable farming operation.

Conclusion: Maria and Juan's adoption of agricultural insurance illustrates its importance in managing the risks associated with farming. By selecting the right insurance policy for their needs, they were able to safeguard their farm's financial health against natural disasters and other risks. This case underscores the value of agricultural insurance as a critical tool for the longevity and stability of farming businesses.

4.3. Agricultural supports

Agricultural support is financial support given by the government to farmers and agricultural businesses. Think of them as special help that makes farming a bit easier and more successful. Agricultural support can come in different forms, like direct payments, tax breaks, low-cost resources, tools, or even advice on how to farm better.

In this section, you will learn:

- Identify types of agricultural support
- Understand the benefits of government aid
- Recognise effects on food prices
- Learn about global agricultural policies

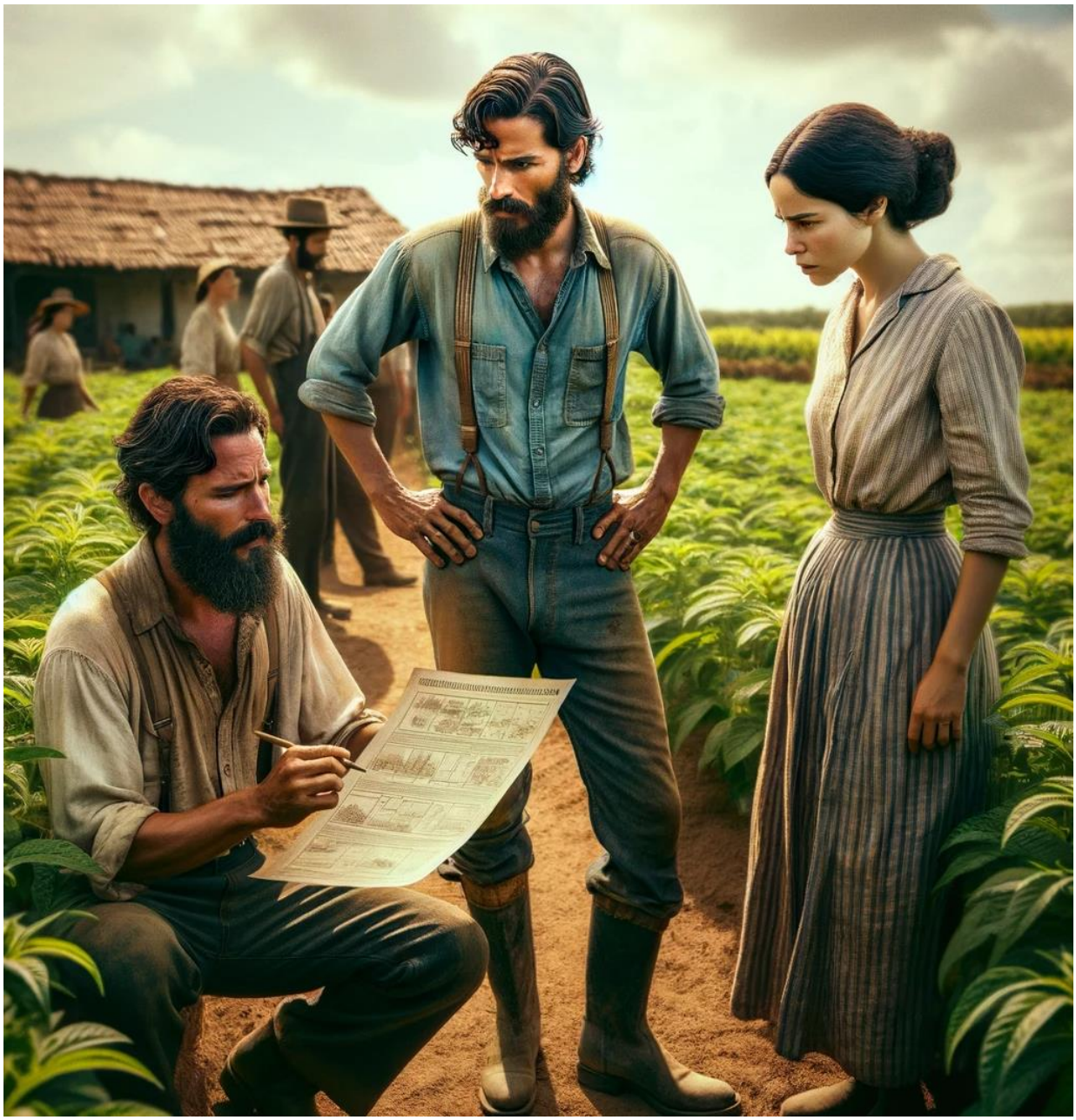
Agricultural support helps you when things get tough, such as when the weather is bad or prices are low. It can also encourage you to grow certain types of crops that the country needs. This is important because what you grow and how you grow it affects everyone's food supply.

The rules about agricultural support can change depending on the country. Sometimes, governments give money directly to farmers. This extra money can help pay for seeds, equipment, or other farming needs. In other cases, the government might pay a part of the cost for things like insurance (Ozer and Ikikat Tumer, 2020), which helps protect you if your crops fail.

Agricultural support is also about making sure that food prices stay reasonable for everyone. When you receive support, you can produce more food, and this can help keep food prices from going too high. This is good for both the people who buy food and those who grow it. For example, the Common Agricultural Policy (CAP) of the European Union, which represents significant financial support, has effects on economic efficiency, social equity, and environmental sustainability. It is designed to help farmers cope with fluctuations in demand,

weather, and prices, ultimately supporting the stability of food supplies and prices (Tarditi, 1998).

Case Study: Maria and Juan



Introduction: Maria and Juan's small family-owned farm let us explore how they utilised agricultural support to enhance their farming operations. After successfully implementing an agricultural insurance system, they sought additional ways to support and expand their farm, mainly through accessing agrarian support.

Challenge: Maria and Juan recognised the potential benefits of agricultural support but were initially overwhelmed by the complexity of agricultural support programs. They were unsure which agricultural support they were eligible for and how this could benefit their organic vegetable production. The couple was also concerned about the application process and compliance with the specific requirements of the agricultural support programs.

Solution: To address these challenges, Maria and Juan embarked on a journey to educate themselves about agricultural support. They attended local agricultural workshops and consulted with agricultural extension officers to understand the types of agricultural support available and their eligibility criteria. They discovered they were eligible for an agricultural support program for organic farmers. This program offered financial assistance for practices that promote soil health, reduce chemical usage, and conserve water – all of which aligned with their farming methods. Maria and Juan meticulously prepared their agricultural support application, ensuring they met all requirements. They used their well-maintained financial records to demonstrate their farm's commitment to sustainable practices. Their application highlighted how the agricultural support would help them invest in better irrigation systems and organic fertilisers, leading to more sustainable and profitable farming.

Impact: Their application was successful, and the agricultural support significantly eased their financial burden. The funds allowed them to invest in a drip irrigation system, reducing water usage and costs. They also purchased high-quality organic fertilisers, enhancing their soil health and crop yields. With these improvements, Maria and Juan could increase their production and expand their market reach. The agricultural support also helped them maintain the sustainability of their farming practices, which is a core business value.

Conclusion: Maria and Juan's experience with agricultural agricultural support showcases the potential benefits these programs can offer small-scale farmers. By taking the time to understand and access these agricultural supports, they were able to make significant improvements to their farm. This case demonstrates the importance of seeking out and effectively utilising available resources, such as agricultural support, to support and grow agricultural businesses sustainably.

4.4. Modernisation in agricultural tools and machinery (drones)

In today's world, agriculture is rapidly changing, and modern tools and machinery are playing a big role in this transformation. A significant innovation in this area is the use of drones. Drones, also known as unmanned aerial vehicles (UAVs), are small, remote-controlled flying machines that can help farmers in many ways (Nazarov, 2023).

In this section, you will learn:

1. Define what drones are and how they operate
2. Monitor crop conditions using drone imagery
3. Enhance irrigation and conserve water with UAVs
4. Apply pesticides and fertilisers efficiently

Firstly, let us understand what drones are and how they work. Drones have cameras and sensors that capture images and data from above the fields. These images provide valuable information about the farm's crops, soil, and overall condition.

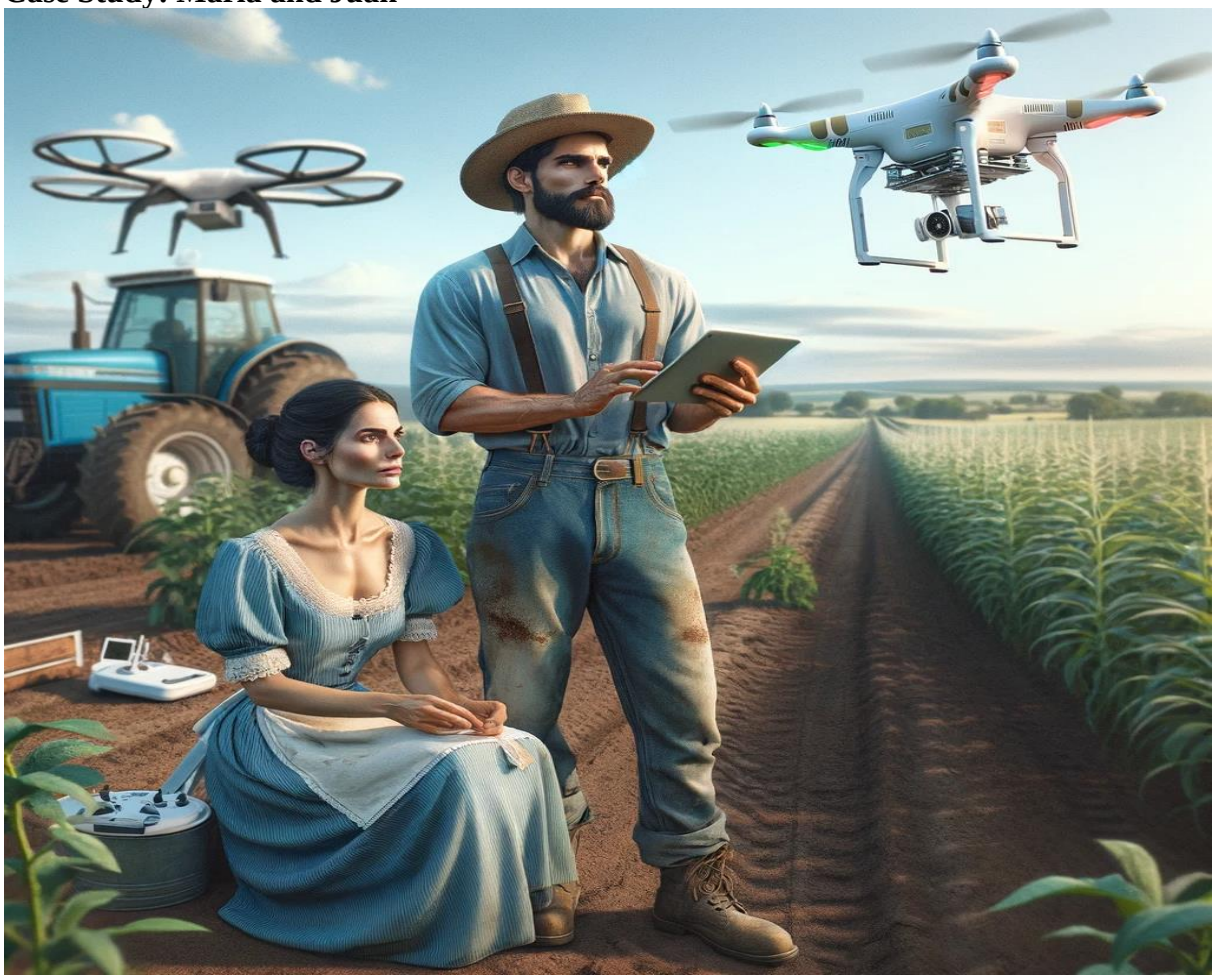
One of the main uses of drones in agriculture is for monitoring crops. Drones can fly over a large area quickly, allowing you to see how your crops are growing, identify any problems like pests or diseases, and take action to address these issues. This is much faster and more efficient than walking through the fields.

Drones are also helpful in improving irrigation. They can identify which parts of a field need more water, ensuring water is used efficiently. This is not only good for your crops but also helps conserve water.

Another important use of drones is in spraying pesticides and fertilisers. Drones can be equipped to spray your crops with great precision, which means less wastage of these materials and less harm to the environment.

Learning to operate a drone may seem challenging, but it becomes easier as technology improves. Most drones are user-friendly and come with simple controls and instructions. Many training programs and online resources are also available to help you learn how to use them effectively in farming.

Case Study: Maria and Juan



Introduction: Maria and Juan turned their attention to modernising their farm. They focused on integrating advanced tools and machinery, specifically the use of drones, to enhance their agricultural practices.

Challenge: Maria and Juan recognised that to stay competitive and sustainable, they needed to embrace technological advancements in agriculture. However, they were initially hesitant about the complexity and cost of implementing modern technology, especially drones. They were unsure about the practicality of drones in their relatively small operation and concerned about the learning curve associated with this new technology.

Solution: Determined to modernise their farm, Maria and Juan began researching the use of drones in agriculture. They attended demonstrations and workshops and consulted with tech-savvy farmers and agricultural technology experts. They learned that drones could be incredibly

beneficial for tasks like crop monitoring, irrigation management, and pest control. After careful consideration, they invested in a user-friendly agricultural drone equipped with cameras and sensors. The drone could efficiently survey their fields, providing data on plant health, soil conditions, and moisture levels. This information allowed Maria and Juan to make more informed decisions about irrigation, fertilisation, and pest control, leading to more efficient use of resources.

Impact: The introduction of the drone had a significant positive impact on their farm. The detailed aerial data helped them identify problem areas quickly, leading to timely interventions and reduced crop losses. They also managed to decrease their water and fertiliser usage due to the precise data provided by the drone, leading to cost savings and a smaller environmental footprint. Furthermore, showcasing their use of drone technology attracted positive attention from the local farming community and customers, positioning their farm as a forward-thinking and innovative operation.

Conclusion: Maria and Juan's venture into using drones represents the benefits of embracing modernisation in agricultural tools and machinery. By overcoming initial hesitations and investing in drone technology, they were able to improve the efficiency and sustainability of their farm operations. This case highlights the importance of staying abreast of technological advancements in agriculture and demonstrates how even small-scale farms can effectively integrate modern tools like drones to enhance their farming practices.

4.5. Cooperatives

A cooperative in agriculture is a type of organisation where farmers come together to achieve common goals. It is like a team where each member has a voice and can share resources, knowledge, and benefits. Imagine a group of farmers who decide to work together. They might buy seeds, tools, or machinery as a group, which can be cheaper than buying them alone. They also might sell their products together, getting better prices and reaching more customers than they could individually.

In this section, you will learn:

- Join and participate in farming cooperatives
- Leverage collective buying and selling power
- Make democratic decisions in a co-op
- Promote sustainability and fair conditions

In a cooperative, decisions are made democratically, which means every member has a say. It is not about how much money you have invested; each member gets one vote. This way, everyone's opinion is valued, and decisions are made for the benefit of all members.

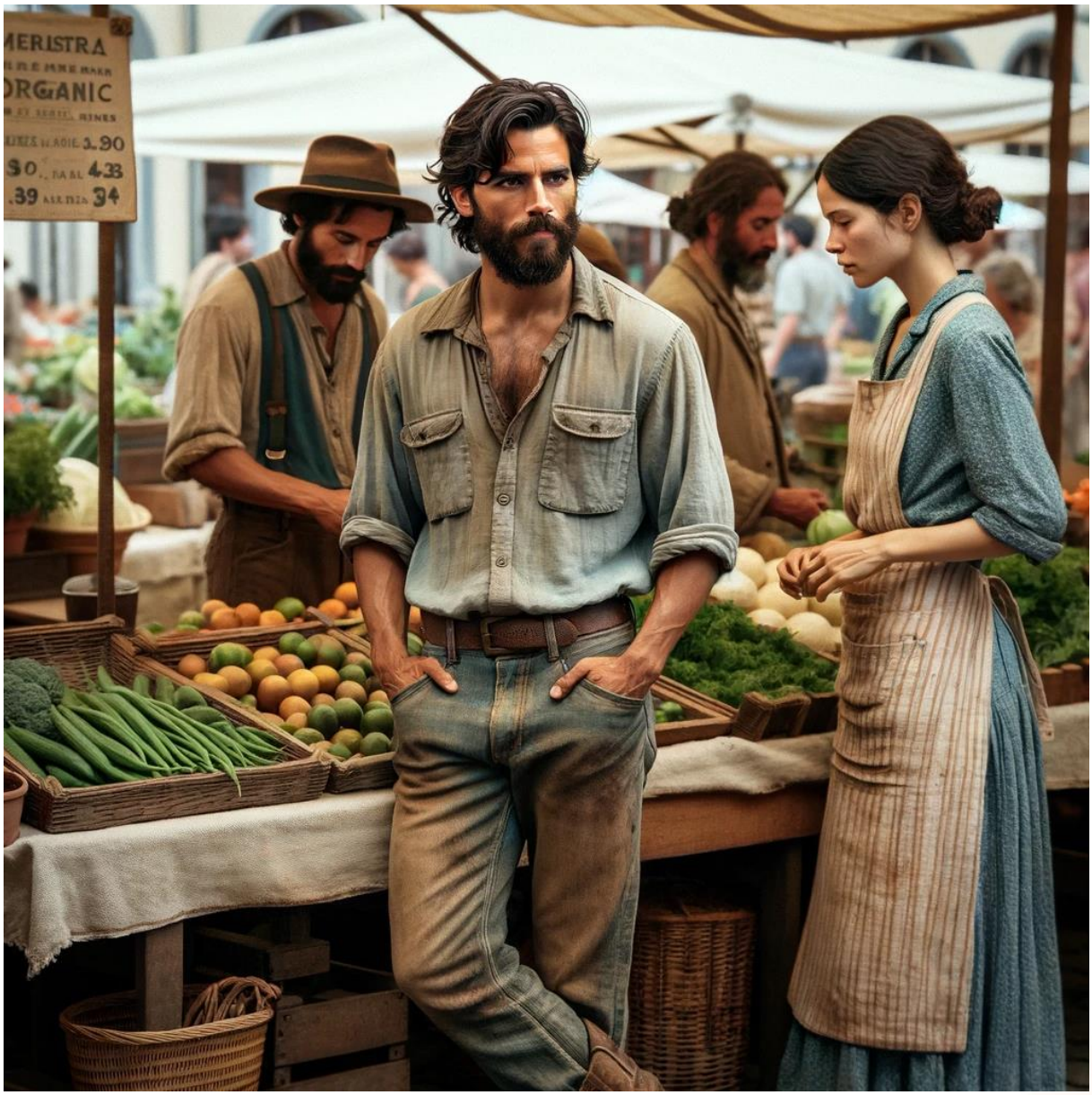
Joining a co-operative can have many benefits. You learn from other farmers, share experiences, and get support in difficult times. Being part of a cooperative can be very helpful if you are new to farming or the country. You can gain knowledge about local farming practices, regulations, and markets.

Cooperatives also focus on fair working conditions and sustainability. This means they care about the environment and about treating workers well. This is good for the community and the planet.

To join a co-operative, you usually pay a small fee or contribute in some way, like working for the cooperative. The cooperative's profits or benefits are shared among the members. Sometimes, if the cooperative does well, members might get some money back, or the cooperative might invest in something that can help all members.

Being part of a cooperative means working together, respecting each other, and making good decisions for everyone. It is about building a stronger community and a better future for all involved farmers.

Case Study: Maria and Juan



Introduction: Maria and Juan sought to enhance their farm's market position and community engagement. They decided to explore the concept of agricultural cooperatives, recognising the potential benefits of collaboration and shared resources in farming.

Challenge: While Maria and Juan were successful in individual farming practices, they faced limitations in market access, bargaining power for supplies, and shared knowledge opportunities.

The idea of joining a cooperative was appealing, but they were unsure how to integrate into an existing co-op or start a new one and were concerned about losing some degree of independence in their farming operations.

Solution: Maria and Juan started by researching local agricultural cooperatives and networking with other farmers. They attended meetings and workshops where they learned about the structure, benefits, and responsibilities of being part of a cooperative. Convinced of the benefits, they joined a local cooperative aligned with their organic and sustainable farming values. This co-op pooled resources among farmers, allowing for better purchasing power for seeds, equipment, and other supplies. It also provided a shared platform for marketing their products, offering greater exposure and access to larger markets than they could achieve individually. As part of the co-op, Maria and Juan participated in knowledge-sharing sessions, learning new farming techniques and sharing their own experiences in drone technology. They also contributed to collective decision-making processes, ensuring their voice and interests were represented.

Impact: Joining the cooperative brought Maria and Juan's farm several benefits. They saw reduced costs in purchasing supplies due to the cooperative's collective bargaining power. Their market reach expanded, leading to increased sales and profits. The shared knowledge and experiences within the co-op also helped them improve their farming practices and adopt new sustainable techniques. Moreover, being part of the cooperative fostered a sense of community and support, crucial for their personal and professional growth. They felt more connected and empowered as part of a larger group working towards common goals.

Conclusion: Maria and Juan's experience with an agricultural cooperative demonstrates the power of collaboration and shared resources in farming. Joining the cooperative allowed them to reduce costs, expand market access, and gain valuable knowledge, all while maintaining their farm's individuality and values. This case illustrates cooperatives' significant role in strengthening individual farms and the broader agricultural community.

4.6. Marketing

Marketing is a crucial part of agriculture, as it involves your strategies and actions to sell agricultural products to consumers. It is about connecting the products you grow or produce with people who want to buy them. It involves understanding who your customers are, what they need, and how you can meet those needs with your products.

In this section, you will learn:

- Identify and understand your target customers
- Communicate your product's unique qualities
- Set fair and profitable pricing strategies
- Utilise various promotion and distribution channels

A key aspect of marketing is knowing your product well. This means understanding what makes your agricultural products special, like their quality, organic status, or the unique way they are grown. Once you know this, you can communicate these qualities to your customers, making your products more appealing to them.

Pricing your products correctly is also vital. You must balance making a profit with offering a fair price that customers are willing to pay. Researching prices in your area and understanding the costs involved in producing your goods can help you set the right price.

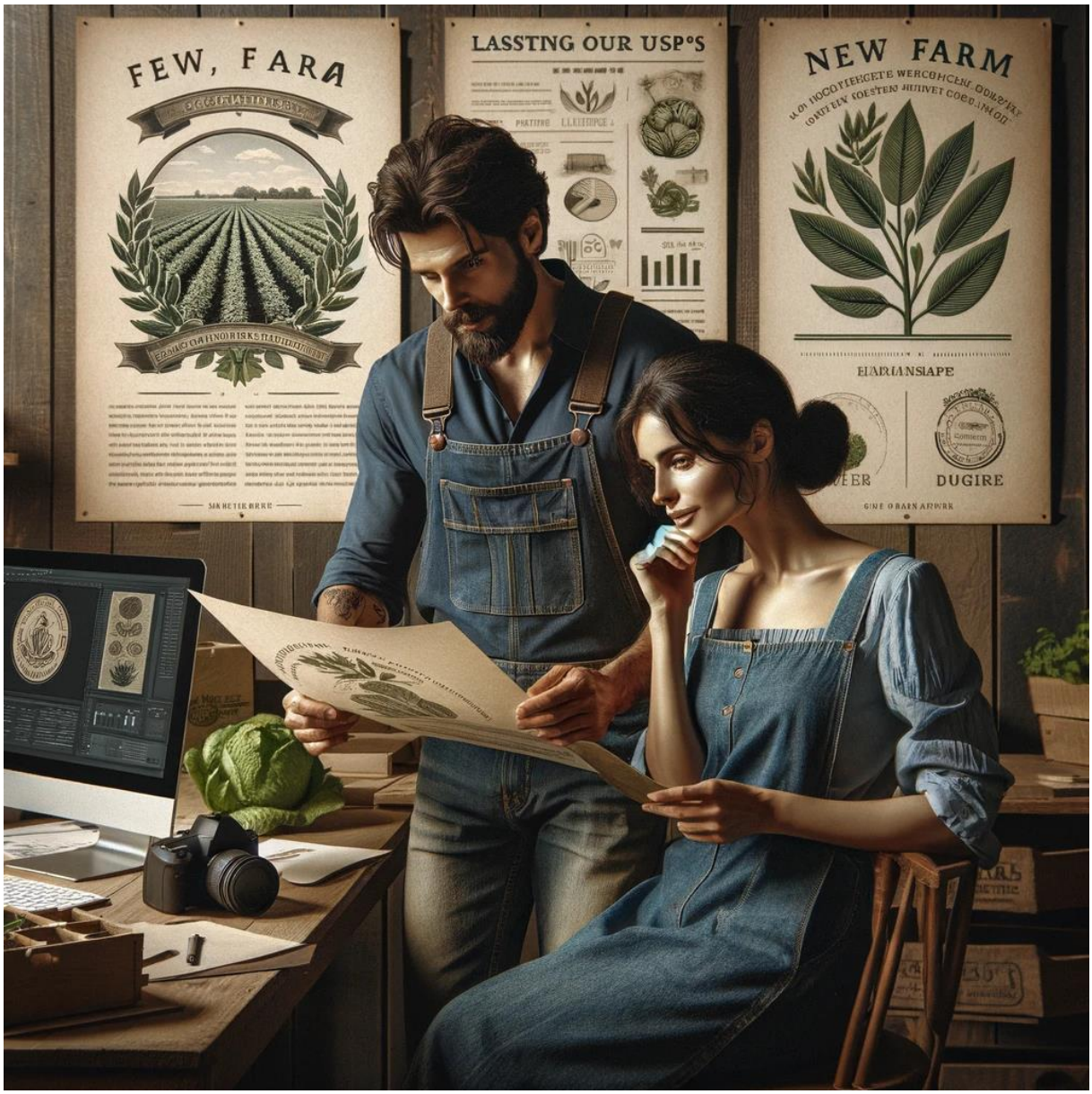
Promotion is another important part of marketing. This can be as simple as word-of-mouth, telling people in your community about your products, or using digital tools like social media. Even simple flyers or local advertisements can be effective. The goal is to let as many potential customers as possible know about your products.

Distribution, or getting your product to the customer, is also crucial. This could mean selling directly to customers at local markets, working with local stores or restaurants, or even selling online. Choosing the right method can help you reach more customers and sell more products.

Customer relationships are the key to success. Happy customers are more likely to come back and even recommend your products to others. Good relationships can be built through excellent customer service, listening to feedback, and ensuring your products consistently meet their needs.

Effective marketing in agriculture is about connecting your unique products with the people who will love them. It is a combination of knowing your product, setting the right price, promoting it effectively, choosing the best way to get it to your customers, and maintaining good relationships with them. With these concepts in mind, you are well on your way to successfully marketing your agricultural products.

Case Study: Maria and Juan



Introduction: Maria and Juan successfully integrated various agricultural practices and technologies into their farm and then focused on refining their marketing strategies. They aimed to expand their customer base and increase revenue from their organic vegetable produce.

Challenge: While their farm produced high-quality organic vegetables, Maria and Juan faced challenges in reaching a wider market and effectively communicating the unique value of their produce. They needed a marketing strategy that attracted more customers and highlighted the sustainable and organic nature of their farming practices.

Solution: To tackle this challenge, Maria and Juan began by identifying their unique selling points (USPs) - organic production, sustainable practices, and high-quality produce. They decided to leverage these USPs in all their marketing efforts. Firstly, they created a brand for their farm, complete with a logo and slogan that reflected their commitment to sustainability and quality. They then launched a website and social media profiles to increase their online presence and reach a broader audience. Through these platforms, they shared stories and images of their

farming processes, building transparency and trust with consumers. Maria and Juan also started attending local farmers' markets and community events, providing them direct access to customers and opportunities to share the story behind their produce. Additionally, they partnered with local restaurants and health food stores, supplying them with fresh produce and gaining exposure to different customer segments.

Impact: Maria and Juan's strategic marketing efforts significantly increased their customer base and farm revenue. Their online presence attracted customers who valued organic and sustainable production, while their presence in local markets and partnerships with businesses broadened their reach within the community. Their story-driven marketing approach created a loyal customer base that appreciated the quality and ethos of their farm. This not only increased sales but also allowed them to charge a premium for their produce, reflecting its true value.

Conclusion: Maria and Juan's approach to marketing transformed their small farm into a well-recognized and trusted brand in their community. By focusing on their unique selling points and engaging directly with consumers and local businesses, they were able to market their produce effectively and significantly boost their farm's revenue. This case study underscores the importance of strategic marketing in agriculture, demonstrating how it can elevate a farm's presence and profitability in the market.

4.7. Conclusions and recommendations

The handbook chapter on "Innovations in Agricultural Production" effectively addresses your training needs in the agricultural sector, focusing on essential topics like agricultural accounting, insurance, agricultural support, modernisation in tools and machinery, co-operatives, and marketing. Each case study, particularly those of Maria and Juan, illustrates practical approaches and solutions that you can adopt to enhance your skills and knowledge in these key areas.

In conclusion, this chapter provides a comprehensive guide to familiarise yourself with modern agricultural practices. It emphasises the importance of understanding the financial aspects of farming, utilising available resources like agricultural support and insurance, embracing technological advancements such as drones, participating in cooperative movements for collective benefit, and employing effective marketing strategies. These practices are crucial for your personal development in your host countries and the potential contribution you can make upon returning to your home countries. The chapter recommends a continued focus on practical, real-world applications and learning, ensuring you are well-equipped to meet the challenges and opportunities in the agricultural sector.

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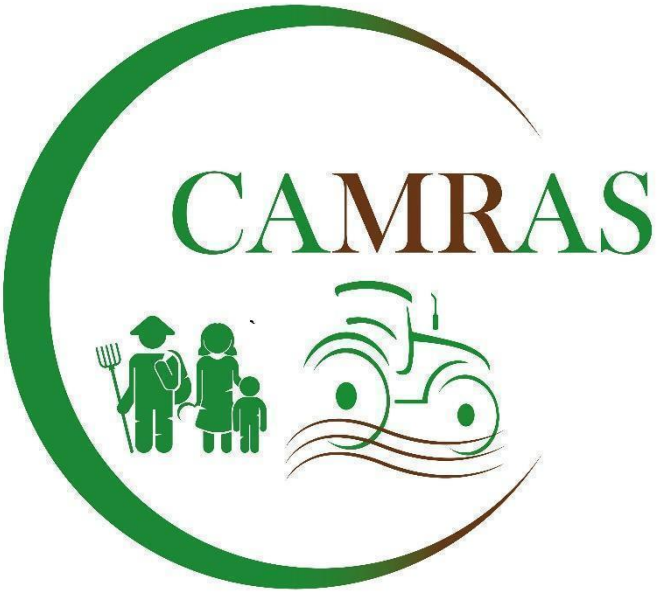


Handbook – Module 5

Sustainable Agriculture (TENGO)

Ali Kiraç

Sare Uyanik

This chapter gives information about the concept and importance of sustainable agriculture for humans and the entire world. It covers organic farming, good agricultural practices, protection of the natural resources and crop losses at harvest and post production. Also, this chapter mainly aims to raise awareness about the importance of sustainable agriculture, which is today's trend topic, and to encourage new initiatives in the agricultural sector.

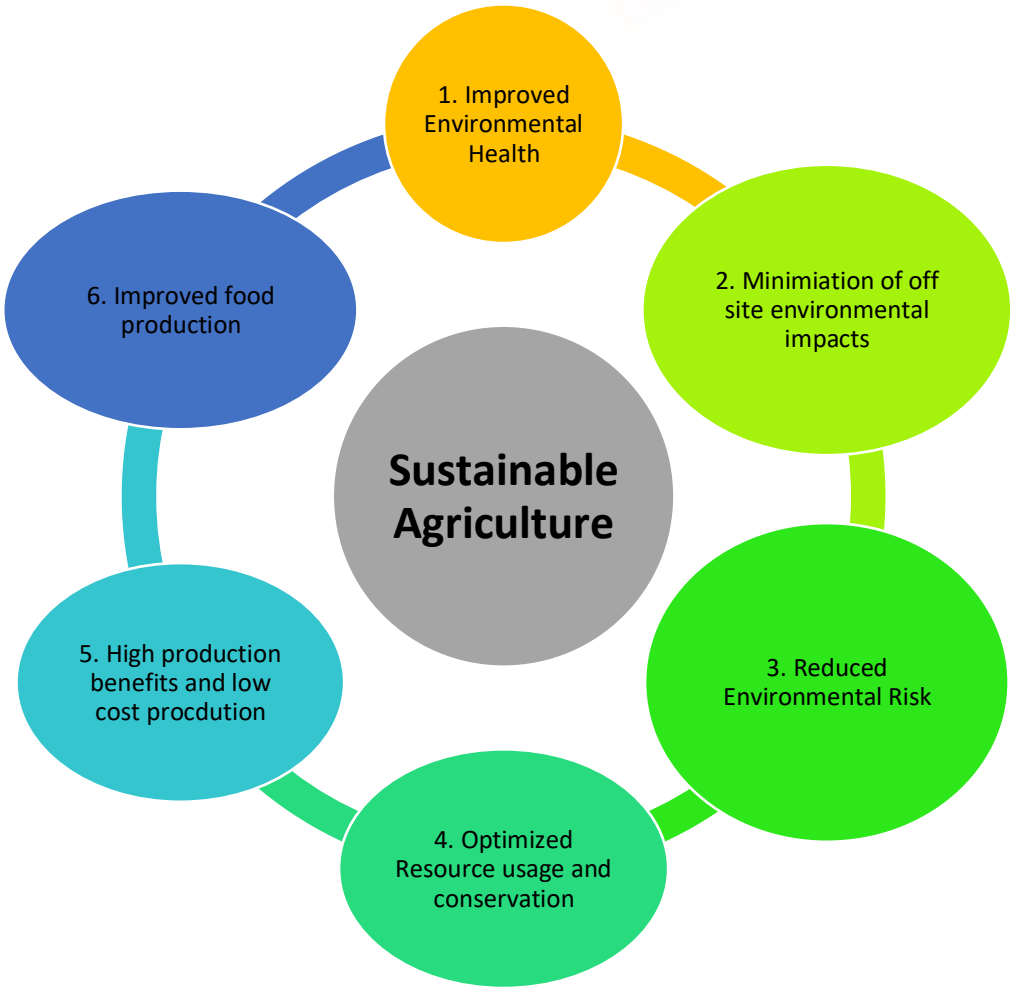
In this module, you will

- receive information about sustainable agriculture and organic farming and raise an awareness of its importance,
- learn about good agricultural practices,
- learn about protection of the natural resources and decrease crop losses at harvest
- recognize the impact of sustainable agricultural production for economy, social life and the environment.

5. Sustainable agriculture

Today, one of the main global challenges is how to ensure food security for a world growing population whilst ensuring long-term sustainable development. According to the Food and Agriculture Organisation (FAO, 2009), food production will need to increase by 70% to meet the food needs of a world population projected to reach 9 billion by 2050. With the increase in the urban population, lifestyle and eating habits in developed and developing countries are changing, and in addition, changes in climate change are putting significant pressure on the planet's resources. For example, we face challenges like the reduction of freshwater resources and biodiversity or the loss of productive agricultural areas. Initiatives and innovative approaches are needed to promote sustainable agricultural production and minimise crop losses in production processes due to these challenges.

Agriculture depends on soil, water, natural resources and the diversity brought about by these factors. Huge soil tillage and increased usage of chemical fertilisers and pesticide-based industrial agricultural practices are causing the reduction of soil health, water pollution and damage of biodiversity. The next generations depend on natural resources just as we do today. Sustainable agriculture is a powerful approach to protect natural assets, as it prioritises the health of the planet, people, ecosystems and environment, thereby meeting today’s and future demands for food production with technological practices. By adopting eco-friendly farming practices, people can produce nutritious food, protect natural resources, preserve biodiversity, and mitigate climate change effects. This chapter explores the importance of sustainable agriculture, highlights key practices, and emphasises the benefits of transitioning towards a more environmentally conscious agriculture system. The components of sustainable agriculture are defined as follows:



Sustainable agriculture has emerged as a critical solution to address the growing challenges faced by the agricultural sector, such as environmental degradation, social inequality, and economic instability. The main aims of sustainable agriculture are to balance short-term economic needs with long-term environmental preservation, ensuring the continued productivity of agricultural systems while minimizing harm to the environment. Additionally, sustainable agriculture seeks to enhance the quality of life for farmers, and workers including refugees and immigrants, by fostering practices that promote economic stability, social well-being, and community development. Achieving these goals involves developing and implementing innovative farming practices that prioritize environmental stewardship, economic viability, and social equity, ultimately contributing to a more sustainable and inclusive agricultural sector.

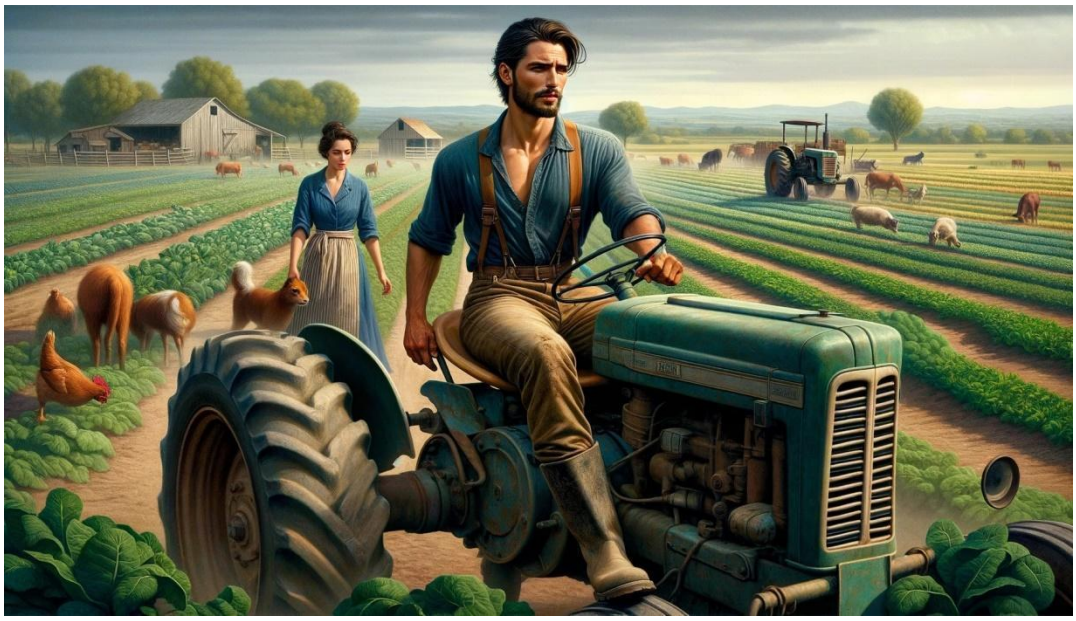
Sustainable agriculture encompasses practices that bolster biodiversity, foster healthy ecosystems, and fortify food systems (Kayişoğlu & Türksoy, 2023).By reducing reliance on chemical inputs, sustainable methods promise long-term cost savings while curbing energy consumption and greenhouse gas emissions. Sustainable agriculture practices generally consume less energy than traditional methods and reduce fuel consumption and greenhouse gas emissions. Sustainable agriculture is an approach aimed at improving agricultural practices while considering environmental and social impacts, in addition to providing healthy food for future generations. In this context, the potential roles of migrants and refugees in sustainable agriculture hold significant importance (Lipinski et al., 2013).

Migrants and refugees can actively participate in sustainable agriculture projects due to their experience in agriculture and related activities. Their expertise and skills in agriculture can contribute to the development of more efficient and sustainable farming practices through collaboration with local communities. Additionally, the impact of migrants and refugees on agriculture and food production can positively contribute to local economies and food security.

However, migrants and refugees may encounter various challenges in fully realizing their potential in sustainable agriculture. These challenges include language and cultural barriers, access issues, uncertainties regarding land use, and resource constraints. To overcome these challenges, it is important for local and international organizations to develop support programs and policies for migrants and refugees.

In conclusion, the role of migrants and refugees in sustainable agriculture can contribute to both improving these groups' living standards and promoting sustainable agriculture. However, to realize this potential, it is necessary to consider the challenges and needs faced by migrants and refugees and develop appropriate policies and programs accordingly.

Case Study 1: Maria and Juan



Introduction: Maria and Juan have run a small family-owned farm located in a rural area, primarily focusing on organic vegetable production successfully for five years Although, they have rich agricultural knowledge and produce high-quality products, they have difficulty implementing and managing sustainable farming practices on their farms. They cannot adequately apply sustainable farming practices.

Challenges: Maria and Juan struggled to implement sustainable farming practices adequately. This had negative effects on the long-term productivity and environmental sustainability of their farms. The inadequacy of sustainable farming practices led to issues such as soil erosion, water pollution, loss of biodiversity, and overconsumption of chemical fertilizers and pesticides.

Solution: Maria and Juan received education and consultation on sustainable farming practices from local agricultural experts or farm advisors, covering principles and methods of organic farming. Technological support were provided through tools like water-conserving irrigation systems, organic fertilizers, and biological pest control. They understood the value of ensuring access to resources such as financial assistance and affordable organic inputs is crucial for farmers to adopt sustainable methods effectively.

Impact: The adoption of sustainable farming practices by Maria and Juan increased environmental sustainability, promoted more efficient use of soil and water resources, and preserved biodiversity. Additionally, by increasing productivity, farmers' income increased and long-term farm success was supported.

Conclusion: Maria and Juan embraced sustainable farming practices that can create healthier and more resilient ecosystems. This can improve the long-term productivity of farms, increase farmers' income, and contribute positively to local communities and the economy. Moreover, by reducing environmental impacts and conserving natural resources with increase of environmental sustainability at the local and global level.

5.1. Organic Farming

Source: Shutterstock

The increasing consumer demand for agricultural products, unconscious and wrong agricultural practices, frequent use of chemical pesticides harmful to human health and the environment call for organic agriculture. Organic Agriculture is an approach that prioritises soil, natural life, ecosystems and human health in production processes. It is based on cycles adapted to biodiversity and natural conditions, avoiding the use of inputs and production methods with negative effects (IFOAM, 2021).

Organic farming is a production system that mainly focuses on sustainable relationship with the environment and maintains soil and human health. It depends upon biodiversity, various ecological processes, and natural cycles substituting the use of chemical inputs which adverse effects on the environment.

It is one of the best farming methods to decrease the cost of the production and also to increase the quality of the product. The product should be free from the chemical residues and other toxic substances. The use of green manure, cover crops, animal manure, and soil rotation

reduces or even stops the use of pests and the emergence of diseases, improves soil fertility, and maximizes the soil's biological activity (Mandal, 2020).

Organic farming does not allow the use of synthetic chemical fertilizer, antibiotic, herbicides, or pesticides. Thus, the objective of organic farming is agricultural production of fibres, grains, vegetables, flowers, fruits, foods, and animal products such as milk, eggs, and meat in the most natural way. In this field, the role of migrants and refugees is becoming increasingly important (Mandal, 2020).

The main objective of organic agriculture are:

- to realise production without damaging the diminishing natural resources such as soil, plant, air and water,
- to support local and regional productions of products (animal, plant and aquaculture products), many of which are in danger of extinction,
- to contribute to the biodiversity in production,
- to minimise the damage to soil and nature,
- to use natural resources efficiently in agricultural production and to reduce waste,
- to produce healthier and cleaner, safe foods for human health,
- to increase the economic income that can be obtained from this market,
- to use of renewable energy sources in production processes (Dey et al., 2021).

Migrants and refugees, often active in rural areas and agricultural work, have become a valuable resource in organic farming projects. Their familiarity with traditional farming methods and sensitivity to preserving natural resources enable them to work in harmony with the principles of organic farming. Additionally, organic farming projects can provide employment and social integration opportunities for migrants and refugees. These projects can help these groups integrate into their communities and contribute to local economies.

However, migrants and refugees may encounter various challenges in fully realizing their potential in organic farming. These include factors such as education, access, and resource constraints. To overcome these challenges, it is important for local and international organizations to develop education and support programs for migrants and refugees.

In conclusion, organic farming can be a sustainable livelihood for migrants and refugees and contribute to the proliferation of environmentally friendly farming practices. It is important to support migrants and refugees in realizing their potential in organic farming and increasing opportunities in this field. The benefits of organic farming in broadways can be divided into four parts: economic, ecological, social and soil health benefits (Dey et al., 2021).

Economic Benefits

- **Reduced Input Costs**: Organic farming often involves lower input costs compared to conventional farming methods. This is because organic farmers rely on natural inputs such as compost, crop rotations, and biological pest control methods instead of purchasing expensive synthetic fertilizers and pesticides. By reducing the need for external inputs, organic farmers can lower their production costs and improve profitability.
- **Utilization of Organic Outputs**: Organic farming emphasizes recycling and efficient use of organic materials within the farm system. For example, organic farmers use compost and animal manure as natural fertilizers, reducing the need to purchase external fertilizers. By maximizing the use of on-farm resources, organic farmers can lower their dependency on external inputs and improve cost-effectiveness.
- **Optimal Utilization of Biological and Genetic Potential**: Organic farming practices prioritize the preservation and enhancement of soil health, which supports the biological and genetic potential of plant and animal species. By maintaining diverse and healthy ecosystems on farms, organic farmers can optimize the productivity of their crops and livestock over the long term, leading to more sustainable and resilient agricultural systems.
- **Sustainable Production Levels**: Organic farming promotes sustainable production levels by focusing on soil conservation, water management, and biodiversity conservation. Practices that enhance soil fertility reduce erosion, and conserve water resources. Organic farmers can maintain productive agricultural systems over the long term without depleting natural resources or causing environmental harm.
- **Improved Management and Conservation**: Organic farming requires careful management of soil, water, energy, and biological resources. By adopting practices such as crop rotation, cover cropping, and integrated pest management, organic farmers can improve the efficiency of resource use on their farms while conserving natural ecosystems and biodiversity.
- **Enhanced Disease and Pest Resistance**: Organically cultivated plants often develop greater resilience to diseases and insect pests. This is because organic farming practices focus on promoting plant health through soil management, crop rotation, and biological pest control methods. By reducing the need for chemical inputs to combat pests and diseases, organic farmers can lower their production costs and improve profitability.

Overall, the economic benefits of organic farming include reduced input costs, optimized resource utilization, sustainable production levels, improved management practices, and enhanced resistance to pests and diseases, all of which contribute to the long-term profitability and viability of organic farming operations.

Ecological Benefits

- **Reduced Energy Consumption**: Organic farming typically requires less energy input compared to conventional farming methods. This is because organic farming relies on natural processes and avoids the use of synthetic inputs such as fertilizers and pesticides, which often require significant energy for production and application.
- **Habitat Preservation and Biodiversity**: Organic farming practices often involve maintaining or enhancing natural habitats within and around farms. By avoiding synthetic chemicals and promoting biodiversity through techniques like crop rotation and intercropping, organic farms can provide habitats for a wide range of species, from insects to birds, which contributes to overall ecosystem health and resilience
- **Lower CO_2 Emissions**: Organic farming tends to have lower carbon footprints compared to conventional farming methods. This is partly due to the avoidance of synthetic fertilizers, which are energy-intensive to produce and can release greenhouse gases during their manufacture. Additionally, organic farming practices such as cover cropping and composting can sequester carbon in the soil, further reducing net emissions.
- **Prevention of Environmental Degradation**: Organic farming practices prioritize soil health and fertility through methods like crop rotation, composting, and the use of organic matter. Through the avoidance of synthetic chemicals and promotion of soil conservation practices, organic farming helps prevent soil erosion, nutrient depletion, and water pollution, thereby contributing to overall environmental sustainability (Kolkowska, 2021).
- **Regeneration of Degraded Areas**: Organic farming techniques can be used to regenerate degraded lands, such as those affected by soil erosion, salinization, or chemical contamination. By restoring soil health and biodiversity, organic farming can rehabilitate ecosystems and make them more resilient to future environmental challenges. Organic farming offers a holistic approach to agriculture that not only produces food but also promotes environmental stewardship and sustainability.

Social Benefits

1. **Accessibility for Small and Medium Farmers:** Organic farming practices can be adopted on small-scale farms and benefit medium farmers who may have limited access to resources such as land, capital, and technology. By emphasizing traditional and low-cost methods of soil fertility management, pest control, and crop diversification, organic farming enables small farmers to reduce their dependency on external inputs and costly technologies, making agriculture more accessible and sustainable.
2. **Reduction of Dependency on External Inputs**: Organic farming reduces farmers' dependency on external inputs such as synthetic fertilizers, pesticides, and genetically modified seeds. This is particularly beneficial for resource-poor farmers who may not afford these inputs or face challenges accessing them due to factors such as remote location or financial constraints. By promoting self-reliance and local resource management, organic farming empowers farmers to rely on their own knowledge and resources, thereby improving their resilience to external market fluctuations and input supply disruptions.
3. **Employment Generation:** Organic farming contributes to employment generation at the community level by creating opportunities for diverse agricultural activities such as

composting, organic input production, crop diversification, and value-added processing. Additionally, organic farming often requires more labour-intensive practices such as manual weeding, intercropping, and biological pest control, which can generate employment opportunities for rural communities, including women and the youth. By promoting diversified and labour-intensive farming systems, organic farming contributes to rural livelihoods and economic development.

Overall, the social benefits of organic farming include increased accessibility for small and marginal farmers, reduced dependency on external inputs, and employment generation at the community level, all of which contribute to more inclusive and sustainable agricultural development. Organic farming can empower farmers, enhance their resilience to external challenges, and promote social equity and rural livelihoods.

Soil Health Benefits

- **Complete Plant Nutrition:** Organic fertilizers, derived from natural sources like compost, provide a comprehensive array of nutrients essential for plant growth. Unlike synthetic fertilizers which may lack certain micronutrients, organic fertilizers nourish plants with a balanced diet, promoting healthier growth and development.
- **pH Regulation:** Organic matter, such as compost and manure, acts as a buffer against soil pH fluctuation. While synthetic nitrogenous fertilizers tend to acidify soil over time, organic inputs help maintain a more neutral pH balance, creating a healthier environment for plant roots and soil organisms.
- **Nutrient Supply:** Organic farming relies on organic inputs like compost and manure to supply nutrients to plants. These organic sources not only provide essential macronutrients like nitrogen, phosphorus, and potassium but also furnish a range of micronutrients vital for plant health. By delivering a diverse array of nutrients, organic farming ensures optimal nutrition for plants, promoting robust growth and resilience against pests and diseases.
- **Improved Soil Structure:** Organic farming practices, such as crop rotation, cover cropping, and the addition of organic matter, contribute to the physical properties of soil. Organic matter enhances soil structure by improving aggregation, porosity, and water retention capacity. This results in better aeration, drainage, and root penetration, creating an optimal environment for plant growth and microbial activity.
- **Microbial Activity:** Organic matter serves as a source of energy for soil microbes, particularly those involved in organic matter decomposition. Microbes break down organic matter into simpler forms, releasing nutrients for plant uptake and contributing to soil aggregation. This enhances soil fertility, promotes nutrient cycling, and improves overall soil health in organic farming systems.

Migrants and refugees, often having experience in agriculture and soil-related activities, can play an important role in the organic farming sector. By working in this sector, they can support themselves financially and contribute to their hosted communities. Organic farming projects not only offer employment and social integration opportunities for migrants and refugees but also contribute to the proliferation of environmentally friendly farming practices. They may encounter various challenges in realizing their potential in organic farming, including education, access, and resource constraints. However, with support and educational programs provided by local and international organizations, these challenges can be overcome, enhancing migrants’ and refugees' contributions to the organic farming sector.

Overall, the organic farming sector can serve as a sustainable livelihood for migrants and refugees while also promoting community and environmental health. Providing education and support is crucial for migrants and refugees to realize their potential in this sector.

Types of Organic Farming

There are two types of organic farming: Pure organic farming and integrated organic farming:

Pure organic farming entails the utilization of organic fertilizers and bio-pesticides while completely eschewing inorganic chemicals and pesticides. This method is committed to natural inputs, promoting soil health and biodiversity without relying on synthetic substances.

Integrated organic farming integrates organic farming practices into conventional farming through methods such as integrated nutrient management and integrated pest management. This approach emphasizes cultivating crops using natural resources, ensuring optimal nutritional content while simultaneously safeguarding crops from pests and diseases.

Techniques of Organic Farming

There are several techniques of organic farming. Among these, the following have been established as commonly used:

Crop Rotation involves cultivating different types of crops sequentially in the same area, typically aligned with distinct seasons. This practice helps optimize soil health, manage pests and diseases, and enhance overall crop productivity through strategic diversification.

Green Manure refers to the practice of incorporating the biomass of decaying plants, typically extracted from their roots, into the soil to enrich its nutrient content and enhance soil health. This technique aids to improving soil quality, fostering microbial activity, and promoting sustainable agricultural practices.

Biological Pest Control is a method that uses living organisms to control pests with or without the use of chemicals.

Compost is a type of fertilizer obtained from recycled organic materials used as fertilizer in agricultural farms and is rich in nutritional value.

Methods of Organic Farming

Organic farming represents an agricultural approach centred on cultivating crops and rearing livestock with a strong emphasis on natural and sustainable methodologies. This method prioritizes minimizing reliance on synthetic inputs like chemical fertilizers, pesticides, and GMOs. The main objective is to yield nutritious, high-quality food while upholding environmental protection, fostering biodiversity and preserving soil fertility for future generations (IFOAM, 2022).

Some key principles and methods of organic farming include:

Soil management can be defined as operations or practices to protect the soil and increase its fertility. Farmers are involved in soil cultivation and production also focus on building healthy soil by using techniques such as crop rotation, cover cropping, composting, and adding organic matter like manure and plant residues (Tuğrul, 2009).

Weed management: Farmers encounter unwanted weeds during agricultural production processes and have to combat them. For agricultural production, weeds negatively affect the growth of crops and reduce crop yield. Organic weed management prioritizes natural and sustainable approaches to control weeds without the use of chemical inputs. Organic agriculture focuses on lowering weed and not removing it completely. The two most widely used weed management techniques are:

- **Mulching:** Mulching is a process of covering the soil surface to prevent weed seed germination by blocking light transmission preventing seed germination. .
- **Mowing or cutting:** In agriculture, mowing or cutting weeds plays a significant role in organic agriculture, especially in settings such as field crops, orchards, vineyards, and pasturelands. Managing weed control involves trimming vegetation to control weed growth and maintain the desired height and health of cultivated crops.

Crop diversity: Monoculture is the practice used in the agriculture fields where we harvest and cultivate only type of crop in a particular place. Recently, polyculture has come in existence where we harvest and cultivate kinds of crops. To meet the increasing crop demand and produce the required soil microorganism.

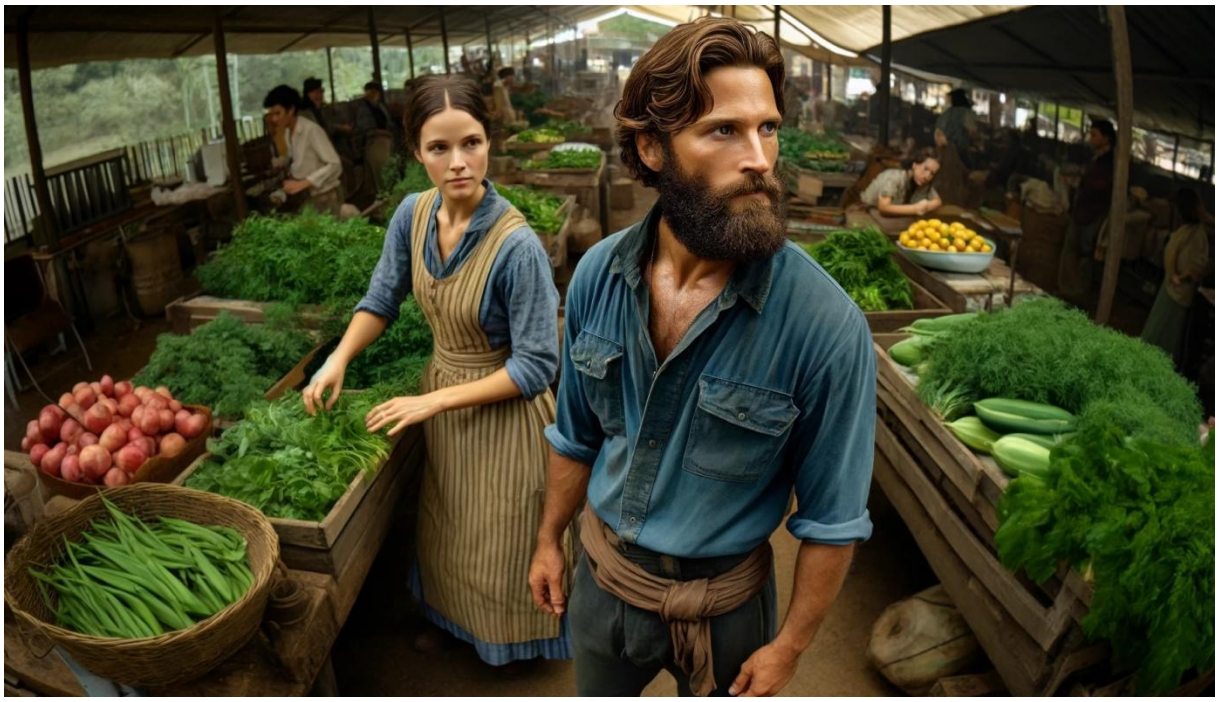
Biological pest control: Instead of relying on synthetic pesticides, organic farmers use biological pest control methods such as beneficial insects, trap crops, natural predators, and botanical extracts to manage pests and maintain ecological balance on the farm.

Controlling other organism: In agricultural production there are both beneficial and harmful organisms that affect the soil and crops. To protect the soil and crops, it is necessary to control the growth of such organisms. Organic production processes can be supported by using methods such as herbicides and pesticides that contain fewer chemicals or are natural.

Animal welfare: In organic livestock farming, animals are raised in accordance with strict animal welfare standards. They have access to outdoor grazing areas, receive organic feed free from synthetic hormones and antibiotics, and are treated humanely throughout their lives.

Overall, organic farming methods prioritize environmental sustainability, biodiversity conservation, and the production of nutritious and safe food while minimizing negative impacts on ecosystems and human health. Organic certification standards set by regulatory bodies ensure compliance with organic farming practices and provide consumers with confidence in the authenticity and integrity of organic products (Akkaya, 2018).

Case Study 2: Maria and Juan



Introduction: Maria and Juan struggled to adequately implement and manage organic farming practices. This situation had negative effects on the long-term productivity and environmental sustainability of their farms.

Challenges: Small-scale farmers Maria and Juan, despite successfully operating their own farms, faced difficulties to adequately implement and manage organic farming practices. Despite having rich agricultural knowledge and high-quality products, they faced some challenges in effectively managing organic farming practices. This situation had negative effects on the long-term productivity and environmental sustainability of their farms. The inadequacy of organic farming practices led to issues such as economic benefit, ecological benefit, social benefit, and soil health benefit and also, soil erosion, water pollution, loss of biodiversity, and overuse of chemical fertilizers and pesticides.

Solution: Maria and Juan received education and consultation on organic farming practices, covering principles, fertilizer and pesticide use, and natural pest control from local agricultural experts or organic farming associations. They were provided with infrastructure and resources supporting organic farming, such as organic fertilizers, specialized irrigation systems, financial aid for certification by forming cooperatives with other small farms. This helped them increase market access through farmers' markets and online sales, and secure financial support via incentives and grants and improved access to seeds. Establishing policies to support marketing and promotion of organic products, including incentives and purchase programs, was also crucial for fostering organic farming.

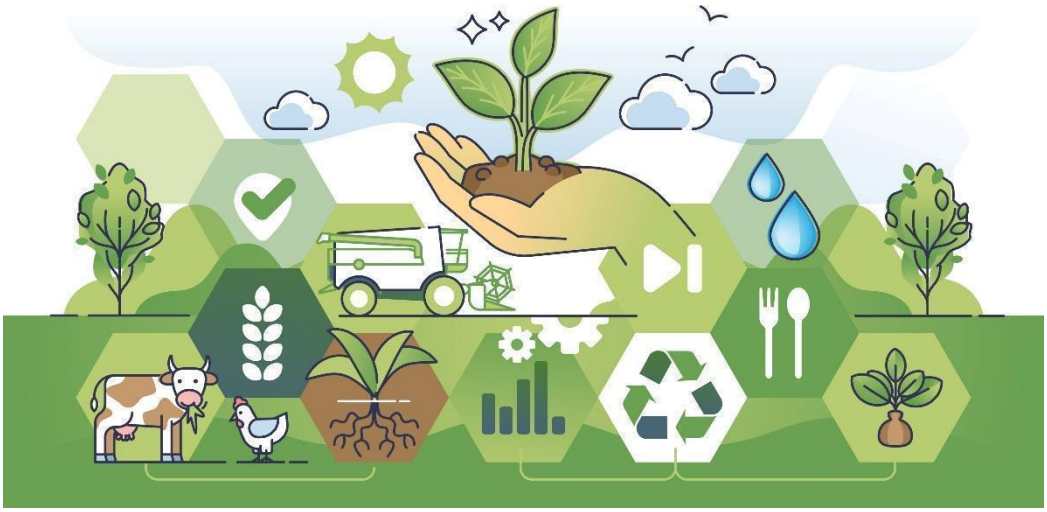
Impact: The adoption of organic farming practices by farmers like Maria and Juan enhanced environmental sustainability by promoting more effective use of soil and water resources, reducing soil erosion, and preserving biodiversity. Additionally, better market access and reduced costs led to an increase in the farm's income and the creation of a more financially

sustainable business model. The effective implementation of organic methods preserved the natural ecosystem, increased biodiversity, and maintained soil health, resulting in more productive farming in the long term. The acceptance of organic farming within the local community enhanced social support and raised the overall agricultural knowledge level through information sharing. Additionally, healthy soil management ensured long-term agricultural sustainability and minimized soil issues such as erosion.

Conclusion: Maria and Juan embraced organic farming practices that created healthier products and more balanced ecosystems. This led to improved long-term productivity, increased income for farmers, and the provision of products that are more beneficial for public health. Moreover, the widespread adoption of organic farming encouraged environmental sustainability, the preservation of natural resources and protection public health.

5.2. Good agricultural practices

Good Agricultural Practices (GAP) consist of a set of standards for the safe and sustainable production of crops and animal products. GAP aim to help farmers maximize yields and optimize their business while minimizing production costs and environmental impact. GAP also aim to protect food quality and food safety by minimising harmful environmental impacts, especially inputs in the production stages and in the process of agricultural products until they reach the consumer.



Sources: Shutterstock

GAP are vital because they strengthen responsible farming methods, from location selection and land preparation to harvesting and processing. According to the Food and Agriculture Organization of the United Nations (FAO, 2009), GAP ensure safe and healthy agricultural products by applying existing knowledge to address environmental, economic and social sustainability for on-farm production and post-production processes. In line with principles of GAP, the product must be traceable from the field to the dining table, and each process must be recorded. The use of pesticides, fertilizers, etc. is carried out according to analysis results and under control. The final product is certified according to the report issued by the inspection body. These practices aim to minimize environmental impacts, optimize crop yields, ensure food safety, and promote the well-being of workers and communities. When it comes to migrant

and refugee workers in the agriculture sector, implementing GAP becomes particularly important for several reasons (Tarlengco, 2024):

Worker Safety and Health: GAP include measures to protect the health and safety of agricultural workers, including training on the safe handling of chemicals, proper use of protective equipment, and access to clean water and sanitation facilities. Migrant and refugee workers, who may already face vulnerabilities and barriers to accessing healthcare, require additional support and protection in agricultural settings to ensure their well-being.

Fair Labour Practices: GAP emphasizes fair labour practices, including fair wages, reasonable working hours, and the prohibition of child labour as well as forced labour. Migrant and refugee workers in the agriculture sector often face exploitation and unfair labour practices due to their marginalized status. Implementing GAP ensures that these workers are treated ethically and fairly, with their rights protected.

Training and Capacity Building: GAP encourage continuous training and capacity building for agricultural workers to enhance their skills and knowledge in sustainable farming practices. Providing training programs tailored to the needs of migrant and refugee workers can empower them to contribute effectively to agricultural operations while promoting environmentally sustainable practices.

Social Integration and Inclusion: GAP promote social integration and inclusion by fostering respectful and inclusive work environments where all workers, including migrants and refugees, are treated with dignity and respect. Creating supportive work environments that value diversity and cultural sensitivity can improve the well-being and productivity of all agricultural workers.

Access to Resources and Support Services: Implementing GAP involve providing access to essential resources and support services, such as healthcare, education, and legal assistance, to agricultural workers. Migrant and refugee workers may face additional barriers to accessing these services, and GAP implementation should address their specific needs and challenges.

Overall, integrating GAP in the agriculture sector can help ensure the well-being, safety, and rights of migrant and refugee workers while promoting sustainable and responsible agricultural production. It requires collaboration between governments, agricultural businesses, civil society organizations, and international agencies to create supportive policies and programs that prioritize the needs of these vulnerable workers.

5.3. Protection of natural resources

Natural resources, bestowed upon life by the natural environment, serve to fulfil the requirements of both humans and other living organisms. Air, water, land, natural gas, timber, oil, coal, and similar assets are typical examples of these resources. The focus of the CAMRAS project in this section is to protect and ensure the sustainability of these valuable natural resources. Protection of natural resources can be explained as the judicious use of resources found in the natural environment in a manner that does not jeopardize future generations harnessing the same resources to meet their needs. Humanity's quality of life is sustained by these resources within the natural ecosystem. However, the burgeoning human population's escalating demands on the finite and restricted natural resource reservoir underscore the critical necessity for their preservation, ensuring human continuity. Recent times have witnessed mounting apprehensions due to excessive utilization and overexploitation of these resources,

surpassing the Earth's capacity to sustainably support such activities. The imperative for safeguarding and governing natural resources effectively has long been recognized; today, amidst climate change, market dynamics, modernization, and population growth, the call for their efficient management resonates louder than ever. Managing these resources has become increasingly daunting due to their intricate complexities. The alarming pace of depletion and strain on natural resources poses a grave threat to the quality of land, forests, and water, jeopardizing their capacity to regenerate at the rate they are being exploited. Globally, the sustainability of natural resources confronts severe risks of depletion and extinction. Conflicts are emerging concerning these resources, fuelling a dilemma between their conservation and exploitation. The economic significance and political interests attached to these natural resources have compounded the challenges associated with their management in the natural environment. The agricultural sector holds great importance in the global economy, serving not only as a source of food but also as a provider of employment opportunities, raw materials, and various other essential resources. Agriculture encompasses crop and animal production, which rely on natural resources. Critical factors for successful crop and animal production include land, labour, capital, etc. Land, akin to other production factors, plays a pivotal role in both animal and crop cultivation, and its effective management dictates its ability to meet the evolving needs of a growing population efficiently. However, a significant portion of the world's arable land is either already in use or has been depleted due to unsustainable practices, rendering it unproductive (Heikila et al,. 2016).

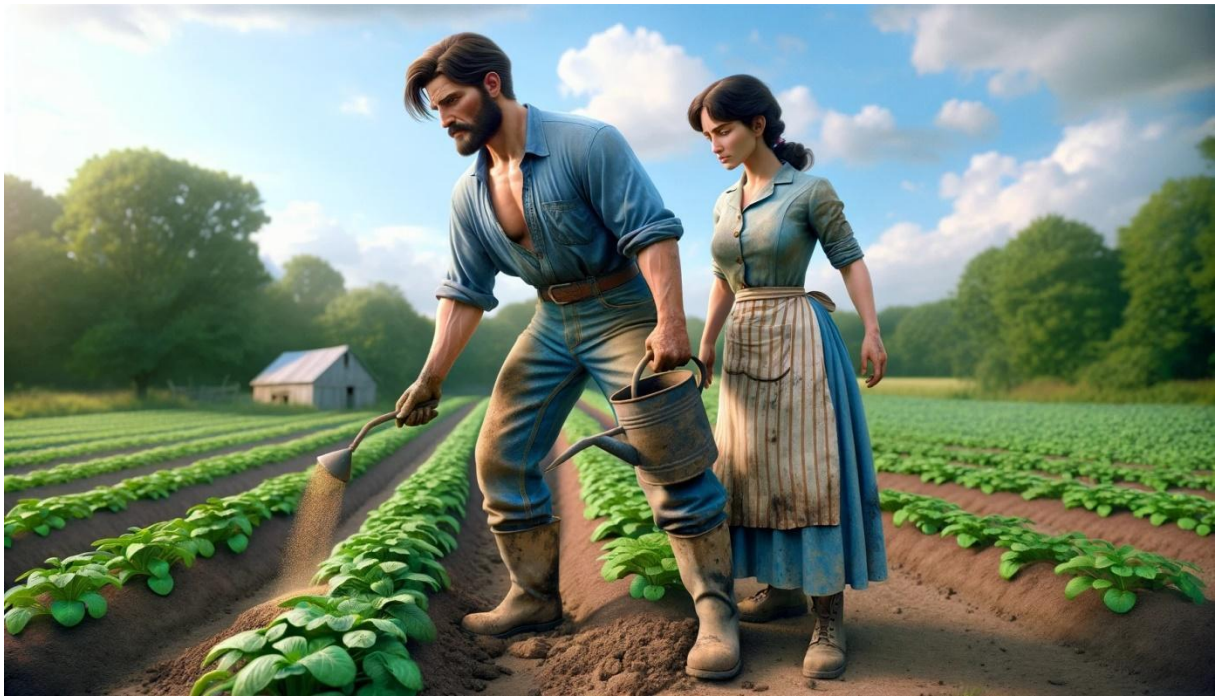
In the light of the above challenges, sustainable agriculture emerges as the solution, as safeguarding food security while preserving natural resources is prioritised. Contemporary industrial and commercial agricultural practices are increasingly classified as unsustainable due to their rapid depletion and degradation of natural resources, outpacing nature's capacity for replenishment. A primary objective of sustainable agriculture is to promote cultivation systems and farming methodologies that alleviate the adverse impacts on natural resources. The conservation of natural resources stands as a pivotal concern for global environmental sustainability. Recognizing the significant role of refugee and migrant communities as stakeholders in this endeavour is essential. These groups encounter numerous obstacles in accessing and stewarding natural resources. Frequently forced to leave their countries due to factors like war, conflicts, natural disasters or climate change, these individuals cause an increase in the demand for natural resources in the areas they seek refuge. The situation places significant stress on local ecosystems and natural reservoirs. Growing population, overuse of water resources, and deforestation negatively impact and affect the environment. Consequently, this results in the erosion of agricultural lands, depletion of water resources, and a decline in biodiversity.

However, collaboration with refugees and migrants is key to conserving and sustainably using natural resources. This requires cooperation and solidarity between local communities, civil society organizations and the international community. Refugees and migrants should participate in local training courses, environmental issues, use clean energy sources, engage in recycling programs, and promote sustainable use of natural resources by working together with local communities. The CAMRAS project plays an important role in providing education on environmental protection, empowering local communities, refugee and migrant communities with education and effective management of natural resources.

In conclusion, natural resource conservation should be approached with a broader perspective in areas where refugees and migrants live. This not only ensures environmental sustainability

but also contributes to creating a suitable and healthy environment for the long-term settlement of refugee and migrant communities.

Case Study 3: Maria and Juan



Introduction: Maria and Juan have difficulties implementing and managing good agricultural practices on their farms and also protection of natural resources. They cannot adequately apply good agricultural practices, especially when producing.

Challenges: Maria and Juan had lack of managing good agricultural practicesand eco-friendly farming. This led to serious issues regarding the long-term sustainability and environmental protection of the farm. Particularly, their inadequacy in conserving natural resources during the production process can result in erosion and damage to significant resources such as soil, water, and biodiversity.

Solution: Maria and Juan received education and consultancy from agricultural organizations, experts and universities and also CAMRAS's online learning platform (camras.eu) on conserving and sustainably managing natural resources, covering topics such as soil and water conservation, habitat support, and erosion control. Local agricultural experts or environmental specialists provided guidance on proper practices. Additionally, they encouraged the use of modern agricultural techniques and technologies, such as terracing and drip irrigation, aided in resource conservation. Legal regulations and incentives, like financial benefits or tax reductions, were established to promote sustainable agricultural practices among farmers.

Impact: Maria and Juan took the necessary measures to preserve and sustainably preserve natural resources by receiving consultancy and training support from relevant institutions and increased environmental sustainability. Adopting good practices increased the productivity of soil and water resources, reduced erosion and protected biodiversity. In addition, the spread of environmentally friendly agricultural practices has made a positive contribution to the local economy and the welfare of society.

Conclusion: Proper management of good agricultural practices and environmentally friendly practices by Maria and Juan has resulted in significant achievements in terms of the long-term sustainability and environmental protection of their farm. Their success in preserving natural resources during the production process has reduced the risk of serious erosion and damage to critical resources such as soil, water and biodiversity. Implementation of measures such as farmer training on the conservation of natural resources and the use of technology has increased the long-term sustainability of farms and played an important role in protecting the environment. This has not only increased their income but also contributed to their and the society's overall well-being through the widespread adoption of environmentally friendly agricultural practices.

5.4. Crop losses during harvest and afterwards

Worldwide, a large amount of food is lost or becomes waste during harvest and afterwards. Approximately a third of the food produced for human consumption every year in the world is wasted or lost (Ishangulyyev, et al, 2019). Developing countries experience significant post-harvest losses in the early stages of the supply chain, mostly due to financial and structural constraints in harvesting techniques, storage and transportation infrastructures, and climatic conditions conducive to food spoilage (FAO, 2013).

In the case of the loss and waste in fruits and vegetables constitute 45% of the entire supply chain, while the processing stage is responsible for 18% of losses (Facchini et al, 2023).

Reasons for losses occurring during and after harvest are listed below:

- Deficiencies in pre-harvest care measures,
- harvesting before or after its time,
- harvesting is not done by the characteristics of the product,
- not using appropriate equipment during harvest,
- not using knowledgeable and experienced workdays during harvest.

Pre-harvest losses: Pre-harvest losses, stemming from adverse weather conditions, pest infestations by insects, mites, rodents, birds, weed growth, or crop diseases, can lead to damage and deterioration of crops. Some examples are:

- **Environmental factors:** adverse weather conditions (droughts, floods, storms)
- **Pests and diseases:** The crop damage occurs due to pest and disease, rat menace, weed etc.

Harvest losses: During the harvesting process, losses may occur due to shattering, mechanical damage, and shedding of grains.

Post-harvest losses: Losses occur post-harvest, spanning from the separation of the product from its immediate growth site to its arrival at the consumer. Some examples are follows:

- **Stacking or stoking:** Grain losses during harvesting happen when crops are left stacked in the field or stored in a suitable location to attain the required moisture content before threshing.

- **Threshing losses:** Losses can occur during mechanical or manual threshing processes.
- **Winnowing/cleaning losses:** Losses may occur during the cleaning process of threshed grain products, where the cleaned grains are separated from chaff, husk, or other waste materials.
- **Storage losses:** Storage losses refer to the losses that occur while the crop product is stored in a storage facility.
- **Transport losses:** Losses that occur during transporting of the product from the farm to storage

Actions to reduce losses during harvest

The hand workmanship must be correct in harvesting fruits and vegetables, which is usually done by hand. Collecting the product without crushing, scratching or cracking it and cutting the handle from the appropriate place reduces losses both in crating and transportation. Additionally, if we do not apply as much fertilizer as necessary while growing the product, losses increase during and after harvest.

As for grain products, harvesting is generally done with machines, namely harvesters or threshing machines. To prevent harvest losses in these stages, it is necessary to be careful not to harvest too early or too late. Additionally, on rainy and windy days' grain loss will increase in harvests. Even the time of harvest is very important for the moisture content of the crop. Farmer should also pay attention to the speed of the machine, its calibration and whether the sieves are well-adjusted (Heikila, et al., 2016).

If legumes such as beans, lentils and chickpeas are to be plucked by hand, plucking the plant from its root and making the clusters properly will reduce crop loss. Consequently, crop losses during and after harvest can have significant effects on communities, farmers, refugee and migrant agricultural workers. Refugees and migrants often work in the agricultural sector for low wages, and they frequently engage in seasonal and temporary jobs in agriculture. Crop losses can result in significant economic losses and income reductions for these workers.

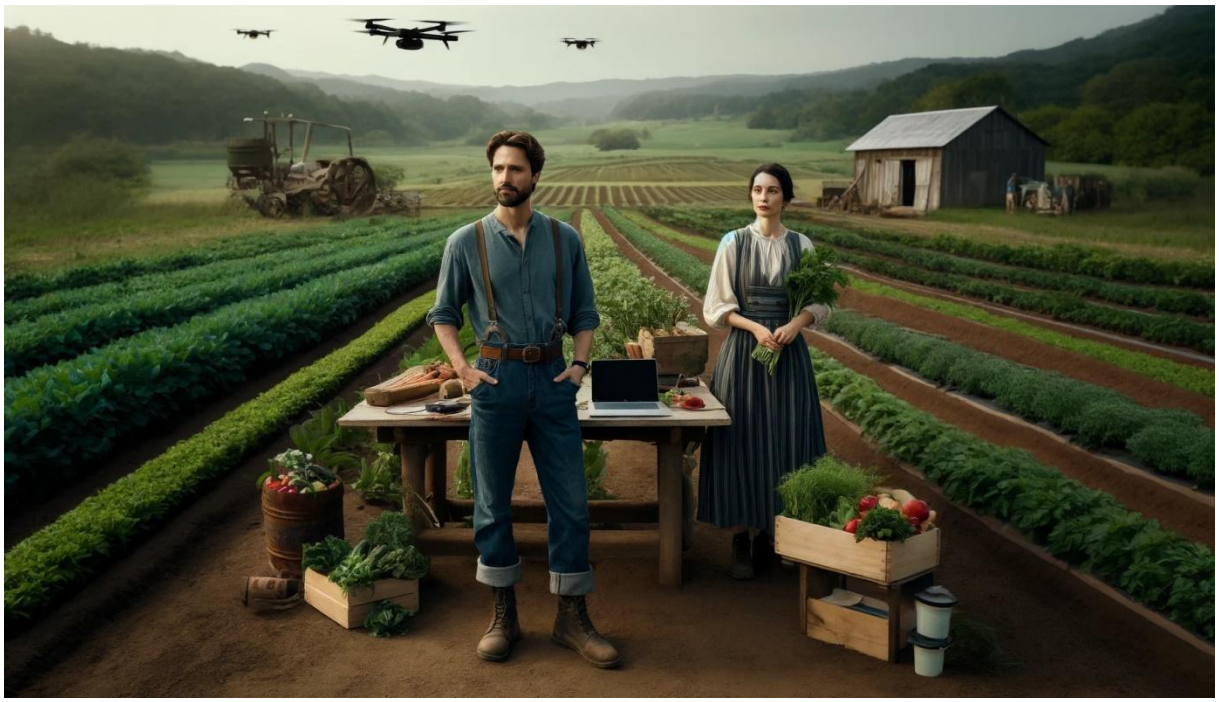
Crop losses can increase economic insecurity and food insecurity risks for refugee and migrant agricultural workers. Losses experienced during and after harvest can negatively impact these workers' livelihoods and their ability to support their families. Additionally, these losses can further jeopardize the food security of already vulnerable refugee and migrant communities.

Therefore, support and training programs for agricultural workers are important to reduce crop losses. These programs can help minimize losses by providing workers with education on harvest and crop preservation techniques. Furthermore, ensuring fair wages and working conditions for agricultural workers is important to increase their economic security and reduce food insecurity risks.

Post-production losses: The combination of harvest losses and post-harvest losses encompasses various stages including transportation, storage, threshing, stacking, and harvesting. These losses occur at different points along the value chain and can be attributed to a multitude of factors. Some losses are influenced by climatic conditions such as humidity, temperature, and rainfall, leading to bio-deterioration, while others result from pest infestation, spillage, scattering, or mechanical causes such as removal by birds or rodents.

The postharvest losses in agriculture have a significant impact on the sustainability and security of the world's food supply. The reasons behind these losses are several factors, such as insufficient infrastructure, inadequate storage facilities, improper handling procedures, and limited market access. The primary effect of the negative consequences of these losses on farmers' livelihoods, food supply, and resource utilization, as well as the economic, environmental and social implications cannot be underestimated.

Case Study 4: Maria and Juan



Introduction: Maria and Juan realized the importance minimising losses during and after production. They believed that necessary measures had to be taken to minimise production losses.

Challenges: Maria and Juan faced significant crop losses during and after harvest. This situation had a negative impact on the farm's efficiency and profitability. In addition to the losses during and after harvest, they also struggle to manage these losses.

Solution: Maria and Juan analysed and investigated the underlying reasons for crop losses during and post harvesting. They searched for proper agricultural techniques and took suggestions from farm engineers and academicians to manage the losses. They followed some steps and instructions to reduce crop losses in agriculture. Some of them included fighting against harmful organisms and controlling pre-harvest diseases, harvest at the right time, appropriate transportation and storage. They also searched and implemented technological solutions used in harvesting and storage processes. For instance, technologies like cooling systems that maintain optimal temperature and humidity levels, or automated monitoring and control systems for warehouse management, helped them market and sell their produce. Thanks to becoming members of common sales points or co-operatives, they ensured that the products reached the consumers in a short time period.

Impact: Management of the agricultural losses enhanced their productivity and profitability. Proper methodologies has also a valuable impact on the sustainability and protection of the

world's food supply chain. In addition, reducing crop losses through technological solutions and cooperation enables farmers to increase their incomes.

Conclusion: Reducing crop losses during and after harvest increased the farmers' profitability and contributed to the sustainability of the farm. Controlling pre-harvest diseases, pests and adverse weather conditions and the use of proper storage and packaging methods improved the quality of the produce and enabled them to be sold at better prices. Together with technological solutions and collaboration, this led to increased income for farmers and strengthens the local economy.

5.5. Conclusions and recommendations

Sustainable agriculture, including organic farming and good agricultural practices, is essential for long-term environmental sustainability and food security. Protecting natural resources is crucial for maintaining ecosystem health and resilience in agricultural systems. Crop losses during and after harvest pose significant challenges to the livelihoods of migrants, refugees, and agricultural workers, highlighting the need for improved post-harvest practices.

Within the scope of this chapter, CAMRAS proposes recommendations on how to sustain agriculture and good farming practices for small, medium and large farmers. Vocational training programs should prioritize sustainable agriculture practices, including organic farming and good agricultural practices. Education and training programs should be organized for farmers to raise their awareness about natural resource conservation and sustainable farming techniques. Access to resources and support for implementing sustainable farming methods, particularly for migrants, refugees, and agricultural workers need to be provided. Empowering migrant, refugee, and agricultural worker communities to participate in decision-making processes related to agricultural development and environmental conservation is of utmost importance. The opportunity to engage in continuous learning and capacity building in sustainable agriculture practices to enhance productivity and resilience in agricultural systems is another asset. By implementing these recommendations and prioritizing vocational training programs that focus on sustainable agriculture, organic farming, good agricultural practices, and natural resource protection, stakeholders in the agricultural sector can increase their knowledge on sustainability farming and contribute to friendly environment.

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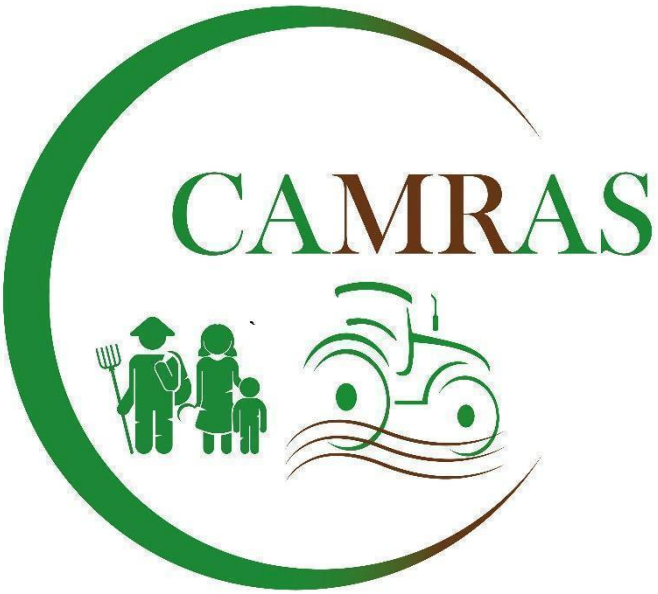

Module 6

Worker Skills and Labour Issues (Inercia Digital)

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Worker skills and other labour issues are indispensable components of modern agriculture. Only by considering these fields, effective and sustainable agricultural production can be warranted. Based on these assumptions, this module has been prepared.

In this module, you will learn about:

- the importance of creating work environments that appreciate the well-being of workers and vocational training as factors contributing to effective and sustainable agriculture,
- the importance of worker rights, and the value of ethical practices,
- the outcomes of problem-solving abilities, cooperation and communication in the agricultural sector.

6. Worker skills and labour issues

The agricultural sector in the European Union (EU) stands as a multifaceted and pivotal industry, playing a fundamental role in ensuring both food security and economic stability. This segment focuses on the critical aspect of worker skills and labour issues within the EU's agricultural landscape. A skilled and motivated workforce proves indispensable for the sustainability and advancement of the agricultural sector, addressing challenges and fostering innovation.

Within the EU, the agricultural workforce needs a unique blend of traditional farming knowledge and modern technological skills. The cornerstone lies in the provision of adequate education and training programs. These initiatives must align with the dynamic needs of the sector, encompassing topics such as sustainable farming practices, precision agriculture, and the seamless integration of technology into agricultural processes.

Given the EU's diverse nature, effective communication and collaboration among agricultural workers require language and cultural competence. Migrant and refugee workers, facing potential language barriers, underscore the need for comprehensive language training programs. Simultaneously, promoting cultural awareness becomes paramount, ensuring a harmonious working environment, fostering mutual understanding, and facilitating collaboration.

In the face of the agricultural sector's inherent risks and uncertainties, workers must exhibit adaptability and resilience. Training programs should centre around building resilience and cultivating problem-solving skills. These skills empower workers to respond effectively to unforeseen challenges, contributing to the sector's overall sustainability.

The modern agricultural landscape is heavily reliant on technology, spanning from precision farming equipment to data analytics. Workers must be familiar with and embrace these technological advancements to optimise production processes and resource management. Upskilling initiatives become crucial, bridging the digital divide and ensuring that the workforce is adept at operating and maintaining technological solutions. This is why an ambitious project like CAMRAS is eminently important in our days.

Ensuring the safety and well-being of agricultural workers is a cornerstone of workforce management. Training programs must stress the importance of adhering to safety protocols, the proper use of equipment, and the prevention of occupational hazards. This focus on worker safety is not only pivotal for the welfare of workers but also for the overall productivity and sustainability of the agricultural sector.

The agricultural workforce in the EU comprises a diverse range of individuals, including migrants and refugees. To foster inclusivity, addressing any discriminatory practices and ensuring equal opportunities for all workers is imperative. The development of policies and initiatives to create a fair and supportive environment is vital, fostering a sense of belonging and contributing to the overall success of the agricultural sector. Training for migrants in the agricultural sector is important as it helps address precariousness and exploitation in a sector crucial for the EU and the 2030 Agenda for Sustainable Development (Molinero & López-Sala, 2020).

Since some of the main objectives of the CAP Strategic Plans of the EU are fostering knowledge and innovation, to support generational renewal, to improve the position of farmers in the food chain, to increase competitiveness and to ensure a fair income for farmers, it is essential to mention it. The common agricultural policy (CAP) 2023-27 entered into force on 1 January 2023. This marked the beginning of the implementation of the 28 approved CAP Strategic Plans in 27 EU countries (EU members have one Strategic Plan each, except Belgium, which has one for Flanders and one for Wallonia).

In November 2023, the European Commission published an assessment of CAP Strategic Plans delivery on CAP objectives. The report relies on the information contained in the CAP national plans as well as on qualitative appraisals of the potential effects of the choices made by EU countries. This preliminary assessment summarises the combined contributions of the interventions planned by EU countries to address the CAP specific objectives and the six EU-wide Green Deal targets on:

Fairer income for farmers and keeping rural areas vibrant;
Environment and climate action;
Social sustainability and societal expectations such as animal welfare.

The report also acknowledges areas for which the plans collectively could have shown higher levels of ambition or pursued more optimal approaches (European Commission., n.d.).

In conclusion, enhancing worker skills and addressing labour issues in the EU's agricultural sector necessitates a comprehensive approach. By investing in education, promoting inclusivity, and fostering a culture of adaptability and innovation, the EU can cultivate a resilient and skilled agricultural workforce capable of meeting the challenges of the 21st century. This lays the foundation for sustainable agricultural practices and contributes to the overall prosperity of the European Union.

6.1. Labour rights

Ensuring a fair and sustainable work environment within the European Union's (EU) agricultural sector is one of the EU priorities. Acknowledging the significance of these rights is paramount for shaping the working conditions and overall well-being of individuals engaged in agriculture. In the EU's agricultural sector, labour rights prioritise fair remuneration, ensuring that workers receive wages reflective of the value of their work and contributing to a decent standard of living. Simultaneously, regulations regarding working hours aim to prevent exploitation and ensure that employees have reasonable working hours, allowing for adequate rest and maintaining a healthy work-life balance. EU legislation is important in terms of labour rights in the agricultural sector because it aims to reduce costs, increase supply, and improve market dynamics, purchasing power, and competitive ability (Gołaś, 2019).

The safety and health of agricultural workers are fundamental labour rights. Employers are obligated to provide a secure working environment, including proper training on the use of equipment, access to protective gear, and measures to prevent occupational hazards. Rigorous safety standards contribute not only to worker well-being but also to the overall sustainability of the agricultural sector.

The EU's labour rights framework emphasises the freedom of association and the right to engage in collective bargaining. Agricultural workers have the right to form or join trade unions to collectively negotiate terms and conditions of employment. This enables workers to voice their concerns, contribute to decision-making processes, and ensure their rights are upheld through collective agreements. Equality and non-discrimination are fundamental principles in the EU's labour rights framework (Fontecha, 2017). Agricultural workers are entitled to equal treatment, irrespective of their gender, age, nationality, or other protected characteristics. Policies and measures are in place to prevent discrimination, promoting a diverse and inclusive workforce within the agricultural sector.

Labour rights extend to social protection measures and benefits for agricultural workers. This includes access to healthcare, maternity and paternity leave, and other social security benefits. Adequate social protection contributes to the overall well-being of workers and ensures a level playing field within the agricultural labour market.

Recognizing the diverse composition of the agricultural workforce, specific attention is given to the rights of migrant workers. Labour rights for migrant workers include protection against exploitation, access to fair wages, and assurance of decent living conditions. Legal frameworks are in place to safeguard the rights of migrant agricultural workers, promoting equal treatment. To uphold labour rights in the agricultural sector, effective enforcement mechanisms and compliance measures are implemented. Regulatory bodies and inspections work to ensure that employers adhere to established labour standards, providing a deterrent against unfair labour practices and fostering a culture of compliance.

Labour rights within the EU's agricultural sector are designed to create a balanced and ethical working environment. By prioritising fair remuneration, safe working conditions, and the principles of equality, the EU aims to build a resilient agricultural workforce that contributes to the sustainable development of the sector while upholding the dignity and rights of all workers.

6.2. Business ethics and reliability

Ensuring the ethical conduct and reliability of businesses within the European Union's (EU) agricultural sector is fundamental to the industry's long-term sustainability and overall integrity. These principles not only shape the reputation of individual businesses but also contribute significantly to the broader trustworthiness of the agricultural ecosystem.

One of the foundational aspects of ethical business conduct in the EU's agricultural sector is environmental responsibility. This entails a steadfast commitment to sustainable farming practices, the conservation of natural resources, and the minimization of environmental impact. Companies are increasingly expected to adopt eco-friendly approaches that prioritise biodiversity, soil health, and responsible water usage. The integration of green technologies and adherence to environmental regulations further underscore the importance of ethical practices in safeguarding the ecosystem. Social responsibility represents another critical dimension of business ethics in the agricultural sector. Companies are expected to prioritise the well-being of their workforce, fostering fair labour practices and promoting inclusivity. This includes providing

safe working conditions, ensuring fair wages, and respecting the rights of all employees, including migrant and refugee workers. Ethical businesses actively engage with local communities, contributing to their development and maintaining positive relationships.

Transparency and honesty serve as vital components of reliability in the agricultural business realm; these in the agricultural cooperatives are vital components of reliability, which in turn contributes to financial control, profitability, and sustainability (Silva & Santos, 2022). Businesses are expected to provide clear and accurate information about their products, production processes, and supply chains. This transparency builds trust among consumers and stakeholders, enabling them to make informed decisions. Ethical businesses are also committed to fair competition, avoiding deceptive practices that could undermine the market and harm both consumers and competitors. Innovation and adaptation to changing societal needs represent ethical business practices in the EU's agricultural sector. Companies are encouraged to embrace technological advancements that improve efficiency, reduce environmental impact, and enhance overall sustainability. Ethical businesses actively participate in research and development, contributing to the evolution of the sector while adhering to ethical principles.

Compliance with regulations and adherence to ethical standards are essential for building and maintaining credibility. Ethical businesses operate within the legal frameworks established by the EU, ensuring that their practices align with established norms and guidelines. This commitment to compliance not only fosters a trustworthy business environment but also contributes to the stability and reputation of the agricultural sector as a whole. Business ethics and reliability are integral to the success and sustainability of the agricultural sector in the EU. Ethical practices encompass environmental responsibility, social engagement, transparency, innovation, and compliance. Upholding these principles not only benefits individual businesses but also ensures the credibility and sustainability of the entire agricultural sector.

6.3. Problem solving ability

In this context, these abilities are crucial for fostering resilience and innovation. A workforce equipped with strong problem-solving skills contributes significantly to the sector's adaptability and sustainable development.

Problem-solving ability in the EU's agricultural sector requires a high degree of adaptability to changing conditions. From fluctuations in weather patterns to market dynamics, the sector is inherently prone to uncertainties. Workers with robust problem-solving skills can navigate these challenges, adjusting strategies and practices to optimise productivity and resource utilisation. As agriculture undergoes technological advancements, problem-solving becomes intertwined with innovation. Workers need the ability to embrace and implement new technologies effectively. This not only enhances efficiency but also opens avenues for sustainable practices. Efficient resource management is a key challenge in agriculture, and problem-solving skills play a pivotal role in optimising resource use. Workers must be adept at identifying inefficiencies, minimising waste, and implementing sustainable practices. Problem-solving in resource management contributes not only to economic viability but also to the long-term ecological sustainability of the agricultural sector. The health of crops and livestock is fundamental to agricultural productivity. Problem-solving ability comes into play when addressing issues related to pest control, disease management, and overall well-being. Workers with strong problem-solving skills can diagnose problems promptly, implement effective solutions, and prevent potential setbacks in production. Problem-solving skills are important in agriculture for crop and livestock health because they help tackle complex problems, adopt scientific management practices, and enhance the efficiency of solutions (Pereira et al., 2021).

Agricultural businesses face market challenges influenced by factors such as global demand, trade policies, and consumer preferences. Problem-solving in this context involves strategic planning, diversification, and adaptation to market trends. Workers with effective problem-solving skills contribute to the economic resilience of the agricultural sector by navigating market complexities and identifying opportunities for growth. Agriculture often involves collaborative efforts among diverse stakeholders, including farmers, researchers, and policymakers. Problem-solving ability extends to effective collaboration, where workers can contribute ideas, share insights, and collectively address challenges. This collaborative approach fosters a supportive ecosystem that enhances problem-solving at both individual and systemic levels.

In recognizing the significance of problem-solving abilities not only for the agricultural sector but also for societal integration, migrants and refugees can actively cultivate these skills to navigate challenges in their host societies. Access to language and skill training programs becomes pivotal, facilitating effective communication while equipping individuals with the technical know-how needed in the agricultural sector. Problem-solving naturally becomes an essential extension of acquiring new skills and adapting to the work environment.

Additionally, fostering cultural integration is crucial. Exposure to local customs, agricultural practices, and community dynamics enhances problem-solving ability by providing context to the challenges migrants and refugees may encounter. Establishing mentorship programs, encouraging networking opportunities, and active engagement with local communities further create a conducive environment for the development of problem-solving skills. This not only accelerates the integration process but also contributes to the diversity and adaptability of the European Union's agricultural workforce, recognizing the instrumental role of problem-solving in both professional and societal contexts.

To finish with, problem-solving ability is a cornerstone of success in the EU's agricultural sector. Workers equipped with adaptive problem-solving skills contribute to the sector's resilience, innovation, and long-term sustainability. As the industry continues to evolve, nurturing and enhancing these skills among the workforce are essential for addressing the multifaceted challenges inherent to agriculture in the European Union.

6.4. Team spirit and cooperation

The collaborative ethos within this sector is not merely a by-product but a deliberate orchestration that allows stakeholders to navigate the complexities of agricultural endeavours with synchronised finesse. Interdependence characterises the core of agricultural activities, necessitating seamless cooperation among farmers, labourers, researchers, and various stakeholders. This synergy becomes the lifeblood of operations, from the meticulous stages of planting and cultivation to the collective efforts involved in harvesting and distribution. Success in the agricultural realm is a symphony composed by the hands of a united and cohesive team. Shared goals and objectives serve as the gravitational force pulling individuals together within the EU's agricultural sector. This shared vision extends beyond the confines of individual interests, encompassing broader aspirations such as sustainable farming practices, environmental conservation, and economic viability. The unifying thread of common objectives propels the sector forward, fostering unity and collaborative efforts.

The exchange of insights and information is the currency that fuels effective team spirit. In the agricultural context, this involves a continuous dialogue among team members, farmers, and stakeholders. The collective intelligence cultivated through open communication becomes a repository of best practices, emerging technologies, and innovative approaches. This shared

knowledge base becomes the bedrock for perpetual improvement within agricultural processes. Adaptability to change is the hallmark of a cohesive team within the agricultural sector. Given the sector's susceptibility to external factors such as changing weather patterns and market dynamics, a united team can flex and adjust strategies collaboratively. This adaptability becomes a linchpin for the sector's resilience, ensuring its ability to weather uncertainties and evolve sustainably.

Cross-sector collaboration emerges as a natural extension of team spirit within agriculture. Collaboration between researchers, farmers, policymakers, and technology developers forms a dynamic ecosystem. This interdisciplinary approach allows for the integration of cutting-edge solutions, scientific advancements, and practical applications, propelling the agricultural sector into a realm of innovation and efficiency. Community engagement and support knit the fabric of team spirit within agriculture. The active involvement of farmers and businesses within local communities establishes a reciprocal relationship. This engagement not only fortifies the social fabric but also creates an ecosystem of mutual support, enhancing initiatives such as sustainable practices and community-supported agriculture.

In the face of inevitable conflicts, the strength of a team lies in its ability to resolve disputes constructively. A robust team spirit involves effective conflict resolution mechanisms and resilience in the face of challenges. An environment of understanding and mutual respect allows teams to navigate conflicts collaboratively, maintaining a steadfast focus on shared objectives.

Cooperation activities in agriculture contribute to the societal and economic development of farms, farmers, rural societies and so on (Ribašauskienė et al., 2019). To visualise the intricacies of collaboration within the agricultural sector, the following table outlines key stakeholders and their interconnected roles:

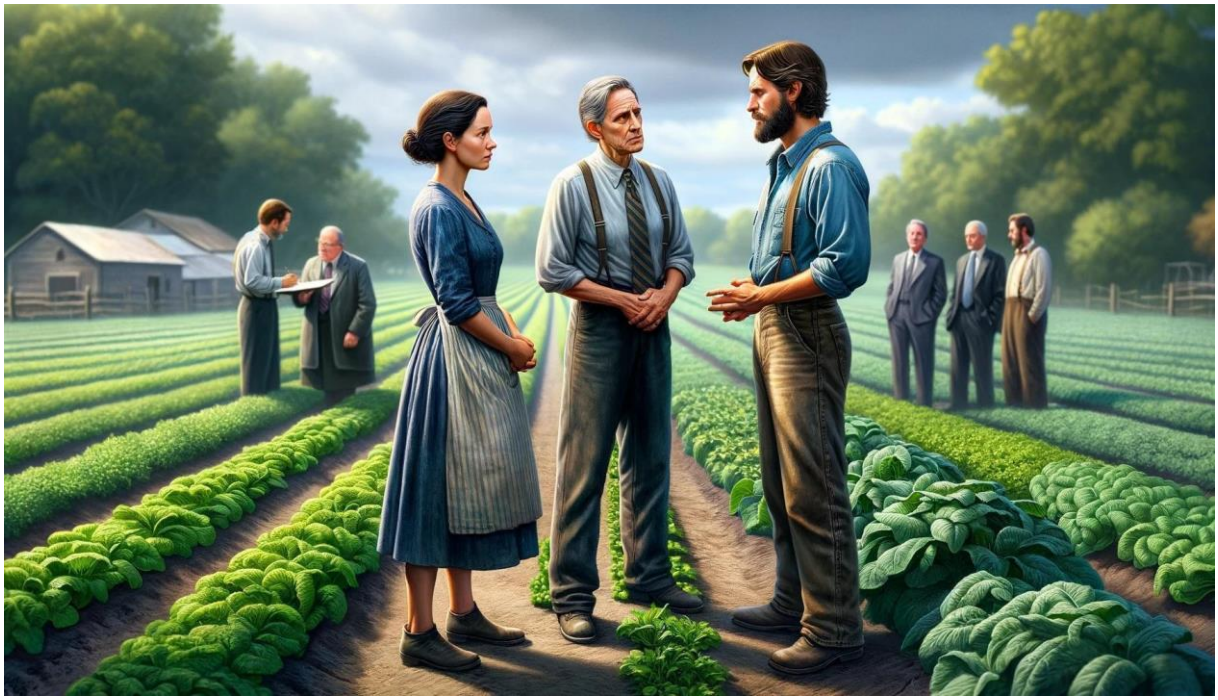
Table 1: Key stakeholders and their interconnected roles

Stakeholder	Role in cooperation
Farmers	Primary producers, implementing on-the-ground practices
Researchers	Contributing scientific advancements and innovations
Policymakers	Influencing regulatory frameworks and policies
Technology developers	Introducing technological solutions
Local communities	Providing support and engaging in sustainable practices

Understanding the significance of team spirit and cooperation is essential for migrants and refugees to integrate successfully into host societies and actively participate in democratic conventions. Access to cultural integration programs becomes a gateway, providing insights into local customs, agricultural practices, and community dynamics. Exposure to the collaborative ethos within the agricultural sector allows M/Rs to grasp the importance of working as a cohesive team. Through this understanding, they can contribute effectively to the sector, aligning with shared goals and objectives.

Participating in community engagement and support initiatives is vital for M/Rs to appreciate the reciprocal relationship between farmers, businesses, and local communities. This active

involvement establishes a foundation for team spirit and collaboration, fostering a supportive ecosystem that goes beyond agricultural practices. Additionally, M/Rs gaining insights into conflict resolution mechanisms and developing resilience contribute not only to their successful integration but also to the harmonious collaboration that characterises the agricultural sector. By recognizing the interconnected roles outlined in collaborative activities, M/Rs can actively engage in building a narrative of collective resilience and shared prosperity within the European Union, aligning with democratic principles and contributing to the societal and economic development of the agricultural sector.



In essence, team spirit and cooperation are not just adjectives in the agricultural narrative; they are verbs that animate the sector's success and sustainability. The harmonious collaboration among stakeholders, the exchange of knowledge, and the adaptability to change all contribute to an agricultural tapestry that goes beyond productivity—it weaves a story of collective resilience and shared prosperity within the European Union.

6.5. Effective communication

In this dynamic environment, where communication and information is vital, the ability to convey thoughts, share insights, and foster understanding is paramount. Clear communication is the catalyst for seamless coordination among farmers, labourers, researchers, and various entities in the agricultural landscape. From conveying planting schedules to discussing market trends, a shared language ensures that the entire agricultural orchestra operates in harmony. It's the conduit through which strategies are articulated, challenges are discussed, and innovations find their way from concept to cultivation.

Innovation in the agricultural sector often hinges on effective communication channels. The rapid evolution of technologies requires a swift and efficient exchange of information. Whether adopting precision farming techniques or integrating cutting-edge solutions, the ability to convey technological advancements ensures that the sector remains at the forefront of innovation, optimising both productivity and sustainability. Effective communication in the agricultural

sector in the EU is important for improving supply chain efficiency and quality management (Saurabh & Dey 2020).

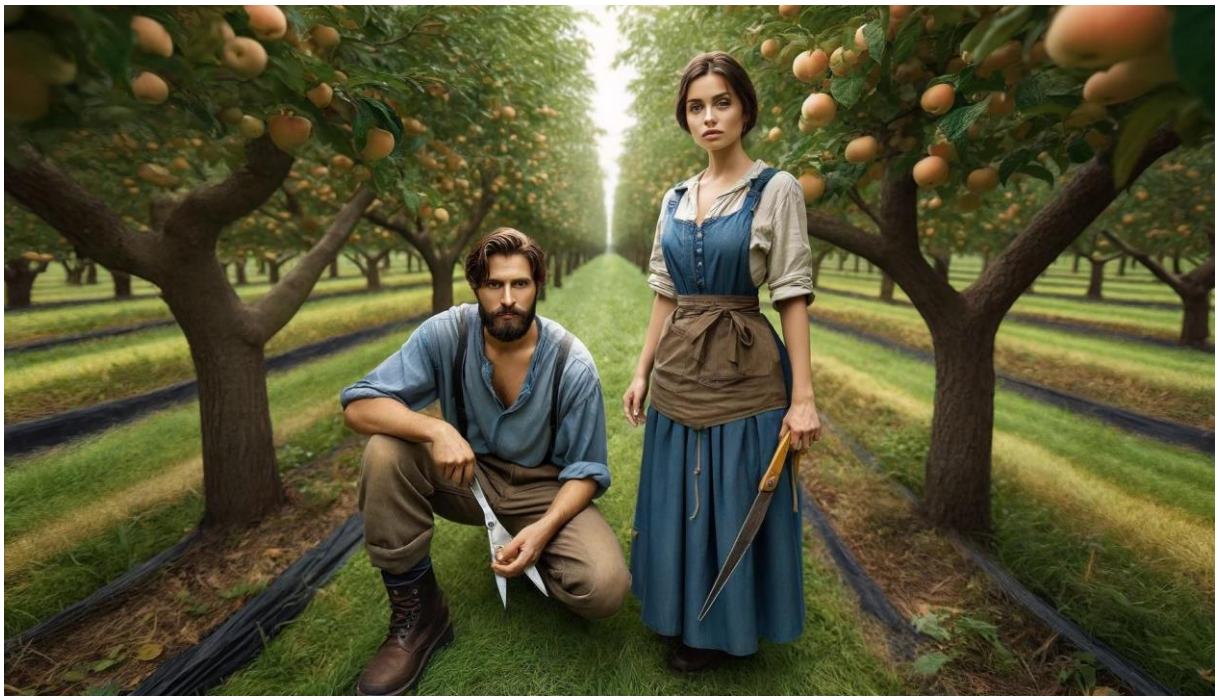
Beyond the field, effective communication extends to engaging with the broader community and consumers. Transparent communication about farming practices, environmental initiatives, and product information fosters trust. It bridges the gap between the agricultural sector and the public, cultivating a shared understanding of the sector's challenges, achievements, and commitment to sustainable practices.

Recognizing the essential role of effective communication not only in the agricultural sector but also for societal integration, migrants and refugees can actively engage in training programs aimed at cultivating these skills. Access to language and communication training becomes crucial, providing Migrants and Refugees (M/Rs) with the tools to convey thoughts, share insights, and foster understanding within the agricultural landscape. Beyond language proficiency, specialised programs can equip M/Rs with the ability to communicate transparently about farming practices, environmental initiatives, and product information, fostering trust and enhancing their integration into both the agricultural sector and the broader community. As M/Rs become effective communicators, they contribute to the collaborative and innovative language that underpins the interconnected agricultural landscape in the European Union.

To enhance communication skills in the EU, migrants or refugees can pursue language courses tailored to the specific region or country, fostering proficiency in the local language. Participation in communication workshops offers practical insights into conveying thoughts effectively. Community integration programs provide opportunities to practise language skills in real-life situations and build connections within the community. Leveraging online resources for language learning and communication skills development can offer flexible and accessible options. Engaging in cultural exchange initiatives allows individuals to adapt communication styles to different contexts. Attending networking events within the community or specific industries provides opportunities to practise and build professional connections. Seeking out professional development programs focused on communication within specific sectors, including agriculture, can be valuable. Establishing mentor-mentee relationships with individuals experienced in the local context offers personalised guidance on effective communication in various settings. Active participation in these initiatives contributes to successful integration into the EU's diverse social and professional landscapes.

To sum up, effective communication is not merely a tool within the EU's agricultural sector; it is the language that speaks volumes about collaboration, innovation, and transparency. As the sector continues to evolve, a commitment to clear and open communication is essential, paving the way for a resilient and interconnected agricultural landscape within the European Union.

Case Study: Maria and Juan



Introduction: Maria and Juan, a couple passionate about organic farming, embarked on their journey to run a small family-owned farm in a rural area. Despite their love for the land and dedication to their craft, they soon found themselves facing a different kind of challenge: social isolation.

Challenge: As migrants in a rural community, Maria and Juan discovered that building social connections was more challenging than they anticipated. Their farm work demanded long hours, leaving little time for socialising. Additionally, the rural setting meant fewer opportunities for meeting like-minded individuals or participating in community events. Over time, they began to feel increasingly isolated and disconnected from the broader social fabric.

Solution: Recognizing the importance of social connection for their well-being and happiness, Maria and Juan decided to take proactive steps to address their feelings of isolation. They began by reaching out to other local farmers, attending agricultural workshops, and joining community gardening groups. By actively seeking out opportunities for social interaction within the farming community, they gradually started to build a network of supportive peers who shared their passion for sustainable agriculture.

In addition to connecting with fellow farmers, Maria and Juan also explored avenues for engagement beyond the agricultural sector. They volunteered at local community events, attended town hall meetings, and participated in cultural activities, all of which helped them forge connections with a diverse range of individuals in their rural community. Through these efforts, they discovered a sense of belonging and camaraderie that enriched their lives both personally and professionally.

Impact: By prioritising social connection, Maria and Juan experienced a profound transformation in their overall well-being. Their newfound network of friends and acquaintances provided them with emotional support, practical advice, and valuable resources to navigate the

challenges of farm life. They no longer felt isolated but instead embraced a sense of community and belonging that infused their work with renewed purpose and vitality.

Furthermore, their expanded social circle opened up new opportunities for collaboration, learning, and growth. They exchanged ideas with fellow farmers, shared best practices, and collaborated on joint projects that enhanced the sustainability and resilience of their farm operations. Through these collaborative efforts, Maria and Juan not only strengthened their social ties but also fostered a culture of mutual support and cooperation within the local farming community.

Conclusion: Maria and Juan's journey highlights the importance of addressing social isolation in rural farming communities. By actively seeking out social connections and engaging with their local community, they were able to overcome feelings of loneliness and build a supportive network of peers. Through their efforts, they not only improved their own well-being but also contributed to the creation of a vibrant and interconnected farming community where individuals could thrive both personally and professionally.

6.6. Conclusions and recommendations

When seeking employment in the agricultural sector, M/Rs must prioritise understanding and asserting their labour rights. Familiarity with EU regulations on working hours, wages, and conditions is essential for ensuring fair treatment. Additionally, M/Rs should be enabled to actively seek information from relevant authorities and advocacy groups to empower themselves.

In navigating the agricultural job market, M/Rs should prioritise employers with a commitment to business ethics and reliability. Thoroughly reviewing contracts, assessing the reputation of potential employers, and seeking references contribute to making informed choices that align with ethical standards.

Additionally, developing problem-solving abilities is key for M/Rs in the agricultural sector. Embracing training programs, cultivating adaptability to changing conditions, and actively participating in mentorship initiatives can enhance their problem-solving skills. This not only contributes to personal growth but also enhances their value within the evolving agricultural landscape.

Besides, team spirit and cooperation are integral aspects of successful integration into the agricultural workforce. M/Rs should be given opportunities to actively engage in cultural integration programs, community initiatives, and mentorship opportunities to foster collaboration. Building effective communication skills further strengthens their ability to contribute positively to the cohesive nature of agricultural teams.

Last but not least, effective communication is a cornerstone for M/Rs in the agricultural sector. Engaging in language courses, communication workshops, and online resources enhances language proficiency and fosters an understanding of cultural nuances. Participating in community integration programs and networking events further refines communication skills, contributing to successful integration and collaboration within the EU's agricultural landscape.

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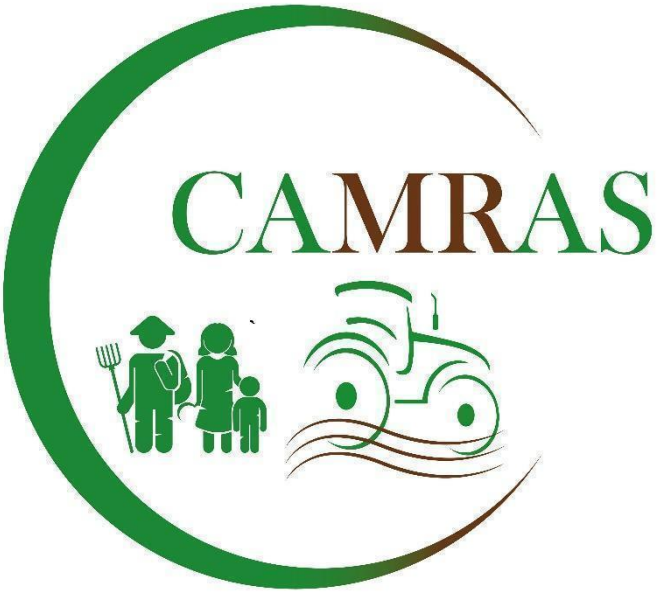

Module 7

Problems of the Agricultural Sector (KSU & TENGO)

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Ali Kiraç

In this module, you will

- receive information about current problems and challenges in the agriculture sector,
- see how these problems and challenges have an effect on farmers, workers in the field and migrants and refugees (M/Rs),
- see how these problems and challenges have an effect on agricultural production and products.

7. Problems of the agricultural sector

Agriculture remains an important source of livelihood for the majority of the world, but the sector is still very unproductive. Food, agriculture, and fisheries depend on the world's natural resources, so future food production will depend on how well these resources are conserved and used. Agriculture represents a crucial sector that underpins our population growth and well-being.

Although the share of the agricultural sector in the GDP is gradually decreasing in both developed and developing countries, the sector's contribution to industrial sectors such as food, farming tools and machinery, fertilisers, and chemicals, as well as to service sectors such as storage, transportation, and marketing, is increasing day by day.

According to the World Bank, agricultural development is one of the most powerful tools to combat extreme poverty, boost prosperity, and feed the global population (The World Bank, 2024). However, the current methods of food production, including mono-cropping and intensive tilling, have degraded over one-third of the world's productive topsoil while failing to provide the agricultural yields necessary to sustain the growing global population.

The agricultural sector, which has strategic importance for reasons such as meeting the food needs of the population, providing raw materials for agriculture-based industries, closing the trade deficit, and providing employment and livelihood for a certain population, faces many natural, social, economic, and political problems. The problems faced by the agricultural sector can be listed as follows:

1. weather unpredictability and climate change,
2. increased costs,
3. lack of labour force,
4. price fluctuations,
5. insufficiency and fragmentation of agricultural land,
6. insufficient or low level of technology use,
7. financing issues,
8. multiple legal procedures in the implementation of supports,
9. low investment in agriculture,
10. the level of farmers' education, income, and adoption of innovations,
11. growing population.

These problems are explained in detail in the following sections. Case studies demonstrate how M/Rs and local farmers can address challenges.

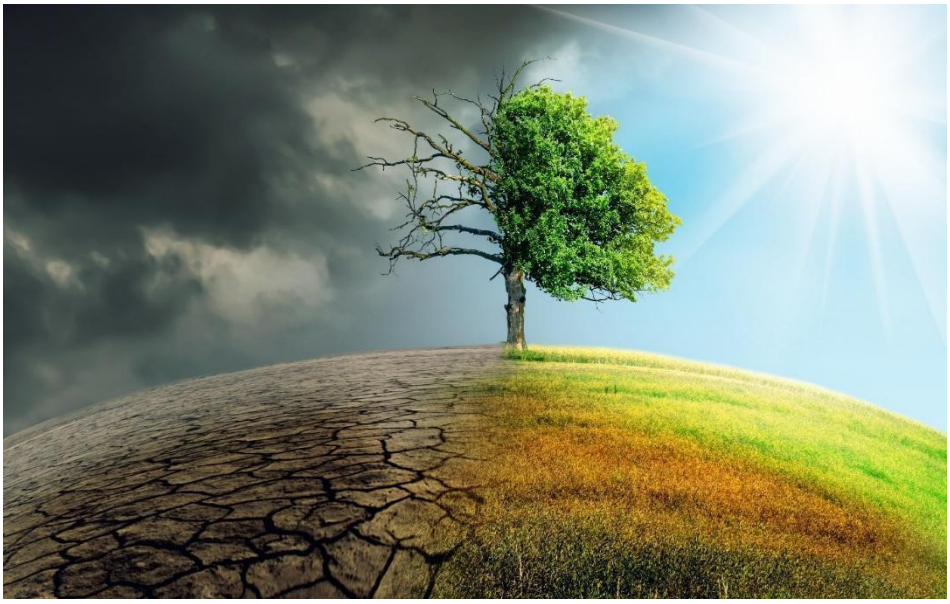
7.1. Weather unpredictability and climate change

Unpredictable weather has emerged as one of the most significant challenges in agriculture for 2023 (Miranda, 2023). Extreme weather events such as droughts, floods, and storms have impacted agricultural production, making it challenging to plan harvesting and planting, resulting in significant losses. Losses specific to the agriculture sector account for more than 60% of drought-linked losses, or around €5 billion annually (Naumann, 2021).

The demand for water for agricultural purposes will double by 2050 due to growing demands for food. This fact becomes more significant when coupled with the fact that agriculture is by far the most important driver of water shortages around the world. Irrigation accounts for 70% of global water withdrawals (Pandey, 2019).

Changing weather patterns, extreme weather conditions such as hail, frost, storms, tornadoes, high temperatures and droughts triggered by climate change are among the main causes of food insecurity (İkikat Tümer & Birinci, 2020). All these events have a huge impact on food production, as they significantly limit the quality, availability, and accessibility of resources, and compromise the stability of food systems around the world.

Agriculture is highly dependent on climate and weather conditions. Prolonged drought or extensive rainfall can have devastating repercussions on soil health and fertility. Average global crop yields for maize or corn are projected to drop by 24% in the next 60 years (Ogoyi, 2023).



Sources: Shutterstock

Case study: Maria and Juan

The migrants Maria and Juana run a small family farm located in a rural area, engaging in both plant and animal production. The farm has been successfully operated for five years.

Introduction: Despite having sufficient agricultural knowledge and producing high-quality products, Marian and Juan were struggling to effectively manage extreme weather events such as storms, hail, frost, drought, excessive rainfall, and high temperatures. They particularly struggled to manage the process when faced with climate events such as droughts, floods, and storms during production.

Challenge: Small-scale farmers like Maria and Juan, despite successfully operating their own farms, struggle to effectively cope with extreme weather events such as storms, hail, frost, drought, excessive rainfall, and high temperatures. They particularly face difficulty in managing production processes when confronted with climate events such as droughts, floods, and storms. This situation could jeopardise farm incomes and sustainability.

Solution: In this situation, Maria and Juan first began to regularly monitor and analyse climate data. This way, they would be able to determine the expected weather conditions for the upcoming weeks and plan their agricultural activities more reliably. Later, during dry periods, they will be able to opt for efficient irrigation methods (such as drip irrigation). However, Maria and Juan can perform better during dry periods by growing plant varieties that consume less water by choosing crop varieties that are more resistant to climate change and extreme weather events. They can also protect plants from weather events by using protected farming methods such as greenhouses or high tunnels. Finally, they decided to create emergency plans for the farm in case of disasters such as floods or storms. These plans include steps to secure equipment, protect animals, and minimise damage. They also decided to take out agricultural insurance against disasters such as tornadoes and fires.

Impact: With the measures they took against unpredictable weather events, Maria and Juan increased farm productivity, reduced product losses, minimised risks, and made farm activities more sustainable. Additionally, the use of modern agricultural technologies reduced Maria and Juan's workload by increasing labour productivity.

Conclusion: Maria and Juan can cope with unpredictable weather events and make their farms more sustainable by implementing various solutions. Steps such as monitoring climate data, diversified production plans, and the use of modern agricultural technologies can enhance the resilience of the farm and ensure its long-term success. These solutions will not only help Maria and Juan sustain their presence in rural life but also contribute to the local economy.

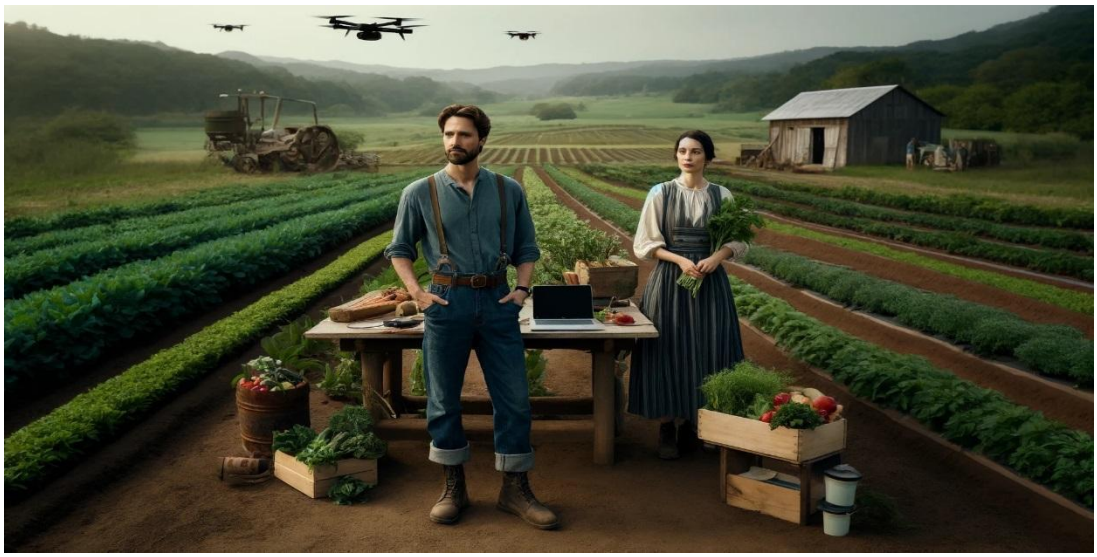
7.2. Increased costs

The costs of agricultural inputs have consistently increased since the onset of the COVID-19 pandemic. Geopolitical issues and subsequent inflation created additional challenges for businesses in their pursuit of profitability.

53 % of actors in the agricultural sector consider this issue more severe than in the previous year. Despite some improvement regarding inflation, input prices have continued to rise overall. This affects both growers and consumers since costs travel through the supply chain, increasing prices (Ogoyi, 2023).

It takes at least six months for the expenses incurred for production in the agricultural sector to turn into products. Therefore, the capital turnover rate is lower compared to other sectors. In crop production, there is an average of six months between the seed meeting the soil and the harvest of the product. During this period, producers incur expenses for activities such as irrigation, spraying, fertilising, harvesting, transportation, and marketing. In animal husbandry, after purchasing or breeding offspring such as calves, lambs, or chicks, expenses for feeding, medication, vaccination, veterinary care, hygiene, and maintenance care vary between 2 to 18 months. For example, the time between a chick arriving at the farm and being brought to the market is an average of 60 days, whereas the time it takes for a calf to grow and be brought to the market is 18 months. In dairy cattle farming, the process is slightly longer. It takes at least 24 months for a calf to reach the age of first lactation. Especially in developing countries, the increase in the prices of factors constituting production costs and the inadequacy of support for agricultural production lead to increased costs.

Case study: Maria and Juan



Maria and Juan, who live in a rural area and engage in agricultural production, want to ensure sustainability on their farm and expand their operations. Therefore, they aim to reduce costs and increase profitability.

Introduction: Even though Maria and Juan wanted to increase the sustainability of their business, raise their living standards, expand their business and employ more workers, they faced problems in reducing production costs.

Challenge: Increasing input prices leads to rising costs and decreasing profitability. This situation makes it difficult for farmers to cope with profitability issues.

Solution: Maria and Juan decided to conduct a detailed analysis to increase efficiency and reduce costs in their farm operations. This analysis would help them identify which inputs are driving up costs and understand where they can make improvements to enhance productivity. They attempted to increase efficiency using innovative agricultural techniques. In addition, they planned to develop better marketing strategies by creating new marketing policies to sell their products at better prices. Some of these policies include increasing access to local markets, establishing direct sales channels, or focusing on high-demand market segments such as organic farming. They also planned to leverage support programs offered by the government or agricultural organisations to reduce costs.

Impact: Increasing efficiency and reducing costs led to increased profitability for Maria and Juan's farm. The use of innovative agricultural techniques enhanced the farm's environmental sustainability. Better marketing strategies increase the farmers' income by enabling them to sell their products at better prices.

Conclusion: Farmers like Maria and Juan can implement various strategies to increase profitability in the face of rising input costs. Steps such as increasing efficiency, using innovative agricultural techniques, developing better marketing strategies, and taking advantage of support programs can enhance their farm's profitability and ensure long-term success. These solutions can strengthen farmers' economic situations and support the sustainability of local agriculture.

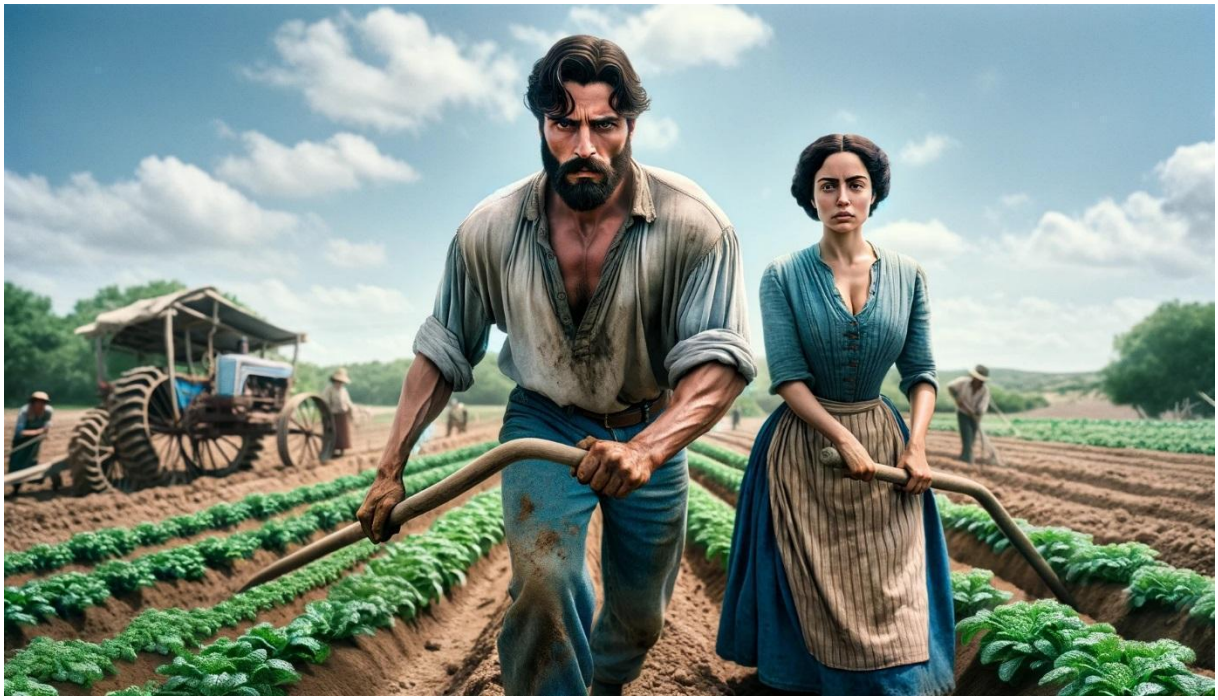
7.3. Lack of labour force

Access to qualified and affordable labour is essential in agriculture. This issue directly impacts the supply chain, affecting the entire production process from planting to harvesting. Finding innovative practices and policies that facilitate hiring agricultural workers and greater access to training programs is crucial to solidifying the farm workforce.

Farmers often face problems finding a labour force due to reasons such as work-wage imbalance in the agricultural sector, the lack of the concept of overtime in animal production, recruiting seasonal labour force in crop production, the integration of work-family life, lack of specialisation, and the existence of unregistered working conditions.

M/Rs prefer to work in the agricultural sector face several reasons including finding a job easily, low housing costs, providing job opportunities for other family members, lack of expertise, and adaptation to work environments. Nevertheless, over time, the domestic workforce in the sector has been replaced by M/Rs in many countries.

Case study: Maria and Juan



Maria and Juan have difficulty finding both permanent and seasonal workers for their farm. Labour shortages can reduce the productivity of both animal and plant production and may compel farmers to work more extensively.

Introduction: Maria and Juan, who wanted to stabilise their income and ensure the sustainability of their business despite the fluctuations in the prices of their products, faced significant challenges. Additionally, price fluctuations made it difficult for them to decide on their crop patterns.

Challenge: In rural areas, the demand for labour may vary seasonally, while the supply of labour may consistently be insufficient. This situation makes it challenging for farmers to find stable and reliable labour. The difficulty in finding labour can lead to additional costs and increased workload for farmers. Additionally, with the constantly changing labour force, work productivity and quality may also decrease.

Solution: Maria and Juan have decided to participate in programs aimed at developing local labour in rural areas to address their labour shortage issue. These programs can provide young farmers with agricultural skills and knowledge, establishing a stable labour source for their farms. Additionally, they explored job profiles on the camras.eu website, which connects workers with employers, to find suitable positions for their needs. Subsequently, they participated in seasonal worker programs that offer support in finding seasonal labour and provide assistance in worker health and safety. Additionally, they considered using technological automation and machinery in agricultural operations, believing that such machines can reduce labour requirements. Therefore, they decided to review the training courses available on the camras.eu website to learn how to use these machines effectively.

Impact: Local and M/Rs labour development programs and seasonal worker programs will enhance farms' access to stable and reliable labour, thus increasing productivity. The use of technological automation and machinery can reduce the need for labour and improve working conditions on farms.

Conclusion: Farmers like Maria and Juan can participate in local and M/R workforce development programs, access M/R workforce, apply for seasonal worker programs, and use technological automation and machinery to solve the problem of labour shortage. These solutions can enhance farm productivity and enable farmers to adopt a more sustainable business model. Additionally, they can contribute to the economic development of the local community.

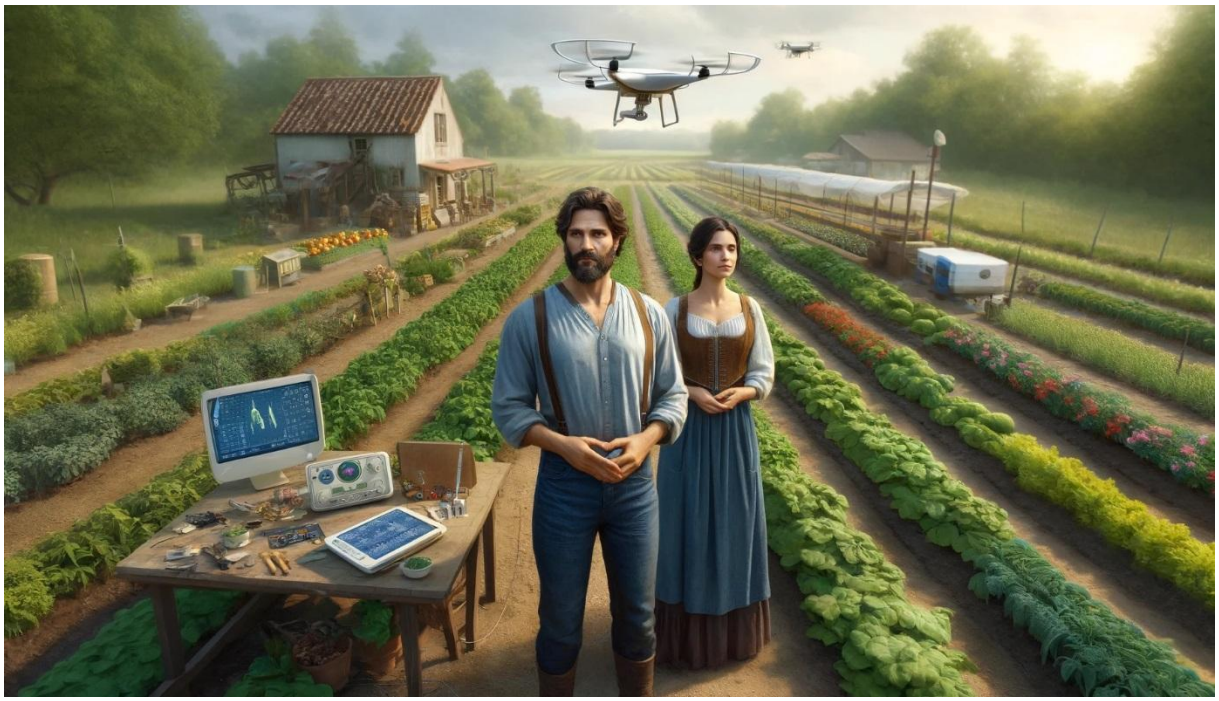
7.4. Price fluctuations

There are several reasons for the increase in food prices. These include issues with crop supply due to global warming and associated droughts, as well as the adverse effects of rising oil prices on production inputs and transportation costs. In addition, the demand for non-food products created by some large agricultural surplus exporting countries in the world markets, the increase in the demand for forage crops, the speculative effects created by the capital entering the commodity exchanges in the financial markets, and the implementation of trade-restrictive measures by the exporting countries can be counted. In years of abundant agricultural production, also known as years of surplus, product prices and producer income tend to be low. In years of limited production, also known as years of scarcity, product prices are high, consequently leading to high producer income. This situation is closely related to the sustainability of the operation.

Product prices vary not only based on production quantity but also according to seasons. Especially for crops grown in open fields, product prices fluctuate depending on the season, increasing or decreasing accordingly. For example, the prices of tomatoes grown in the field are typically high when the product is first introduced to the market and towards the end of the harvest season, while they tend to be lower during the peak harvest period.

Price fluctuations in produce is a challenge that affects 83% of actors in the supply chain. Moreover, 52% is a more significant problem this year than the previous one (Miranda, 2023). Prices can fluctuate due to supply and demand, weather conditions, or geopolitical events, making predicting these fluctuations challenging. Fluctuations in agricultural product prices affect the total income of producers, the quantity of inputs used in agricultural production, and the country's economy as a whole.

Case study: Maria and Juan



Maria and Juan struggled to control price fluctuations of their products and faced difficulty in determining their product patterns. Additionally, they lacked sufficient market price information regarding the balance between supply and demand for their products.

Introduction: Maria and Juan, who wanted to stabilise their income and ensure the sustainability of their business despite the fluctuations in the prices of their products, faced significant challenges. Additionally, these price fluctuations made it difficult for them to decide on their crop patterns

Challenge: Maria and Juan concluded that they struggled to predict their income due to fluctuations in the prices of their products, which negatively impacted their decision-making processes. This situation made it difficult for them to make financial decisions and created instability. The lack of sufficient market information regarding the balance between supply and demand for their products also made it challenging for Maria and Juan to determine their product patterns. This, in turn, made it difficult for them to grow and market the right products accurately.

Solution: Maria and Juan decided to conduct market research and analysis to determine the demand potential for their products. This decision helped them understand market trends and demand patterns, facilitating their decision-making regarding product patterns. To protect against price fluctuations, Maria and Juan decided to use price risk management tools such as futures contracts. These tools assisted them in fixing the price of their products and reducing their financial risks. Additionally, Maria and Juan took steps to join local agricultural cooperatives to enhance their marketing power and share market information. These cooperatives help farmers obtain better prices for their products and improve their marketing strategies.

Impact: The use of market research and price risk management strategies improved the marketing and protection against price fluctuations of Maria and Juan's products. Joining

agricultural cooperatives enables farmers to share market information and enhance their marketing power, thus helping them obtain better prices.

Conclusion: Farmers like Maria and Juan can conduct market research, utilise price risk management strategies, and join local agricultural cooperatives to cope with price fluctuations and determine their product patterns. These solutions can increase farmers' income and contribute to the sustainability of farm operations. Additionally, they can contribute to the local agricultural economy.

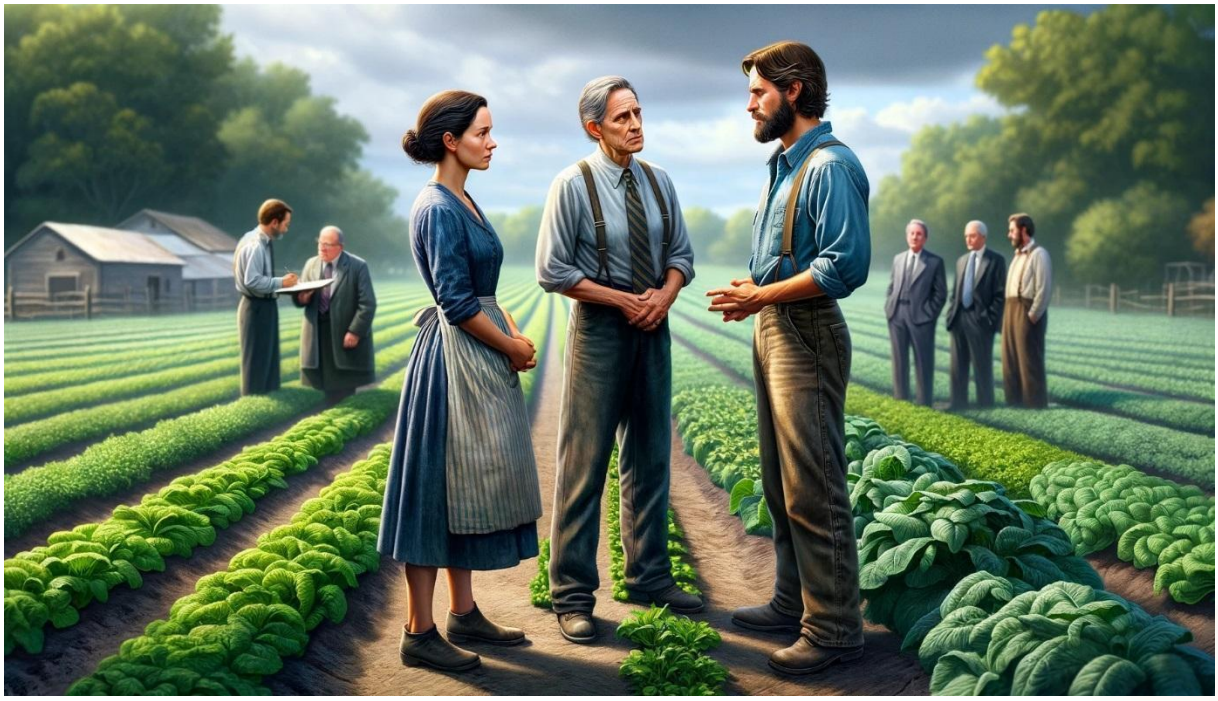
7.5. Insufficiency and fragmentation of agricultural land

In spite of established principles of land use in agriculture including techniques to apply, periods of tillage and selection of land to be cultivated, there are many problematic practices of land use worldwide. Use of land not reserved for agricultural use or applying wrong strategies causes erosion, washing land into seas or piling up to other land. The use of land not suitable for agriculture by neglecting the land’s capacities is a further problem.

Of the 1.38 billion hectares of arable land available worldwide, more than one third has been irreversibly compromised since 1961 owing to extensive land conversion and inappropriate agricultural methods such as mono-cropping and intensive tiling as well as land conversion leading to soil erosion, desertification, and salinization.

The Global Soil Treatment Market valued at USD 36.5 billion in 2018 and is estimated to grow at a CAGR of 6.2% during the forecast period 2020-2025. Soil treatment can be used to treat the contaminated soil and convert it into usable agricultural soil (Mordor Intelligence, 2024).

Case study: Maria and Juan



Maria and Juan wanted to expand their farm and increase their production by acquiring or leasing new land. However, they are encountering various issues in the process of acquiring the land.

Introduction: Maria and Juan needed more land to increase their income, improve their living standards, and expand their business. M/Rs often experience problems in purchasing and renting land. Especially, they have difficulty finding suitable land at an affordable price.

Challenge: Land prices in rural areas were generally high, making access difficult for Maria and Juan. Additionally, finding land of suitable size was another challenge they faced. In some cases, there may be uncertainty or property disputes over land ownership. This situation can hinder the attempts of farmers like Maria and Juan to acquire new land. The complex legal regulations and procedures encountered in the process of buying or leasing land also complicated matters for Maria and Juan.

Solution: Maria and Juan decided to carefully research the land market to choose suitable land for their expansion plan, taking into account factors such as prices, local land conditions and accessibility. They investigated land acquisition support and programs offered by the government or agricultural organisations, financial support provided to farmers, or programs that can facilitate the land acquisition process. They also decided to seek advice from expert lawyers in property and legal matters to assist them in the land acquisition process. Thus, they were able to follow legal regulations and procedures correctly.

Impact: The process of acquiring suitable land enables farmers like Maria and Juan to expand their operations/business and increase their production. Government support and programs help reduce the financial burdens on farmers during the land acquisition process and facilitate their operations.

Conclusion: Farmers like Maria and Juan should conduct thorough resource research to overcome the challenges they face during the land acquisition process. They should take advantage of government support and seek legal advice to navigate through the process effectively. These solutions can help farmers expand their farms and increase their production, thus enabling them to grow their businesses and create a more sustainable agricultural operation. Additionally, they can make positive contributions to the local economy and the agricultural sector.

7.6. Insufficient level of technology use

One of the prominent issues plaguing the agricultural sector is the insufficient level of technology use, which hampers productivity and efficiency. According to recent studies, only around 40% of farmers globally utilise modern agricultural technologies in their operations, significantly limiting their potential output.

The lack of technological adoption contributes to low yields, food insecurity, and income instability for farmers in these areas. Furthermore, data from agricultural surveys conducted in various countries indicate that farmers who do not embrace technological advancements often struggle to compete in the global market, leading to decreased profitability and economic growth in the agricultural sector.

In both Turkey and the European Union, the agricultural sector grapples with the challenge of insufficient and low-level technology use, impacting productivity and competitiveness. In European countries despite the region's overall technological advancements, there are disparities in the adoption of agricultural technology among member states. While some European countries have embraced modern agricultural practices, others lag behind, with a significant portion of farmers still employing traditional methods. On average, less than 50% of farmers in European countries utilise advanced technologies, indicating a widespread issue of insufficient technology adoption across the bloc.

This low level of technology use hampers the agricultural sector's ability to compete globally and adapt to evolving market demands and environmental challenges. To address this issue, European countries are focusing on initiatives to promote technology transfer, provide training and support for farmers in adopting modern practices, and invest in digital infrastructure to enhance the uptake of agricultural technologies. These efforts are crucial for improving productivity, sustainability, and resilience in the agricultural sector of both regions.

7.7. Financing issues

Financial difficulties in the agricultural sector in Turkey and the European Union are based on similar fundamental problems in both regions. Among these, high input costs, low productivity, marketing and distribution problems, effects of climate change and restrictions in access to finance have an important place.

The agricultural sector in Turkey, for example, plays an important role in the economy, but the financial difficulties experienced by farmers prevent the development of the sector. The structural defects in agriculture, insufficient development of production techniques, relatively low productivity, and similar issues increase the financing issues further. In this sense, the greatest issue is that the sector cannot be credited sufficiently. Another problem is indirect or direct subventions. The agricultural sector is not financed with direct and indirect subsidies in Turkey, as in other countries. High input costs, especially increases in basic inputs such as energy and fertiliser, reduce farmers' profitability. In addition, the fact that the capital structure of the agricultural enterprises is disarranged is also one of the financing issues of the agricultural sector. Additionally, the inadequacy of the marketing and distribution system makes it difficult to evaluate products and sell them at competitive prices. Climate change negatively affects agricultural productivity with increasing drought and climate events. However, restrictions in access to finance in the agricultural sector also prevent farmers from investing in modern agricultural techniques and increasing productivity.

Similar problems are encountered in the EU. The agricultural sector in the EU must also be compatible with broader policy objectives such as environmental protection and sustainability. However, high competition, low prices and uncertainties in agricultural policies negatively affect farmers' incomes. Additionally, subsidies and support in the EU's agricultural policies vary, making farmers' incomes unpredictable.

Some suggestions and policy recommendations to increase financial sustainability in the agricultural sector:

Readjustment of Agricultural Support Policies: Agricultural support policies should be effectively readjustment to support farmers' incomes and increase sustainability in the sector. These policies can provide direct income support to farmers or promote sustainable agricultural practices.

Encouragement of Technology and Innovation: Technology and innovation in the agricultural sector can increase productivity and enable more effective use of resources. New agricultural technologies and digital solutions can encourage farmers to switch to more sustainable production methods.

Strengthening Training and Consultancy Services: Training and consultancy services should be provided to farmers on sustainable agricultural practices. These services can help farmers increase productivity and reduce environmental impacts.

Strategies to Combat Climate Change: Appropriate strategies should be developed in the agricultural sector to combat climate change. These strategies include water

management, erosion control, diversified production systems and climate-smart agricultural practices.

Increasing Access to Financial Services: Some measures should be taken to increase farmers' access to financial services. These measures include microfinance programs, agricultural loans, insurance products and other financial instruments.

Market Access and Trade Development: Supporting policies and programs should be developed to enable farmers to better market and distribute their products. Increasing market access is important to reduce trade barriers and facilitate access to agricultural products to international markets.

These suggestions and policy recommendations can be implemented to increase financial sustainability in the agricultural sector and enable farmers to compete more strongly. However, for these recommendations to be effectively implemented, a multilateral approach and participation of local, regional and international stakeholders is required.

7.8. Multiple legal procedures in the implementation of supports

In the agricultural sector, one prominent issue is the presence of multiple legal procedures involved in the implementation of support programs. These procedures often entail complex bureaucratic processes, leading to delays and inefficiencies in delivering crucial assistance to farmers. As a result, farmers may face challenges in accessing timely support, hindering their ability to effectively manage their operations and respond to various agricultural challenges such as market fluctuations, natural disasters, and changing regulatory requirements. Streamlining these legal procedures is essential to ensure farmers receive the necessary support promptly and efficiently, thereby promoting sustainable agricultural practices and bolstering food security.

In Turkey, the agricultural sector faces challenges due to multiple legal procedures involved in implementing support programs. Farmers often encounter delays in accessing support due to bureaucratic complexities, with around 30% of farmers reporting difficulties navigating these procedures. Similarly, within the European Union, the agricultural sector grapples with the burden of multiple legal procedures in support program implementation. In some EU member states, up to 50% of farmers' experience delays in receiving assistance due to bureaucratic hurdles associated with navigating complex legal frameworks.

These challenges hinder the efficient allocation of resources and undermine the timely delivery of essential support to farmers. Streamlining legal procedures in both Turkey and the EU is imperative to ensure the agricultural sector can thrive and contribute effectively to food security and economic stability.

7.9. Low investment in agriculture

In ancient times, people arrived at the understanding that planting seeds and harvesting crops was safer for obtaining food than hunting. The idea that started in ancient times has developed over the years, leading to the growth of the agricultural sector until today. Every year, the world strives to feed more people with less land available. Therefore, investments in the agricultural sector are becoming increasingly popular.

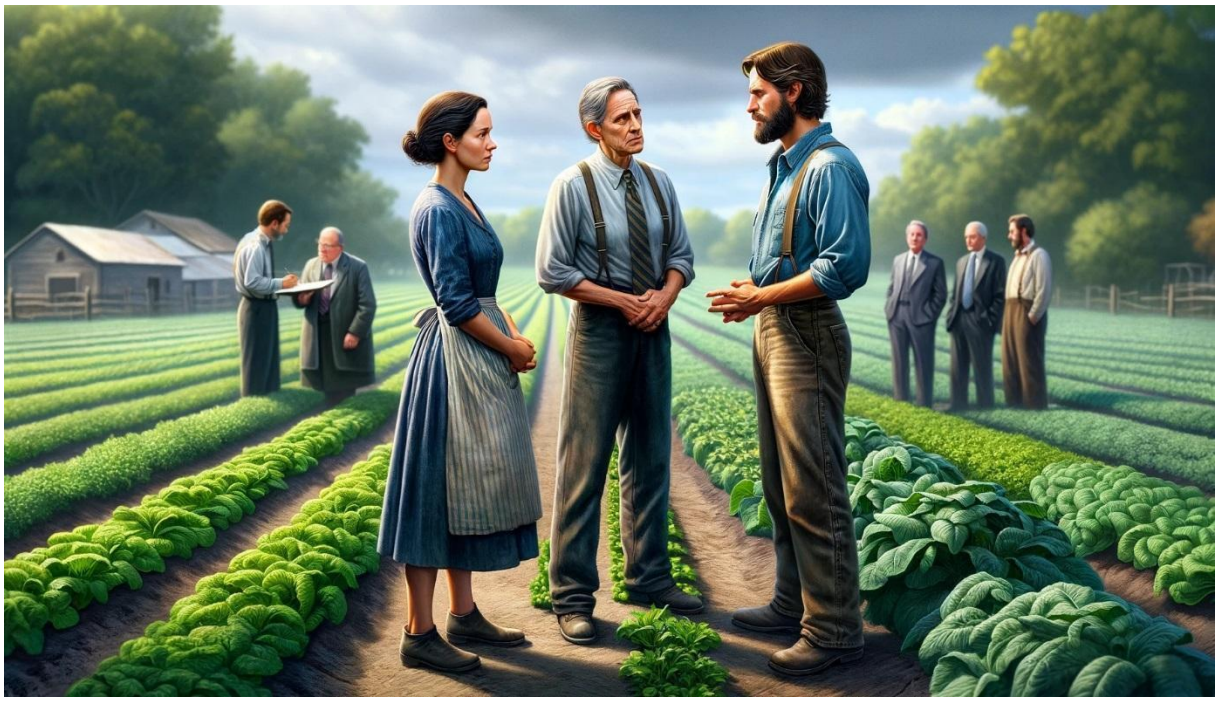
If all stakeholders in the agricultural sector are made aware of how crucial the sector is for humanity and if they acknowledge the indispensability of the sector, investments in the agricultural sector will increase day by day. For this purpose, government support, educational

programs, effective utilisation of cooperatives, facilitation in input procurement, and easy access to production factors (such as labour and capital) can be provided.

An incentive system should be implemented to increase investments, which constitute one of the fundamental elements of growth in the agricultural sector. Various incentives should be provided for investments, including tax exemptions, cheap energy, and favourable financing conditions.

Among the incentive practices for agricultural investments are VAT exemption, Customs Duty Exemption, Tax Reduction, Social Security Premium Support (Employer's Share), Income Tax Withholding Reduction, Social Security Premium Support (Employee's Share), Interest Rate Support, Land Allocation, and VAT Refund. Increasing the number of these practices can indeed boost investments in the agricultural sector.

Case study: Maria and Juan



Farmers living in rural areas like Maria and Juan face difficulties in accessing capital for their farms. Despite their willingness to use credits, they lack sufficient knowledge to access it. Additionally, there are other sector actors who are not willing to invest in the agricultural sector.

Introduction: Maria and Juan faced challenges in accessing external capital (such as bank loans, angel investors, or support from family and friends) to improve their living standards, increase their production, and utilise new technologies.

Challenge: Maria and Juan struggled to access suitable credit from banks or other financial institutions, hindering their ability to meet their operational capital needs. This situation emerged because they were unsure how to apply for it and provide the necessary documentation. The reluctance of other sector actors to invest in the agricultural sector reduced their chances of finding capital.

Solution: To address the financial source issue, Maria and Juan decided to utilise financial education and counselling services to become informed about the credit application process. These services helped them understand the credit application process and provide the necessary

documentation. Village development and support programs offered by the government or civil society organisations provided capital to farmers in rural areas and offered support for business development. By benefiting from government incentives and support programs for the agriculture sector, Maria and Juan accessed capital. These incentives promoted the use of new technologies and enhanced agricultural productivity.

Impact: Financial education and counselling services can increase farmers' access to credit and facilitate the credit application process for farmers like Maria and Juan. Village development and support programs along with agricultural investment incentives can enhance farmers' chances of finding capital in rural areas and assist them in business development.

Conclusion: Farmers like Maria and Juan can address the issue of finding capital by benefiting from financial education and counselling services, participating in village development and support programs, and taking advantage of agricultural investment incentives. These solutions can help farmers improve their businesses and contribute to rural development. Additionally, they can enhance the sustainability and competitiveness of the agricultural sector.

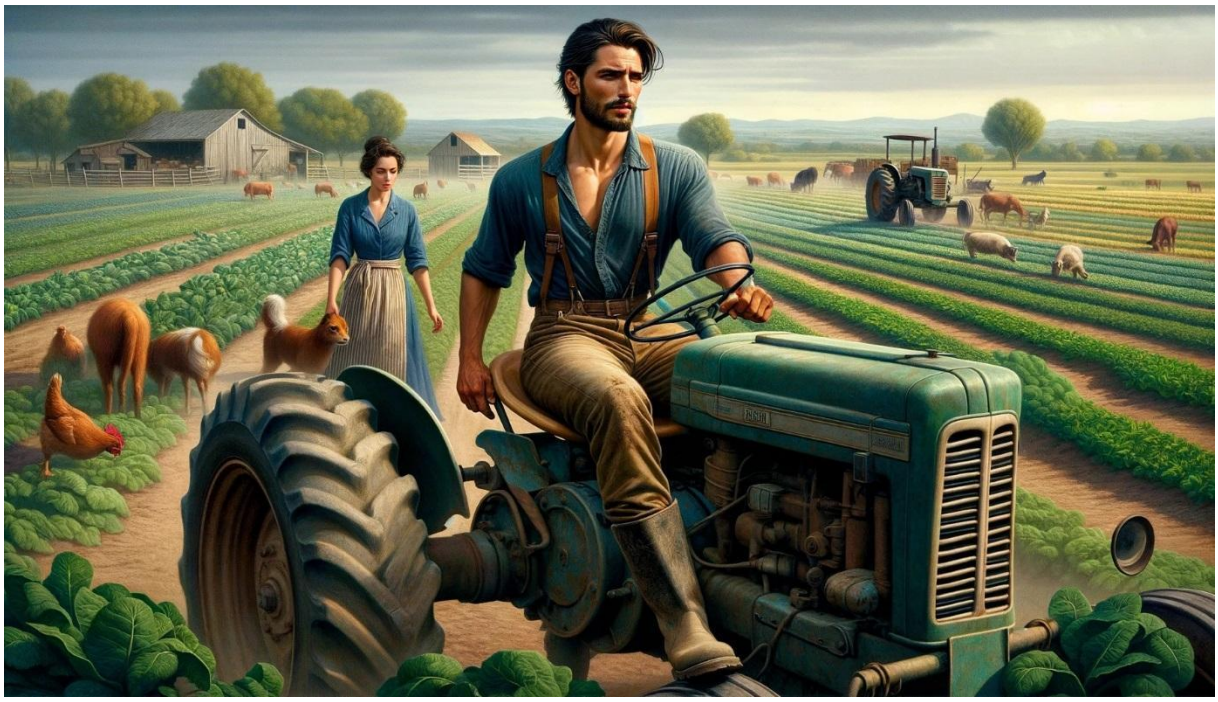
7.10. Farmers' education, income, and adoption of innovations

In the agricultural sector, where the life of a farming family is a cohesive whole, increasing productivity and quality in production will also lead to business success and income growth. As long as farmers closely follow innovations such as technology, development of breeds/species, methods of combating diseases and pests, and techniques to increase productivity and quality, they will make their business successful. It is of great importance for farmers to have a certain level of education, the ability to follow technology, and a sufficient level of income to closely follow innovations. Therefore, there is a directly proportional relationship between vocational education and income levels and the adoption of innovations. The adoption and dissemination of agricultural innovations are extremely important to increase productivity, promoting rural development, and reducing costs (Gürün et al, 2023; Kılıçtek & Aksoy, 2019).

Especially in developing countries, farmers have low education and income levels. Therefore, they face difficulties in keeping up with and adopting technology and innovations. This situation negatively affects business success and income.

M/Rs who want to work in the agricultural sector but do not have sufficient knowledge on this subject can also gain information about the agricultural sector of their host country. They can attend face-to-face and/or online training provided by public institutions or the private sector in the host country. They can increase their knowledge, skills and capacity in the field of agriculture by becoming members of online education platforms of projects such as the CAMRAS project.

Case study: Maria and Juan



Maria and Juan aimed to increase their education and income levels, and enhance their knowledge, skills and capacity thus, they want to adopt innovations more easily.

Introduction: As Maria and Juan have lived in rural areas with fewer educational opportunities than in urban centres, they had difficulty learning innovative agricultural techniques or business management with their limited education levels, so that they suffered from low income, and income inequality can be common in rural areas. Maria and Juan had limited opportunities to increase their income levels and improve their standard of living.

Challenge: Accessing educational institutions, internet connectivity, or technological infrastructure can be limited in rural areas, making it difficult to learn and implement new agricultural techniques.

Solution: The government or civil society organisations initiate programs to improve education and technology access in rural areas. Maria and Juan enhanced their knowledge and skills by participating in training sessions organised by agricultural cooperatives, local organisations, and projects like CAMRAS. In addition, they followed these institutions and organisations' websites via the internet and social media, providing them with opportunities to participate in online training sessions.

Impact: Increased access to education and technology, and the adoption of innovative agricultural techniques and business management, led to increased productivity and quality in agricultural production for Maria and Juan, which in turn can led to increased income levels and stimulate economic growth in rural areas.

Conclusion: Increasing education levels and adopting new technologies for farmers like Maria and Juan can help promote rural development and the adoption of sustainable agricultural practices. The increase in education and income levels can enable rural communities to participate more actively in decision-making processes and contribute to strengthening the local economy. Additionally, farmers can communicate with each other through education and share their knowledge and skills. Increasing the education and income levels of farmers like Maria

and Juan can improve the quality of life in rural areas and stimulate local economic development. This is important not only for them but also for the overall well-being of rural communities.

7.11. Growing population

In 2022, the world population hit 8 billion and if growth continues at the same rate, it will double in next 50 years (Igini, 2022).The reasons behind such unprecedented growth are obvious: high fertility levels and drastic increases in human lifespans – thanks for the most part to remarkable advancements in public health and medicine as well as nutrition and personal hygiene – have accelerated population growth significantly over the last century (Ogoyi, 2023).

An obvious consequence of population growth is a higher demand for food, but if agriculture cannot keep up, more people will suffer from food shortage. Current figures are already alarming: In 2021, as many as 828 million people suffered from hunger, an increase of 46 million compared to the previous year (WHO, 2022). The agricultural sector must undergo serious changes to prevent a catastrophe because of an already scarce arable land to provide sufficient nutritious food resources, combined with other impacts of climate change on food resources.

A constantly growing global population can also have adverse effects, including the lack of water resources and added pressure on available arable land (Pandey, 2019). Agriculture already accounts for 70% of all freshwater used on the planet (Lloyd, 2022). As the global population is estimated to exceed 9 billion by 2050, it is becoming increasingly urgent to find alternative solutions that allow feeding the world without destroying it (UN News, 2019).

Increasing population puts increasing pressure on the agricultural sector, especially in developing countries. The continuous increase in the world population causes an increasing demand for food in the agricultural sector and reveals the necessity of efficient agricultural practices and more effective use of resources to meet this demand. At the same time, as the increasing population tends to urbanise, the world is faced with difficulties such as the decrease in agricultural land and the impact of urbanisation on labour resources in the agricultural sector.

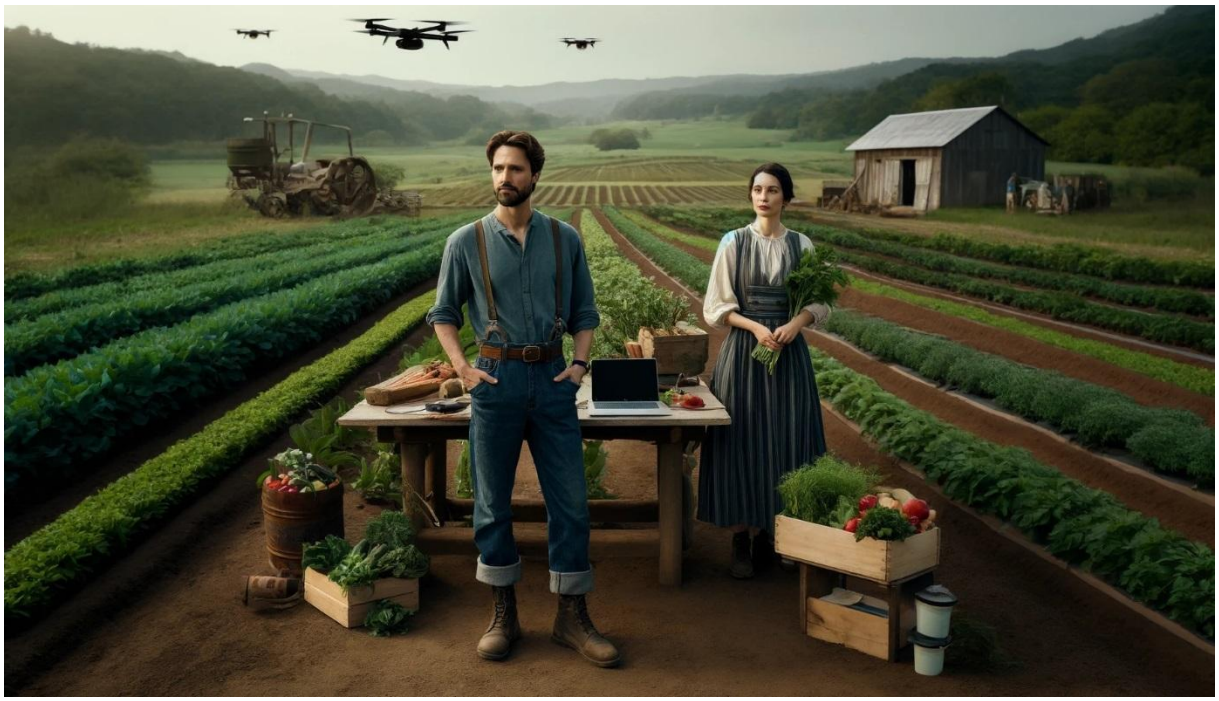
Refugees and migrants play an important role in the agricultural sector as both labour force and consumers. However, because these groups are often disadvantaged and have limited access to resources, they need to be supported to participate sustainably in the agricultural sector. In addition, the employment of refugees and immigrants in the agricultural sector is important in terms of ensuring balance in local labour markets and meeting the needs of agricultural production.

Food security is closely related to the impact of the increasing population and immigrants on the agricultural sector. Food security refers to people's access to healthy and nutritious foods and the provision of these foods in sufficient quantities. While increasing population and immigrants increase the demand for food and increase the pressure on food security, strengthening sustainable production methods and food distribution chains in the agricultural sector is important to ensure food security.

Against this backdrop, various policy recommendations can be offered to increase financial sustainability in the agricultural sector and ensure food security:

- To increase productivity in the agricultural sector, investments should be made in technology and innovation and technical support should be provided to farmers.
- Appropriate policies and programs should be developed to encourage the employment of refugees and migrants in the agricultural sector.
- To ensure food security, sustainable production practices should be encouraged in the agricultural sector and the food distribution chain should be strengthened.
- To reduce the pressure of the increasing population on the agricultural sector, urban agriculture projects should be encouraged and policies should be created to protect agricultural lands.

Case study: Maria and Juan



Maria and Juan wanted to increase their production and crop productivity to meet the food needs of the growing population and ensure food security. However, they had problems in increasing production efficiency.

Introduction: Maria and Juan, engaged in agricultural production in a rural area, struggled to increase their production quantities both to boost their income and to meet the community's food needs. These farmers may have limited resources to improve crop yield and quality.

Challenge: Maria and Juan had limited access to modern agricultural techniques and innovative technologies. Therefore, they faced difficulties arising from not having the technologies required to increase efficiency in plant and animal production. Limited access to agricultural education and information also prevented them from increasing production efficiency. In addition, factors such as climate change and natural disasters caused product loss and decreased productivity in agricultural production. This situation provided Maria and Juan with difficulties in planning and managing their production.

Solution: Maria and Juan decided to acquire the necessary knowledge and skills to increase production efficiency by participating in agricultural training programs and receiving advice from agricultural experts. They increased productivity by investing in modern agricultural technologies and the use of appropriate inputs for the product. They also aimed to improve their capacity in the use of technological infrastructures such as irrigation systems, soil analysis equipment, automatic irrigation systems, climate-compatible agricultural practices, growing plants with high drought tolerance, using water and energy-saving techniques, and preparing appropriate feed rations for feeding animals.

Impact: Agricultural education and technological investments helped Maria and Juan produce more food and achieve food security by increasing production efficiency. Adopting climate-adapted agricultural practices enabled them to cope with climate change and make their production sustainable. Productivity also increased with the use of appropriate inputs as a result of soil analysis and feeding animals in accordance with the feed ratio.

Conclusion: Farmers like Maria and Juan can increase production efficiency by receiving agricultural training and consultancy, making technological investments, and adopting climate-adapted agricultural practices. These solutions can help farmers produce more food and achieve food security, so they can increase their income and meet the food needs of society. It may also have positive effects in terms of environmental sustainability.

7.12. Conclusions and recommendations

The agricultural sector has maintained its importance since the dawn of humanity. With the development of the industrial and service sectors, agricultural products have begun to be used as raw materials in these industries. Moreover, events such as economic crises, wars, and pandemics around the world have further highlighted the importance of the agricultural sector.

The agricultural sector, which is of vital importance to humanity, faces climate events such as drought, excessive or insufficient rainfall, floods, storms, tornadoes, hail, snow, and high temperatures. At the same time, due to the effects of climate change, the frequency and impacts of these climate events are increasing. Therefore, the agricultural sector needs support and prevention due to rising costs, lack of production factors such as labour and capital, fluctuations in product and input prices, and the misuse of agricultural land. Additionally, considering that producers and workers in the agricultural sector generally have low levels of education and income worldwide, public and private sector stakeholders should provide more support to help producers adopt innovations more quickly. This, in turn, will lead to increased productivity and quality in production. Among the most important of these supports are educational assistance in all areas that producers may need from production to the consumer's table, support for foreign trade, promotion of cooperatives, and financial assistance. In conclusion, if countries want to develop, grow, and hold an influential position in the global economy, they must support, protect, and facilitate the development of the agricultural sector.

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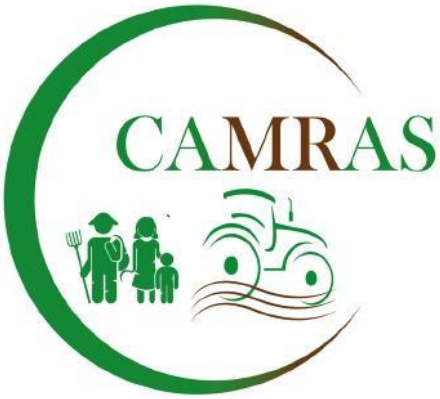

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