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ORGANIC FARMING – A SUSTAINABLE SOLUTION TO REDUCE THE IMPACT OF CLIMATE CHANGE

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Abstract. *Climate change is one of the most important global challenges of the 21st century, with significant effects on natural ecosystems, the world economy and food security. Phenomena such as the increase in global average temperature, the melting of glaciers, the rise in sea levels and the intensification of extreme weather events are the direct result of the accumulation of greenhouse gases in the atmosphere. Agriculture, a fundamental sector for global food security, is in a double situation: on the one hand, it is strongly affected by climate change, and on the other hand, it contributes to its amplification. In this context, organic farming is emerging as a viable and sustainable alternative to conventional agricultural practices. The paper examines the role of organic farming in mitigating the effects of climate change, highlighting its contributions to reducing greenhouse gas emissions and strengthening the resilience of agricultural systems. In the context of the intensification of extreme weather phenomena and the increased pressure on natural resources, organic farming is analyzed as a sustainable solution for the future. The research methodology is qualitative in nature and is based on the analysis of specialized literature, reports prepared by international organizations and relevant European policies in the field. The results highlight the fact that organic farming contributes to the reduction of greenhouse gas emissions by eliminating the use of synthetic fertilizers and by adopting sustainable practices, such as crop rotation and composting. At the same time, it supports the sequestration of carbon in the soil, the protection of biodiversity and the efficient use of water resources. In conclusion, organic farming is an essential tool in combating climate change and promoting sustainable development, and it is necessary to support it through appropriate public policies and investments in the agricultural sector.*

Keywords*: climate phenomena, challenge, alternative, sustainable development, future*

INTRODUCTION

Climate change is one of the most important global challenges of the present, as it directly influences the balance of natural ecosystems, food security and the socio-economic development of the population, having major effects on the environment, economy and society. The increase in global average temperature, the intensification of extreme weather events, prolonged drought, soil degradation, loss of biodiversity and the reduction of water resources significantly affect agricultural activities and the ability of farmers to ensure stable and quality production, as well as the ability of agri-food systems to ensure food security for the population.

Conventional agriculture, characterized by the intensive use of pesticides, chemical fertilizers and excessive mechanization, contributes to the increase in greenhouse gas emissions and the degradation of biodiversity, thus amplifying the effects of climate change on the environment. In recent decades, conventional agriculture has been based on the intensive use of chemical fertilizers, pesticides, herbicides and fossil fuels, with the aim of rapidly increasing agricultural production. Although these practices have contributed to increased agricultural yields, they have caused numerous negative environmental effects, such as soil fertility degradation, groundwater and surface water pollution, biodiversity loss, and increased emissions of carbon dioxide, methane, and nitrous oxide. Conventional agriculture is also considered a victim of climate change, not just a contributing factor.

Agriculture is both a sector vulnerable to climate change and a significant source of greenhouse gas emissions, particularly through emissions of methane, nitrous oxide, land-use change and energy consumption associated with the production of agricultural inputs. For this reason, the transformation of agricultural systems is an important component of global climate mitigation and adaptation strategies (INTERgovernmental Panel on Climate Change, 2022, 2023).

Organic agriculture is a production system that aims to maintain the health of soils, ecosystems and people by capitalizing on ecological processes, biodiversity and natural cycles. It limits the use of synthetic chemical fertilizers and pesticides and promotes crop rotation, organic fertilization, green crops, composting and biological control of harmful organisms (REGANOLD, J. P., WACHTER, J. M., 2016; SCIALABBA, N. E. H., MÜLLER-LINDENLAUF, M, 2010).

In this context, organic agriculture is considered a sustainable alternative and a strategic direction, as it promotes the responsible use of natural resources and the reduction of negative environmental impacts. Organic agricultural production systems are based on respecting natural biological processes, the use of organic fertilizers, crop rotation and biological pest control, thus contributing to maintaining soil fertility and protecting agricultural ecosystems. Organic agriculture supports the development of a resilient agriculture, capable of responding to current and future climate challenges, by reducing pollution and increasing the adaptive capacity of agroecosystems.

One of the main contributions of organic agriculture to mitigating climate change is reducing dependence on synthetic nitrogen fertilizers. Their production requires high energy consumption, and their application can generate emissions of nitrous oxide, a gas with a high global warming potential. By using legumes, organic fertilizers and diversified rotations, organic farming can improve nutrient cycling and reduce some of the emissions associated with external inputs (SCIALABBA, N. E. H., MÜLLER-LINDENLAUF, M, 2010; SKINNER, C.et al., 2019).

Statistical data show a general trend of increasing the area of agricultural land managed organically worldwide. During the period 2000–2024, the area of organic agriculture increased from approximately 14.9 million hectares to 98.9 million hectares (Fig. 1). The absolute increase was approximately 84 million hectares, which means that the area cultivated organically became approximately 6.6 times larger than at the beginning of the period (WILLER HELGA *et al.*, 2026).

However, the evolution was not uniform, and several stages can be delimited.

○ In the first stage, corresponding to the period 2000–2004, the organic agricultural area grew rapidly, from 14.9 million hectares to approximately 29.8 million hectares.

○ In the period 2004–2012, the growth was slower and there were years of stagnation. The organic agricultural area remained around 29–37 million hectares, reaching approximately 37 million hectares towards the end of the interval.

○ After 2012, the pace of expansion accelerated. The area under organic farming increased from approximately 37 million hectares to 50.3 million hectares in 2015, and then to 69.4 million hectares in 2017.

○ Between 2017 and 2021, organic farming continued to expand, but at a more moderate pace. The area increased from 69.4 million hectares to approximately 76.2 million hectares.

○ The largest annual increase in the graph is observed between 2021 and 2022, when the organic agricultural area advanced from approximately 76.2 million to 96.4 million

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hectares. The increase of approximately 20.2 million hectares, or about 26.5%, represents a significant leap compared to the evolution of previous years.

○ In the last years of the analyzed period, a stabilization trend is observed. The organic area increased from 96.4 million hectares in 2022 to 98.4 million in 2023 and to 98.9 million hectares in 2024. The advance of only 2.5 million hectares in the last two years shows that organic agriculture continues its development, but at a slower pace compared to the previous jump.

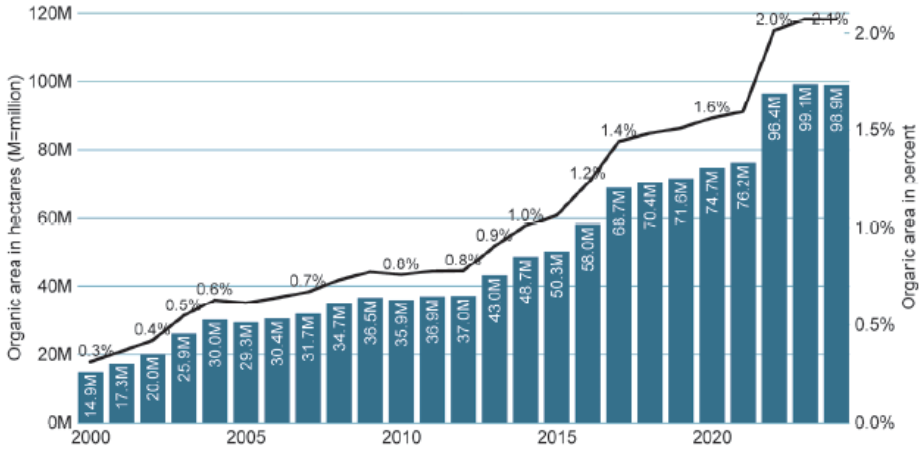


Figure 1. Evolution of organic agricultural areas in the world (2000-2024)
Sursa: WILLER, HELGA, SCHLATTER, B., TRÁVNÍČEK J. (EDS.) (2026) - The World of Organic Agriculture. Statistics and Emerging Trends 2026. Research Institute of Organic Agriculture FiBL, Frick, IFOAM – Organics International, Bonn.

At the same time, the share of organic areas in total global agricultural land increased from around 0.3% in 2000 to just over 2% in 2024. The evolution confirms that organic agriculture has gained importance in the structure of global agriculture. The 1% threshold was reached around 2014, the 1.4% threshold around 2017, and after 2022 the share exceeded 2%.

However, the fact that organic agriculture only represents just over 2% of global agricultural land shows that it remains a relatively small sector compared to conventional agriculture. Its expansion is uneven across regions and is influenced by public policies, consumer demand, the availability of financial support, certification costs and the ability of farmers to apply organic practices.

Organic practices contribute to improving soil structure and fertility, reducing erosion and increasing water retention capacity, essential aspects in the context of increasing drought and desertification. At the same time, organic agriculture favors the protection of biodiversity by conserving natural habitats and reducing the use of chemicals toxic to living organisms.

An important role of organic agriculture is its contribution to reducing the effects of climate change by reducing greenhouse gas emissions and increasing the carbon storage capacity of the soil. Organic agriculture is not only an alternative to conventional agricultural systems, but also a way to protect natural resources, conserve biodiversity and support sustainable rural development.

The SWOT analysis allows the evaluation of organic agriculture as a solution for reducing the impact of climate change, by identifying internal strengths and weaknesses, as well as opportunities and threats from the external environment.

The main strengths of organic farming are related to the protection of soil, water and biodiversity, as well as the reduction of dependence on synthetic chemical inputs. The use of compost, organic fertilizers, green crops and diversified rotations contribute to improving soil structure and increasing organic matter content. Better structured soils can retain more water and can support crops during droughts, thus contributing to the adaptation of agriculture to climate change. An important advantage is the avoidance of synthetic nitrogen fertilizers, the production of which requires a high consumption of energy. However, organic farming is not free from emissions. Inadequate manure management, fuel consumption, animal husbandry and repeated mechanical weed control can generate greenhouse gases. For this reason, climate benefits must be assessed both per hectare and per unit of product obtained.

Weaknesses are mainly associated with the sometimes lower level of production, the costs of certification and the technical difficulties in controlling weeds and pests. During the conversion period, farms bear additional costs without immediately benefiting from the higher price of certified products. These difficulties are more pronounced for small farms, which have limited financial and technical resources.

Opportunities are supported by increasing consumer interest, the development of climate policies and the provision of forms of support for environmentally friendly agricultural practices. Organic farming can be integrated with precision agriculture, agroforestry systems, renewable energy and short supply chains. Also, remuneration for ecosystem services, such as carbon storage and biodiversity conservation, can create additional income for farmers.

The most important threats are generated by the intensification of climate change itself. Prolonged drought, extreme temperatures, floods and the emergence of new diseases and pests can affect organic production, especially in conditions where the possibilities for intervention are more limited. Economic instability and declining purchasing power may reduce demand for organic products, which are generally priced higher.

The global organic food and beverage market grew from €17.9 billion in 2000 to €135.8 billion in 2024. In 2020, when the pandemic began, there was a sharp increase in demand as consumers sought out healthy and organic food products. Food price inflation has had a major impact on consumer spending on food across all regions, with consumers becoming more price-sensitive (WILLER HELGA *et al.*, 2026; WILLER, HELGA, KILCHER, L., 2011).

At European and global level, agricultural policies increasingly promote sustainable practices and the transition to organic farming systems, considered essential for achieving sustainable development goals and reducing the effects of climate change. The development of organic farming is supported by policies and strategies aimed at environmental protection and sustainable development. The European Commission promotes through agricultural and environmental strategies the expansion of organically cultivated areas and the reduction of the use of chemical pesticides, while the Food and Agriculture Organization of the United Nations highlights the importance of sustainable agriculture for ensuring food security and the protection of natural resources.

The growing interest of consumers in healthy, safe and environmentally friendly food products has led to a continuous development of the organic products market. Consumers are increasingly concerned about food quality, the impact of agricultural production on the environment and the protection of health, which contributes to the expansion of organic farming systems and the increase in demand for certified organic products.

The paper aims to analyze the role of organic agriculture in reducing the impact of climate change, by highlighting the main sustainable practices used in this agricultural system and their effects on the environment, economy and society. At the same time, the research aims

to identify the advantages and challenges associated with the development of organic agriculture, as well as the importance of implementing policies and measures to support sustainable agriculture in the current context of global climate change.

MATERIAL AND METHODS

The research entitled "Organic agriculture - a sustainable solution for reducing the impact of climate change" aims to analyze the contribution of organic farming systems to reducing greenhouse gas emissions, preserving soil fertility, increasing carbon storage capacity and adapting agricultural holdings to the effects of climate change. To carry out the work, research methods specific to the agricultural field and sustainable development were used, based on documentary and comparative analysis of scientific and statistical information. Information from scientific articles, specialized studies, international reports and statistical data on organic agriculture and climate change were also used.

The documentary analysis aimed to identify the main organic agricultural practices that contribute to reducing the negative impact on the environment, such as crop rotation, the use of organic fertilizers, composting, biodiversity conservation and reducing the use of chemical pesticides. Dynamics analysis was used to highlight the evolution over time of organically cultivated areas. This method allows the identification of growth, stagnation or decline trends and the periods in which changes were more pronounced. SWOT analysis can be used to identify the main strengths, weaknesses, opportunities and threats associated with the development of organic agriculture in the context of climate change. By combining documentary, comparative and SWOT analysis, the proposed methodology allows for a comprehensive assessment of the contribution of organic agriculture to reducing the impact of climate change.

RESULTS AND DISCUSSIONS

The analysis highlights the potential of organic agriculture to reduce the impact of climate change and increase the resilience of agricultural systems by protecting soil, biodiversity and water resources, as well as reducing greenhouse gas emissions. However, its effectiveness depends on adapting practices to local conditions, supporting producers, innovation and integration with other sustainable natural resource management measures.

● *Reducing greenhouse gas emissions*

One of the most important results identified in the research is related to the reduction of greenhouse gas emissions generated by agricultural activities, as a result of reducing the use of chemical fertilizers and synthetic pesticides. Conventional agriculture uses high amounts of chemical fertilizers and pesticides, the production and application of which involve high energy consumption and significant emissions of carbon dioxide and nitrous oxide. In organic agriculture, the use of organic fertilizers and the reduction of chemical inputs determine the reduction of energy consumption from fossil fuels and the reduction of air pollution. Ecological practices also contribute to the reduction of indirect emissions generated by industrial processes associated with intensive agriculture. Organic farms use less energy from fossil fuels and favor natural soil fertilization processes.

The comparative analysis by TUOMISTO, H. L. *et al*. (2012) shows that organic farming generally has lower energy consumption and favourable effects on soil quality and biodiversity. However, its climate performance differs depending on the indicator used. Emissions are often lower when reported per hectare, but the differences become smaller or can be reversed when reporting per tonne of product.

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SKINNER, C. *et al*. (2019) found that long-term managed organic systems can contribute to reducing soil emissions and carbon storage. However, the effects depend on the management of organic fertilizers, crop rotation and production levels. Inappropriately managed manure can generate methane and nitrous oxide emissions, which is why simply replacing mineral fertilizers with organic ones does not guarantee a reduction in climate impact.

● *Adaptation to climate change*

Organic farming helps agricultural systems adapt to climate change by applying practices that improve soil quality, protect biodiversity and reduce farms' dependence on external inputs. Adaptation involves reducing the vulnerability of crops and farms to drought, high temperatures, irregular rainfall, flooding, erosion and the emergence of new diseases and pests. Crop rotation, polyculture and cover crops help to spread climate risks. When several species with different requirements and growing seasons are grown on a farm, the effects of an extreme weather event do not affect the entire production to the same extent. Diversification also reduces disease and pest pressure, improves the nutrient cycle and keeps the land protected against erosion.

Adaptation can also be supported by cultivating local varieties or varieties resistant to drought, high temperatures and diseases. The use of biological material adapted to local pedoclimatic conditions can reduce production losses and the need for interventions. At the same time, preserving genetic diversity is an important resource for the future development of more climate-resilient crops. Integrating crop production with livestock farming can increase the autonomy and stability of organic farms. Crop residues can be used for fodder, and manure can be used to fertilize the soil and produce compost. By closing the nutrient loop, resource losses, costs and dependence on inputs from outside the farm are reduced. Efficient water management is another important component of adaptation. Rainwater harvesting, drip irrigation, mulching and scheduling irrigation according to crop needs allow for reduced consumption and prevention of losses. At the same time, maintaining soil cover limits evaporation and excessive heating of its surface.

The capacity to adapt also depends on farmers' access to weather forecasts, early warnings, agricultural insurance, advice and digital technologies. Monitoring soil moisture, temperature and crop condition allows for quick decision-making and efficient use of resources. Association of producers in cooperatives facilitates access to equipment, information, financing and markets.

● *Preserving soil fertility*

The analysis of organic practices has shown that the use of compost, manure and green manures contributes to increasing the organic matter content of the soil and improving its fertility, which improves its structure and water retention capacity. Soils rich in humus have the capacity to store higher amounts of carbon, thus contributing to the reduction of greenhouse gas concentrations in the atmosphere. In addition, increasing the organic matter content improves the soil structure and its water retention capacity, which is essential in the context of increasing drought and extreme weather events.

Organic farming practices can contribute to improving soil structure, enhancing biological activity and increasing the organic matter content. Long-term research by MÄDER, P. *et al*. (2002) has shown that organic systems can maintain higher soil fertility and biodiversity, while using lower amounts of energy and external inputs.

The meta-analysis by GATTINGER, A. *et al*. (2012) identified higher organic carbon stocks in the topsoil of organically managed soils compared to conventionally managed ones.

Carbon accumulation is favored by the application of organic fertilizers, the introduction of leguminous crops, the use of cover crops and the diversification of rotations. However, the increase in soil carbon should not automatically be interpreted as a permanent and unlimited reduction in emissions, as results depend on soil type, climate, land history and management practices applied (GATTINGER, A. *et al*., 2013; LEIFELD, J. *et al*., 2013).

Increasing organic matter improves soil aggregation, infiltration and water retention. These characteristics can reduce erosion and support crops during drought, helping farms adapt to extreme weather events (SCIALABBA, N. E. H., MÜLLER-LINDENLAUF, M., 2010).

● *Protecting biodiversity*

Another important result of the research is the contribution of organic agriculture to the conservation of biodiversity, by limiting toxic chemicals and maintaining natural habitats. In intensive agricultural systems, the excessive use of pesticides and monoculture leads to a reduction in the number of plant and animal species and the disruption of the balance of ecosystems. Organic agriculture favors the maintenance of biodiversity by diversifying crops, protecting natural habitats and reducing the use of toxic chemicals. Organic farms have a higher level of biological diversity, with larger populations of pollinating insects, beneficial microorganisms and spontaneous plant species identified that contribute to maintaining the ecological balance compared to conventional intensive systems.

Organic agriculture contributes to the conservation of biodiversity by reducing the use of chemical pesticides, diversifying crops and maintaining habitats favorable to beneficial organisms. The meta-analysis carried out by TUCK, S. L. *et al*. (2014) showed that the effect of organic agriculture on biodiversity is generally positive, but its intensity differs depending on land use and landscape characteristics.

● *Sustainable water management*

The results of the analysis also highlight the positive effects of organic farming on water resources. Reducing the use of pesticides and chemical fertilizers limits the pollution of groundwater and surface water with nitrates and toxic substances, helping to protect aquatic ecosystems and drinking water quality. At the same time, practices such as crop rotation and the use of cover crops help reduce soil erosion and conserve soil moisture, important aspects in areas affected by water scarcity.

● *Increasing the resilience of agricultural systems*

The research also highlighted that organic farming can contribute to increasing the resilience of agricultural systems to climate change. Organic farming systems are better adapted to climate variations due to the diversity of crops and the use of natural practices to protect the soil and plants. Soils with a high content of organic matter are better able to withstand periods of drought and heavy rainfall, reducing the risk of degradation and production losses.

At the soil level, organic farming promotes the abundance and activity of microorganisms involved in the decomposition of organic matter and the cycling of nutrients (LORI, M. *et al*., 2017). Greater biodiversity can support the functioning of agricultural ecosystems, biological pest control, pollination, and the stability of biological processes. These benefits can increase the ability of agricultural systems to adapt to water stress, high temperatures, and the emergence of new diseases and pests.

● *Economic and social impact*

From an economic and social point of view, organic agriculture offers important economic opportunities for the development of rural communities by creating jobs in the agricultural and agri-food sector and for the superior valorization of agri-food products with

high added value. At the same time, the growing demand for organic agri-food products demonstrates the growing interest of consumers in healthy eating and environmental protection. Organic agricultural products are associated with high quality and health benefits, which determines a constant increase in market demand. The development of organic farms can generate new jobs in rural areas and contribute to the diversification of local economic activities. At the same time, organic agriculture supports the development of rural tourism and short food chains, favoring the direct relationship between producer and consumer.

Organic agriculture can produce economic benefits through higher prices for certified products and by reducing certain costs associated with chemical inputs. CROWDER, D. W., REGANOLD, J. P. (2015) found that organic farms can be financially competitive, especially when they receive premium prices. However, the costs of conversion, certification and control can be significant obstacles, especially for small farms.

The evaluation of organic farming must simultaneously include productivity, environmental impact, economic viability and social well-being. The benefits are important, but vary depending on the region, crop, type of farm and the specific way in which organic practices are applied (MEEMKEN, E. M., QAIM, M., 2018; REGANOLD, J. P., WACHTER, J. M, 2016).

However, the analysis also highlighted certain difficulties associated with the transition to organic farming. The conversion period from conventional to organic farming involves high initial costs, which can be a challenge for farmers, also through lower production levels in the first years of applying organic practices. Farmers also have to comply with strict certification and control standards, which requires investment in specific technologies and knowledge. In some cases, the lack of financial support and access to information can limit the development of organic farming, especially in less developed rural regions.

One of the limitations of organic farming is the sometimes lower level of production. SEUFERT, V. *et al*. (2012) showed that the differences between organic and conventional production depend on the type of crop and management conditions. PONISIO, L. C. *et al*. (2015) found that crop diversification and complex rotations can reduce the productivity gap between the two systems.

The analysis by KNAPP, S., VAN DER HEIJDEN, M. G. A. (2018) shows that the relative stability of organic production, per unit of product, may be lower than that of conventional production. However, the use of green manures and improved nutrient management can reduce this difference.

Lower yields may lead to the expansion of cultivated areas to obtain the same amount of products. SMITH, L. G. *et al*. (2019) showed that a full transition to organic agriculture can reduce direct emissions, but the production deficit and additional imports can generate indirect emissions through land use change. Therefore, climate impacts need to be assessed at the level of the entire food system, not just at the farm level.

MULLER, A. *et al*. (2017) showed that the expansion of organic agriculture can contribute to building a more sustainable food system if it is associated with reducing food waste, reducing the use of agricultural crops for animal feed and adopting consumption patterns with a lower share of animal products.

The efficiency of organic agriculture must be evaluated not only by the level of productivity, but also by its benefits on soil fertility, biodiversity, the environment and the health of the population. Although yields may sometimes be lower than in intensive agriculture, the long-term advantages support the development of a sustainable and climate-resilient agri-food system.

Expanding organic farming requires effective policies, financial support, information

to farmers and consumers, as well as investment in research and innovation. Thus, organic agriculture represents an important component of the transition to sustainable production models, adapted to climate challenges and environmental protection requirements.

CONCLUSIONS

The development of organic agriculture supports the transition to a sustainable agricultural model, contributing to reducing emissions, conserving soil and biodiversity, using water efficiently and obtaining safe and quality products. Realizing this potential requires financial support, simplifying certification, training producers, research and innovation, adapting practices to local conditions, developing cooperatives and informing consumers.

The period 2000–2024 is characterized by a clear development of organic agriculture worldwide. The increase from 14.9 to 98.9 million hectares demonstrates the consolidation of this production system and the growing interest in environmentally friendly agricultural practices. By reducing the use of synthetic chemical inputs, improving soil fertility, protecting biodiversity and increasing the capacity of soils to store carbon, organic agriculture can contribute to reducing the impact of agriculture on climate change. However, its still low share indicates the need for continued support, research, innovation and information measures for the sustainable expansion of this sector.

The analysis highlights the fact that organic farming produces important environmental benefits by reducing pesticides and chemical fertilizers, limiting pollution and reducing greenhouse gas emissions. Organic fertilization, crop rotation and conservation practices improve soil structure and fertility, favoring carbon storage, water retention and erosion reduction.

By diversifying crops and protecting beneficial organisms, organic agriculture supports biodiversity, ecosystem balance and their resilience to climate change. At the same time, the development of the organic sector contributes to job creation, stimulating the rural economy, increasing farmers' incomes and promoting responsible consumption. Thus, organic agriculture supports the formation of a sustainable, balanced agri-food system adapted to current climate challenges.

The development of organic agriculture faces difficulties related to conversion costs, necessary investments, strict certification requirements and the possible temporary reduction of production. Limited access to finance, information and advice is a major obstacle, especially for farmers in less developed rural areas.

The expansion of the sector requires effective agricultural policies, financial and institutional support, training programmes and the strengthening of research and innovation. Collaboration between farmers, research institutions, authorities and environmental organisations can accelerate the transition towards sustainable, efficient and climate-resilient agricultural systems.

In the context of climate change and the need to develop sustainable agri-food systems, organic agriculture can represent a strategic solution for protecting the environment and ensuring long-term food security. Expanding the areas cultivated in organic systems and promoting sustainable agricultural practices requires the implementation of effective public policies, financing programs, support measures for farmers and education and information activities on the benefits of organic agriculture. In conclusion, organic agriculture is not only an alternative method of agricultural production, but an essential direction for the development of sustainable agriculture, capable of reducing the impact of climate change in the context of global climate change and protecting natural resources for future generations. By promoting

responsible agricultural practices and through the efficient use of natural resources, organic agriculture contributes to the development of a healthier, safer and more environmentally friendly food system.

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