



The Role and Significance of Crop Production in the Global Economy

Aygun Hajjiyeva¹ , Mehriban Hasanova¹ , Valida Saliyeva¹ ,
Gulnara Tagiyeva¹ , Nasimi Abbaszade¹ 

¹Azerbaijan State Agricultural University, Faculty of Agricultural Economics, Department of Agricultural Economics, Ganja, Azerbaijan.

aygun.haciyeva@adau.edu.az

Abstract. Crop production, as one of the two main branches of agriculture, occupies a vital place in the global economy. It provides the majority of the world's food supply and serves as a primary source of raw materials for processing industries such as textiles, chemistry, and pharmaceuticals. Furthermore, it constitutes the foundation of the feed base for livestock farming while also utilizing organic fertilizers produced by animal husbandry. Currently, more than 20,000 agricultural plant species are cultivated worldwide, of which approximately 650 hold primary significance for the development of human civilization. Modern production technologies are increasingly oriented towards the precise assessment of factors and conditions that influence the productivity and quality of agricultural crops. The role of crop production in ensuring food security and fostering economic growth is substantial. In most countries, especially in rural areas, the livelihoods of the majority of the population depend directly or indirectly on crop production. Therefore, the analysis and evaluation of the role of crop production in the global economy is of particular importance.

Keywords: crop production, agricultural output, food security, food products, evaluation, factor, organic farming, digital technologies

1 Introduction

In the global economy, crop production represents a complex system encompassing various dimensions of production, trade, distribution, as well as social and ecological factors influencing agricultural activities. By supplying food and raw materials to numerous industries, crop production holds one of the central positions in the world economy. It plays a pivotal role in global agriculture by providing the bulk of food

products and serving as the foundation for raw materials required in multiple industrial sectors.

The significance of crop production for the world economy and human livelihoods can be explained through several key aspects:

- Ensuring food security: Crop farming guarantees the production of staple crops that form the basis of human nutrition.
- Economic contribution: As a crucial sector of national economies, crop production generates employment opportunities and fosters economic growth.
- Industrial input: Crop products serve as the primary raw material base for food, textile, and chemical industries, among others.
- Complementarity with livestock farming: By supplying animal feed and utilizing organic fertilizers, crop farming maintains a strong interconnection with livestock production.
- Geographic and climatic adaptability: Crop farming is developed across diverse regions and climatic zones, in some of which it is the only source of employment.
- Technological integration: Modern technologies used in industry increasingly rely on products from crop farming.

For these reasons, the study of theoretical approaches to crop production, the analysis of its role in global agriculture, and the investigation of progressive development trends worldwide are of considerable importance.

2 Materials and Methods

The relevance of this research is determined by the significant role and importance of crop production in the world. When discussing its role in the global economic and social life, particular attention is given to its contribution to food security for the world's population, its provision of employment opportunities in rural areas, and its function as a primary supplier of raw materials for industrial production. The substantial importance of the sector necessitates the study of theoretical issues concerning its development. As in all countries, the role of crop production in Azerbaijan is critical, both in strengthening the national economy and in improving the living standards of the population. In this regard, the progressive experiences of other countries in the development of crop farming should be studied and adapted to local conditions. The relevance of our research is therefore explained by these factors.

Object and Subject of Research. The object of the research is global agriculture, with a particular focus on its crop production sector. The subject of the study is the determination of the place and role of crop production within the global economy.

Research Aim. The aim of this research is to analyze and evaluate the current state of crop production, its role and the factors influencing its development in the global economy, as well as to determine future perspectives for its advancement.

3 Crop Production as a Key Sector in the Global Economy

Crop production in the global economy is a complex system encompassing multiple aspects that influence production, trade, distribution, as well as social and ecological factors in agriculture. By providing various sectors with food and raw materials, crop production occupies a central position in the global economy. It supplies the majority of raw materials for both food products and diverse industrial sectors, establishing its pivotal role in world agriculture.

Crop production is a leading sector in most countries, including the United States. As one of the main branches of agriculture, crop production involves the cultivation of domesticated plants. This includes field crops, vegetables, fruits, and other categories. The diversity of agricultural crops determines the overall composition of crop production.

Cereal crops are plants that provide wheat, which constitutes a primary food source for humans. In addition to human consumption, cereal products serve as feed in livestock production and as raw materials for various industrial sectors. The main cereal crops include wheat, barley, oats, maize, rice, paddy, and buckwheat groats. Together, these crops account for approximately 80% of total cereal yields and form the basis of the dietary intake of many populations.

Cereal cultivation occupies about 50% of the world's arable land. The largest cereal producers are China, the United States, India, and Russia, which collectively account for 54% of global wheat production. Other significant wheat-producing countries include France, Canada, Ukraine, Indonesia, and Brazil. Historically, wheat was known in the Middle East as early as 6,000–5,000 BCE (Serge Svizzero etc.2014). Currently, this crop is cultivated in more than 70 countries worldwide.

The main wheat belt is located in the Northern Hemisphere, with a smaller belt in the Southern Hemisphere. Wheat is predominantly a field crop and is most extensively cultivated in Asia, Europe, and North America. The total annual global cereal harvest is approximately 2 billion tons. The level of development and specialization of cereal farming varies across different regions of the world.

Field crop production represents the principal branch of crop cultivation, specializing in the growth of both food and non-food crops. Globally, cereal farming forms the foundation of food crop production. It not only provides populations with bread but also determines the development trajectory of livestock farming. Furthermore, major cereal crops such as wheat, rice, maize, and barley serve as essential raw materials for numerous sectors of the food industry (Cardno, 2017).

Maize production is primarily concentrated in the southern regions of the temperate zone, although its cultivation also occurs in lower latitudes. In developing countries, maize functions primarily as a food crop, whereas in developed nations it is predominantly used as fodder. Maize was introduced to Europe during the Age of Exploration from the Americas, with Mexico considered its center of origin. Consequently, maize has become widely cultivated, particularly in North America and Asia (Abbasov, I. D)

Rice is an ancient crop primarily cultivated under monsoon climate conditions. It is grown in approximately 100 countries worldwide. Although rice occupies less land area compared to cereals, it provides sustenance for nearly half of the global population. While cereals are predominantly field crops, rice is characteristic of regions with a monsoon climate. The largest rice paddies are located in South and Southeast Asia, where two to three harvests are obtained annually (Abbasov, I. D)

In the field of industrial crop production, technical crops are cultivated. These are agricultural plants that provide raw materials for various sectors of industry. Among them, the following agricultural crops are distinguished:

- Oil crops used in the food industry – soybean, sunflower, peanut, olive, etc.
- Fibrous crops used in the textile industry – flax, cotton, kenaf, jute.
- Starch-producing crops – potato, maize, rice.
- Sugar crops – sugarcane, sugar beet.
- Stimulant crops – tea, coffee, cocoa.
- Spices – saffron, cumin, cinnamon, turmeric, vanilla, etc.
- Tobacco.
- Other crops used in the chemical industry – resin plants, dyeing, grafting, and medicinal plants.

Oil crops play a significant role in human nutrition, which is why their cultivation receives considerable attention in many countries. Sunflower, soybean, peanut, and olive are grown in regions with abundant sunlight and warmth. In the southern parts of temperate climates, sunflower and soybean are the main crops. The largest cultivation areas for these crops are found in the United States, Russia, France, and Ukraine.

Olive production is concentrated in European and Mediterranean countries. There are approximately 60 olive varieties in Europe, and European olives hold industrial importance. About half of the olive fruit consists of oil. The finest varieties of this oil are known as Provence oil, named after the Provence region in southern France. This oil is golden yellow, transparent, non-drying, and aromatic. It is rich in vitamins and easily absorbed by the human body, making it superior to many other edible oils. In addition, olive fruits are preserved both green and ripe for consumption. Peanuts and oil palm are primarily cultivated in African and Asian countries.

Fiber crops are mainly field-grown plants cultivated to obtain fibers used in the production of paper, textiles, or ropes. Cotton and flax are classified as both oil and fiber industrial crops. The leading global cotton exporters are the United States, Uzbekistan, Pakistan, China, India, and Egypt.

Tuber crops serve as human food, animal feed, and industrial raw materials, with potato being the most widely cultivated among them. The potato is believed to have originated in Latin America. The principal potato-producing countries include Poland, Russia, China, Ukraine, Germany, the United States, and India.

Sugar crops include sugar beet and sugarcane, which serve as the primary raw materials for sugar production. These crops yield approximately 110 million tons of sugar annually worldwide, and their cultivation area has been increasing steadily. Sugarcane is grown in tropical, subtropical, and monsoon climates, with Brazil, India, Cuba, and China being the main producers. Sugar beet is cultivated in temperate climates, with Ukraine, France, Poland, the United States, and Russia as the leading producers. China

is the world's largest tobacco-producing country. Other significant tobacco-producing countries include India, Brazil, Italy, Greece, Turkey, and Cuba.

Vegetable production, as a branch of crop cultivation, is primarily concentrated in peri-urban zones surrounding large cities. This localization is determined by the need to target consumers directly and by the relatively short shelf life of the produce. Vegetable crops are cultivated in virtually all countries worldwide. Vegetable farming represents one of the main sectors of peri-urban agriculture. This branch of crop production is highly intensive, employing the latest technologies. In developing countries, vegetables are generally grown for local consumption. In contrast, in developed countries, there has been a growing trend toward the production of ecologically clean vegetables, avoiding the use of chemical preparations. China holds the leading position in global vegetable production, while for some countries, vegetables constitute a significant export product.

Fruit production encompasses the cultivation of fruits, including tropical berries, citrus plants, and viticulture (although viticulture is often considered a separate branch). Fruit cultivation provides populations with nutrient-rich foods abundant in vitamins and microelements. Italy leads in grape production, Hungary in plum production, the United States in lemon and orange production, and Japan in mandarin production. Brazil is the world's largest exporter of bananas, while in some smaller countries of South Africa, banana exports constitute the main part of agricultural exports.

Stimulant crops constitute a distinct category and include coffee, cocoa, tea, and other similar plants. These crops contain stimulating compounds such as tannins and caffeine and are in high demand worldwide. Among globally traded food crops, coffee ranks second in value after wheat. Coffee is exported by approximately 50 countries, with Brazil and Colombia being the largest exporters. The principal cocoa-producing countries are located in Africa. Approximately four-fifths of the world's tea production is cultivated in South Asia, with India, China, and Sri Lanka serving as the main producers and exporters.

Thus, as a branch of agriculture, crop production involves the cultivation of cultivated plants and is present in nearly all natural zones. Its primary objectives are to ensure food security for countries, provide feed for livestock, and supply raw materials for various industrial sectors. The main characteristics of crop production are determined by natural factors such as climate conditions, the availability of land, and soil fertility. Cereal crops such as wheat, rice, maize, and barley occupy a leading role in crop production, with approximately half of cultivated land being used for cereal farming. In addition to cereals, a wide range of industrial crops is cultivated, including oilseeds, fibrous crops, and tuber crops. These crops are predominantly grown in developed countries. Crop production constitutes the principal branch of agriculture concerned with the cultivation of plants and, as indicated in the above discussion, exhibits a highly diversified structure (Deryugina, I.V., 2023)

4 The Current State of Crop Production in Global Agriculture

Crop production occupies a critical and distinctive position within global agriculture. The majority of products cultivated in this sector play a fundamental role in ensuring food security at both national and international levels. Certain food items—such as fruits and vegetables—are produced directly within the crop production sector. Other crops, including wheat, maize, and buckwheat, are utilized as raw materials in the food processing industry. Additionally, various crops serve as raw materials or auxiliary inputs in sectors such as light industry and the chemical industry. Moreover, crop production contributes significantly to employment in virtually all regions where it is developed. In 2022, the total global area of arable land suitable for agriculture amounted to approximately 4.78 billion hectares, reflecting a 2% decrease compared to 2000. Between 2000 and 2022, approximately two-thirds of arable land was used for permanent pastures and grasslands (3.2 billion hectares in 2022), while one-third was allocated for cropland (1.57 billion hectares in 2022, representing a 5% increase relative to 2000). Nearly 30% of the world’s cultivated land is concentrated in three countries: 12% in China, 10% in Australia, and 8% in the United States [FAO, 2023]. The research period under consideration covers the years 2020–2022. The rationale for selecting this timeframe lies in the absence of systematic data for the subsequent years. However, in certain instances, we have also made use of available data pertaining to 2023. Our analysis commences with an overview of the state of global agriculture.

Table 1. Dynamics of crop production in the world

Indicators	2020	2021	2022	In 2022 compared to 2020, %
Area under agricultural crops, mln. ha	1 576	1 580	1 560	99
Per capita, ha	0.20	0.20	0.20	100
Value added in agriculture, billion US dollars	3 616	3 757	3 830	106
Share in GDP, %	4,4	4,3	4,3	98
	868	880	892	103
Population employed in agriculture, mln people	27,0	26,6	26,2	97
Share in the number of employed population in the world, %	16.0	15.8	16.0	100

Source: FAO. 2021, FAO. 2022, FAO. 2023

In global agriculture, the cultivated area of agricultural crops amounted to 1,576 million hectares in the first year of the research period, declining by 1% to 1,560 million hectares in the final year.** In 2020, the value added generated in agriculture worldwide totaled USD 3,616 billion, representing a 78% increase compared to the year

2000. A significant share of this value added was concentrated in Asia, accounting for 64% in 2020. During the COVID-19 pandemic, agricultural value added further increased. By 2022, the value added in agriculture reached USD 3,830 billion, reflecting a 6% growth over the period. The countries with the largest agricultural value added are China, India, and the United States. In terms of its share in global GDP, agriculture accounted for 4.4% in 2020, which decreased slightly by 2% to 4.3% in 2022. Due to the restrictions imposed during the pandemic, value added in the industrial and service sectors experienced a certain decline in 2020, whereas agriculture continued to expand. This resulted in an artificially higher share of agriculture in global value added during that year. Despite its relatively small size in the global economy, the agricultural sector plays a critical role in shaping the food value chain and in the utilization of natural resources. This is manifested in its significant impact on environmental quality and food security.

During the study period, the number of people employed in agriculture increased by 3%, while their share in global employment decreased by 3%. The share of capital accumulation in the value added created in agriculture remained unchanged at 16% during the study period. The per capita arable land area worldwide decreased, as the population increased during the study period while the total arable land area declined. The reduction in per capita arable land can be interpreted positively against the backdrop of increased agricultural output, indicating that the sector has developed intensively and its efficiency has improved.

The table presents the share of gross capital formation in the value added generated in agriculture. Agricultural fixed capital includes machinery, equipment, various tools, and buildings intended for agricultural production. The total gross formation of fixed capital represents investments in the reinvestment of basic assets, which typically yield high profitability.

Government expenditures on agriculture represent the resources allocated to support the sector. In European countries, these expenditures are relatively higher. For instance, in Belgium, they account for 76% of total government spending in agriculture, whereas in other regions, they are somewhat lower. In Australia, for example, government spending on agriculture constitutes 34%, and in the USA and Japan, 26%.

Table 2. Production of major crop products in the world in natural terms

Indicators	2020	2021	2022	In 2022 compared to 2020, %
Total production of crop products, million tons	9315	9489,9	9609	103
Cereals	2996	3071	3059	103
Sugar crops	2124	2130	2184	102
Vegetables	1148	1155	1173	103

Oil crops	1136	1151	1143	102
Fruits	887	909,6	933	101
Root crops	847,6	876	906,8	105
Other crops	176	198	208,8	107

Source: FAO. 2021, FAO. 2022, FAO. 2023

The global production of major agricultural crops increased by 3.5 billion tons, or 56%, compared to the year 2000, reaching 9.6 billion tons in 2022. Cereals, which account for approximately one-third of total crop production, were the dominant crop group in 2022. As shown in the table, the production of crop products in physical terms increased by 3% during the study period. This growth was driven by a combination of factors, including increased irrigation, the use of pesticides and fertilizers, improvements in farming practices, and the adoption of high-yield crop varieties. Among crop products, cereals had the largest share during the study period. Specifically, the share of cereals in total crop production was 32.1% in 2020 and 31.8% in 2022. The production of sugar crops accounted for 22.8% and 22.7% of total crop production, vegetables 12.3% and 12.2%, oilseeds 12.2% and 11.9%, fruits 9.5% and 9.8%, and root crops 0.9% and 0.94%, respectively, for 2020 and 2022. Although many crops are cultivated and harvested worldwide, four crops accounted for half of global production in 2022. These were sugarcane, representing 20% of total production (1.9 billion tons), maize 12% (1.2 billion tons), and wheat and rice each 8% (0.8 billion tons).

Table 3. Production of crop products in terms of value

Indicators	2020	2021	2022	In 2022 compared to 2020, %
Total production of crop products, billion US dollars	2728	2834,6	2899,7	106
Grains	834	860	859,6	106
Sugar crops	106,2	109,2	101,2	103
Vegetables	533,1	542,2	559,4	95
Oil crops	84,3	361,2	374,7	105
Fruits	465,1	474,8	480,1	444
Root crops	198,1	204,7	212	103
Other crops	506,8	282,6	312,8	107

Source: FAO. 2021, FAO. 2022, FAO. 2023

As shown in the table, the value of crop production increased by 6% during the study period. Similar to physical production, cereals accounted for the largest share of crop production value. In 2020, cereals represented 31% of total crop production value, declining slightly to 29.6% in 2022. Sugar crops accounted for 3.8% and 3.4%,

vegetables 19.5% and 19.3%, oilseeds 3% and 13%, and fruits 17% and 16.6% in 2020 and 2022, respectively. Overall, in terms of total crop production value, cereals contributed 29%, sugar beet and sugarcane 23%, vegetables 12%, oilseeds 12%, fruits 10%, and root crops 9%. During the study period, the global crop sector underwent various changes, with different development trends depending on the production region and the type of crops grown. On average, the crops produced during the study period consisted of approximately 30% cereals, 20% vegetables, 16% fruits, and 12% oilseeds. Leading countries in crop production in terms of value were China – USD 1.2 trillion, India – USD 380 billion, the United States – USD 270 billion, and Brazil – USD 160 billion [FAO, 2021; FAO, 2022; FAO, 2023; FAO, 2024]. The development of organic and sustainable farming has been particularly evident in many countries (EU countries, the USA, and China), where government support for ecological agriculture has played an important role.

Table 4. Dynamics of the volume of organic crop areas worldwide in 2020-2022

Indicators	2020	2021	2022	In 2022 compared to 2020, %
Worldwide, min. ha o c.	75214.9	76592.0	78035.6	103,8
Africa	2354.8	2734.9	2754.3	117,0
America	13847.6	13457.7	12414.8	89,7
Asia	6534.3	6863.4	9147.6	140,0
Europe	16570.6	17591.5	17854.2	107,7
Oceania	35 907.6	35 944.5	35 864.7	99,9

Source: FAO. 2021, FAO. 2022, FAO. 2023

As shown in the table, the area of organic crop production worldwide increased by 3.8% during the study period. The largest growth occurred in Asia, with a 40% increase, while Oceania experienced a slight decline of 0.1%. The majority of organic crop areas were concentrated in the Americas. Specifically, the share of Oceania in the global organic crop area was 47.7% in the first year of the study period and 46% in the second year; for the Americas, the respective shares were 18.4% and 16%; and for Europe, 22% and 23%. No significant structural changes in the composition of organic crop areas were observed during the study period.

5. Conclusion

During the study, the development of global agriculture was analyzed. The cultivated area of agricultural crops decreased slightly from 1,576 million hectares in the first year of the study period to 1,560 million hectares in the final year, representing a 1% decline. In terms of production composition, cereals accounted for 32.1% of total crop production in 2020 and 31.8% in 2022; sugar crops 22.8% and 22.7%; vegetables 12.3% and 12.2%; oilseeds 12.2% and 11.9%; fruits 9.5% and 9.8%; and root crops 0.9% and 0.94%, respectively. According to the Food and Agriculture Organization (FAO), steady growth in global crop production was observed during the study period.

Specifically, crop production reached approximately USD 2.8 trillion in 2021, USD 2.9 trillion in 2022, and USD 3 trillion in 2023. On average, the composition of crop production during the study period consisted of 30% cereals, 20% vegetables, 16% fruits, and 12% oilseeds. Leading countries in crop production value were China – USD 1.2 trillion, India – USD 380 billion, the USA – USD 270 billion, and Brazil – USD 160 billion.

Overall, crop production in 2023 increased by 4% compared to 2021 and by 67% compared to 2000. Several factors contributed to this growth in global crop production:

1. **Expansion of Cultivated Areas.** In some countries, the sown area of agricultural crops has increased. Globally, the cultivated area of crops was 1,576 million hectares in 2020 and 1,579 million hectares in 2021, representing a 1% increase compared to the previous year. In 2022, it declined again by 1%. This growth can also be attributed to the implementation of farmer stimulation programs and subsidies for the development of new agricultural lands.

2. **Yield Increases Through Technology.** Modern agrotechnologies, such as the use of drones for crop monitoring, improved irrigation systems, and high-yield crop varieties, have contributed to higher productivity. For example, in 2023, the production of major crops reached 9.9 billion tons, a 4% increase compared to 9.5 billion tons in 2021. Globally, the amount of pesticides applied per hectare increased by 7%, while the use of inorganic fertilizers per hectare increased more than sixfold. The highest pesticide applications were recorded in countries in the Americas, which applied four times more pesticides per hectare than other regions. Similarly, these countries led in the use of inorganic fertilizers, with an increase from 20.7 kg per hectare in the first year of the study period to 82.9 kg per hectare in the final year. In Asia and Europe, the amounts applied were comparable, while in Oceania, this figure increased 9.6 times over the study period.

3. **Investments in Agriculture.** Increased private and public capital investments in agriculture, including improvements in storage, processing, and transportation infrastructure, have supported crop production growth.

4. **Favorable Climatic Conditions in Certain Regions.** For instance, in 2023, favorable weather in Brazil and some Asian countries enabled high yields of maize and soybeans.

5. **Rising Global Demand for Food Products.** This is driven by population growth and increased incomes in developed countries. The global crop market value was USD 4.6 trillion in 2021 and rose to USD 4.8 trillion in 2023.

6. **Global Trend Towards Sustainable Development.** The promotion of organic and sustainable farming practices has been particularly evident in many countries (EU, USA, and China), with government support playing a key role in the development of ecological agriculture.

7. **Rising Prices of Agricultural Products.** Increases in the prices of cereals and oilseeds have incentivized farmers to expand their production. According to FAO data, during the study period, cereal prices increased by 71%. Globally, the value of food exports grew from USD 380 billion in 2000 to USD 1.8 trillion in 2022, a 4.7-fold increase. Of the total export value, 17% consisted of fruits and 16% cereals and their processed products.

Currently, new development trends in the global crop sector are evident, including digitalization, the advancement of precision agriculture, and increased production of organic crop products.

References

1. Abbasov, I. D. (2013). **Agriculture of Azerbaijan and other countries of the world**. Baku: Sharq-Qerb.
2. Supplements to the 2023 edition of **The World of Organic Agriculture** (Feb. 13, 2023). Archived Mar. 14, 2023.
3. Evdokimova, N. E. (2015). On the development of agrarian economy. **Irkutsk Historical and Economic Yearbook**. Irkutsk: BSUEP Publishing.
4. Cardno. (2017). **Agricultural development as a key role in food security and economic development in rural areas**.
5. Svizzero, S., & Tisdell, C. A. (2014). Theories about the commencement of agriculture in prehistoric societies: A critical evaluation
6. Childe, V. G. (1936 [1966]). **Man makes himself**. London: Collins.
7. Udemezue, J. C., & Osegbue, E. G. (2018). Theories and models of agricultural development. **Annals of Research, 1*(5)*, 134–137.
8. European Commission. (2018). **Sustainable agriculture and rural development policy—agricultural development**. International Cooperation and Development. Retrieved from <https://ageconsearch.umn.edu/bitstream/135054/Fris-1972-11-02-245.pdf>
9. Deriugina, I. V. (2023). **World agriculture: Past and future 1980–2010–2050**. Moscow: [Publisher not specified].
10. Polukhin, A. A., & Yusipova, A. B. (2019). Global experience and advanced innovations in digital transformation of agriculture. **International Scientific Agricultural Journal**, (4), 10–16.
11. FAO. (2021). **World food and agriculture – Statistical Yearbook 2021**. Rome: FAO
12. FAO. (2022). **World food and agriculture – Statistical Yearbook 2022**. Rome: FAO.
13. FAO. (2023). **World food and agriculture – Statistical Yearbook 2023**. Rome: FAO.
14. FAO. (2024). **World food and agriculture – Statistical Yearbook 2024**. Rome: FAO.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

