



**BALKANS
GROW**

green resilient organic wisdom



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TRAINING MATERIAL

MODULE 6

MANAGEMENT IN THE AGRI-SECTOR



TITLE

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1. Introduction

Modern agriculture is undergoing significant transformation due to climate change, environmental pressures, market instability, technological development, and changing consumer expectations. Agricultural systems are increasingly expected to provide not only food security and economic performance, but also environmental protection, biodiversity conservation, and sustainable use of natural resources. In this context, regenerative and sustainable agriculture are becoming essential approaches for ensuring the long-term resilience of agricultural production and rural communities.

At the same time, agricultural producers and organisations face numerous challenges, including soil degradation, rising production costs, unstable supply chains, labour shortages, and increasing demand for organic and sustainably produced food. Successfully addressing these challenges requires more than technical agricultural knowledge. It also requires effective management, strategic planning, financial decision-making, market adaptation, and efficient organisation of agricultural operations.

Management in the agri-sector plays a crucial role in supporting the transition to more sustainable, regenerative agricultural systems. Efficient management practices can help agricultural businesses optimise resources, improve productivity, strengthen economic sustainability, and respond more effectively to environmental and market changes. In organic and regenerative farming systems, management is particularly important due to the complexity of balancing environmental, economic, and social objectives.

In this context, the purpose of this module is to provide trainers, agricultural professionals, educators, and learners with essential knowledge and practical skills in agri-sector management, with a special focus on sustainability, efficiency, and organic farming. The module introduces key management principles, financial and strategic planning tools, sustainable resource management approaches, and methods for adapting agricultural enterprises to evolving market demands and sustainability requirements.



After completing this module, trainers and learners will be able to:

- Understand the fundamental principles of management in sustainable agriculture.
- Identify major challenges affecting agricultural and organic production systems.
- Apply financial and strategic planning tools within agricultural enterprises.
- Improve efficiency and sustainability in farm and agri-business management.
- Analyse market trends and consumer demands related to sustainable and organic products.
- Support decision-making processes related to regenerative and sustainable agricultural practices.
- Promote innovation, resource efficiency, and long-term agricultural resilience.

This module is particularly relevant for the Balkan region, where agriculture remains an important economic sector and a key component of rural development. Many countries in the region are currently transitioning toward more sustainable agricultural systems aligned with European Union sustainability goals, regenerative agriculture principles, and organic production standards. Strengthening management competencies can help agricultural producers and organisations improve competitiveness, increase resilience, and support sustainable rural economies.

The module is closely connected with the other training modules within the program. The introductory modules on regenerative agriculture, soil-climate-plant relationships, and the role of animals in agroecosystems provide the scientific and practical foundations of sustainable agriculture. The module on holistic management and sustainable supply chains focuses on integrating regenerative production into broader agricultural systems. This module complements these topics by providing the managerial, organisational, financial, and strategic competencies needed to implement sustainable agricultural practices in real business environments. It also supports the objectives of the Digital Marketing in the New Agriculture module by strengthening



strategic business development and market-oriented thinking in sustainable agriculture.

2. Sustainable Management Practices in Agriculture

2.1. Key Concepts

Essential definitions

Sustainable management practices in agriculture refer to the planning, organisation, and implementation of agricultural activities in ways that ensure long-term productivity while minimising environmental impacts and supporting social and economic sustainability. These practices integrate environmental protection, efficient resource management, economic viability, and social responsibility into agricultural decision-making processes. Sustainable agricultural management, therefore, aims to balance food production with the preservation of natural ecosystems, biodiversity, soil fertility, and water resources (de Oliveira Lima et al., 2024).

According to the European Commission, sustainable agriculture plays a central role in achieving the objectives of the European Green Deal¹ (European Commission, 2019) and the Farm-to-Fork Strategy² (European Commission, 2020), which promotes climate-neutral, resource-efficient, and environmentally responsible food systems. Sustainable management practices are increasingly supported by the Common Agricultural Policy³ (CAP) 2023–2027, particularly through eco-schemes, biodiversity protection measures, and climate adaptation initiatives. (European Commission, 2021a). These policy frameworks encourage farmers and agricultural managers to adopt more sustainable production methods, improve soil and water management, reduce greenhouse gas emissions, and strengthen biodiversity protection. In addition, the CAP 2023–2027 promotes innovation, digitalisation, and knowledge transfer within rural areas, supporting the long-term resilience and competitiveness of the agricultural sector. Sustainable management practices are consequently becoming an essential

¹ https://enlargement.ec.europa.eu/news/european-green-deal-sets-out-how-make-europe-first-climate-neutral-continent-2050-boosting-economy-2019-12-11_en

² <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0381>

³ https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en



component of modern agricultural development and strategic planning across Europe, particularly in regions undergoing agricultural and environmental transition, such as the Western Balkans.

Agricultural management can be defined as the process of planning, organising, directing, and controlling agricultural resources and production activities in order to achieve specific economic, environmental, and social objectives (Đokić et al., 2022). Modern agricultural management extends beyond traditional farm administration and includes strategic planning, sustainability management, environmental monitoring, technological innovation, financial management, and risk reduction (Tsangas et al., 2020). Effective agricultural management also requires continuous adaptation to changing environmental conditions, market demands, technological developments, and policy frameworks. In modern agriculture, management decisions play a crucial role in improving productivity, ensuring efficient use of resources, supporting sustainable rural development, and increasing the long-term resilience and competitiveness of agricultural systems.

Sustainability in agriculture is commonly understood through three interconnected dimensions: environmental, economic, and social sustainability. These dimensions together form the basis for sustainable agricultural development and strategic management (Tsangas et al., 2020). Environmental sustainability focuses on protecting natural resources, conserving biodiversity, reducing pollution, and building climate resilience. Economic sustainability refers to maintaining the profitability, productivity, and long-term competitiveness of agricultural systems, while social sustainability includes rural development, food security, farmer well-being, education, and social inclusion.

In agricultural management, these dimensions are closely interconnected and cannot be addressed separately. Sustainable agricultural systems require balanced decision-making that simultaneously supports environmental protection, economic viability, and social stability within rural communities. For example, environmentally responsible farming practices can improve long-term soil fertility and resource efficiency, while economically sustainable management supports farm profitability, innovation, and resilience to market fluctuations. At the same time, social sustainability contributes to



strengthening rural livelihoods, preserving agricultural knowledge, and supporting the long-term development of local communities. Modern agricultural management aims to integrate sustainability principles into everyday operational and strategic decision-making processes. This includes resource planning, environmental monitoring, efficient production systems, risk management, and adaptation to changing environmental and economic conditions.

One of the core definitions of sustainable agricultural management is sustainable agriculture, which refers to agricultural systems capable of satisfying current food and resource needs without compromising future generations' ability to meet their own needs. Sustainable agriculture promotes efficient use of soil, water, energy, and biological resources while minimising greenhouse gas emissions, environmental degradation, and excessive dependence on chemical inputs (European Commission, 2021b).

In practice, sustainable agriculture seeks to create balanced production systems that maintain long-term productivity while preserving ecosystem stability. This approach encourages the responsible management of natural resources and supports farming methods that reduce negative environmental impacts without limiting agricultural efficiency or food production capacity. Sustainable agricultural systems, therefore, focus not only on increasing yields but also on maintaining soil fertility, protecting water quality, reducing resource depletion, and improving resilience to environmental and climate-related challenges. An important aspect of sustainable agriculture is integrating environmentally responsible farming practices into everyday agricultural operations. These may include crop rotation, reduced tillage, integrated pest management, efficient irrigation systems, use of organic fertilisers, and biodiversity-friendly production practices. Such approaches contribute to healthier ecosystems, improved resource efficiency, and more stable agricultural production in the long term.

Sustainable agriculture also emphasises the importance of adaptability and long-term planning within agricultural management. Farmers and agricultural managers are increasingly required to respond to changing climate conditions, market pressures, technological developments, and sustainability regulations. As a result, sustainable agriculture is closely linked to innovation, strategic management, environmental



monitoring, and the continuous improvement of production systems. In addition to environmental benefits, sustainable agriculture also contributes to economic and social stability within rural areas. Efficient resource management can reduce production costs and increase resilience to market fluctuations. At the same time, sustainable farming systems may support local employment, rural development, food security, and the preservation of traditional agricultural knowledge and practices.

The concept of sustainable food systems is closely linked to sustainable agricultural management practices. Sustainable food systems aim to provide safe, nutritious, and accessible food while protecting the environment, promoting economic resilience, and advancing social equity throughout the entire agricultural value chain. The Farm-to-Fork Strategy emphasises the importance of transforming food systems into fair, healthy, and environmentally friendly systems that support long-term sustainability goals within the European Union (Delgado et al., 2023).

Sustainable food systems also encourage responsible production and consumption patterns, reduce food waste, promote efficient resource management, and strengthen cooperation among producers, suppliers, distributors, and consumers. These systems aim to improve transparency, traceability, and sustainability throughout the entire food supply chain while supporting local economies and rural communities. In modern agricultural management, sustainable food systems are increasingly recognised as essential for strengthening food security, improving public health, supporting climate resilience, and ensuring the long-term resilience and competitiveness of the agri-food sector.

Theoretical foundations

The theoretical foundations of sustainable management in agriculture are grounded in interdisciplinary approaches that integrate management theory, sustainability principles, environmental protection, economic development, and social responsibility (Madu & Kuei, 2012). Modern agricultural management increasingly relies on strategic and adaptive approaches that can respond to environmental changes (Manoj Kumar Jhariya, 2019), market volatility, technological developments, and evolving policy frameworks. Sustainable agricultural systems are therefore viewed not only as



production systems but also as complex organisational, economic, and environmental systems that require integrated management and long-term planning.

One of the most important theoretical approaches in sustainable agricultural management is the systems approach (Liu et al., 2024). This approach views agriculture as an interconnected system in which environmental, economic, technological, and social factors continuously interact. Agricultural production depends on the relationships among natural resources, market conditions, institutional frameworks, technological innovation, and human activities (Manoj Kumar Jhariya, 2019). For this reason, management decisions in agriculture must consider not only productivity and profitability but also environmental sustainability, resource efficiency, and long-term resilience.

The systems approach also underscores the importance of stakeholder cooperation in the agricultural sector, including farmers, suppliers, distributors, policymakers, research institutions, and local communities. Effective agricultural management, therefore, depends on coordination, strategic planning, information exchange, and continuous adaptation to changing conditions.

Another important theoretical foundation is strategic management theory, which focuses on long-term planning, organisational adaptability, competitiveness, and efficient resource allocation. In agriculture, strategic management supports decision-making related to production planning, investment, innovation, environmental management, and risk reduction (Madu & Kuei, 2012). Agricultural managers must continuously evaluate risks and opportunities while ensuring the long-term sustainability and competitiveness of agricultural enterprises.

Innovation management also represents an important theoretical foundation of sustainable agricultural development. Sustainable innovation in agriculture includes technological innovation, digitalisation, process improvement, organisational innovation, and sustainable business models (de Oliveira Lima et al., 2024). Modern agricultural management increasingly integrates smart technologies, precision agriculture, digital monitoring systems, and data-driven decision-making to improve productivity and environmental performance.



Adaptive management theory is particularly important in the context of climate change and environmental uncertainty. Adaptive management is a flexible, continuous decision-making process that enables agricultural systems to respond effectively to changing environmental, economic, and social conditions (Garmestani et al., 2023). This approach encourages continuous monitoring, evaluation, learning, and adjustment of agricultural practices in response to emerging challenges and risks.

The theoretical foundations of sustainable agricultural management are closely connected to the theory of sustainable development, which promotes the balanced integration of environmental protection, economic growth, and social well-being. This approach is reflected through the concept of the Triple Bottom Line (Vukovic et al., 2025), which emphasises the interconnectedness of environmental, economic, and social sustainability within management and organisational practices.

Finally, circular economy theory has become increasingly important within sustainable agricultural management. Circular approaches promote waste reduction, recycling, reuse of agricultural by-products, efficient resource use, and sustainable production-consumption systems. These principles support environmentally responsible agricultural development while improving long-term economic efficiency within the agri-food sector.

Key concepts

Modern sustainable agricultural management is based on several key concepts that support environmentally responsible, economically viable, and socially sustainable agricultural systems (Kamakaula, 2024). These concepts combine innovation, efficient resource management, environmental protection, and strategic planning in order to improve agricultural productivity and resilience. Modern sustainable agricultural management is based on several key concepts that support environmentally responsible, economically viable, and socially sustainable agricultural systems (Kamakaula, 2024). These concepts combine innovation, efficient resource management, environmental protection, and strategic planning in order to improve agricultural productivity and resilience.



One of the most important concepts is climate-smart agriculture (CSA), which focuses on improving agricultural productivity while strengthening resilience to climate change and reducing greenhouse gas emissions (Singh & Singh, 2017). Climate-smart approaches include efficient water management, climate monitoring, sustainable soil management, adaptive farm planning, and the use of resilient crop varieties. These practices are becoming increasingly important in regions exposed to climate-related risks and environmental instability. Closely related to CSA is the concept of regenerative agriculture, which promotes farming practices that restore soil health, improve biodiversity, and strengthen ecosystem resilience (Bless et al., 2023). Regenerative approaches encourage crop rotation, cover cropping, reduced tillage, composting, agroforestry, and integrated crop-livestock systems. Together, these practices contribute to long-term soil fertility, improved water retention, and reduced environmental degradation.

Another important concept is agroecology, which integrates ecological principles into agricultural production systems (Kerr et al., 2022). Agroecological approaches emphasise biodiversity, ecosystem balance, natural resource conservation, and sustainable interactions between plants, animals, humans, and the environment. Agroecology supports environmentally friendly production systems while reducing dependence on intensive chemical inputs. In this way, it complements both climate-smart and regenerative agricultural practices by promoting long-term ecosystem health and sustainable resource use.

Technological innovation has also become a fundamental component of sustainable agricultural management. Precision and digital agriculture utilise digital technologies, sensors, satellite systems, drones, farm management software, remote sensing, and data analytics to optimise agricultural production and improve resource efficiency (Dibbern et al., 2024; Soussi et al., 2024). These technologies enable more accurate application of fertilisers, pesticides, irrigation, and other inputs, helping farmers reduce production costs while minimising environmental impacts. In addition, digital tools support better decision-making, risk management, and long-term strategic planning.

To evaluate the sustainability performance of agricultural systems, managers increasingly rely on analytical and monitoring tools such as Life Cycle Assessment



(LCA) and sustainability indicators. LCA evaluates environmental impacts throughout the entire agricultural value chain, including production, transportation, processing, packaging, and waste management (Kokare et al., 2023). Sustainability indicators measure environmental, economic, and social performance using metrics such as greenhouse gas emissions, water use, soil quality, biodiversity levels, productivity, profitability, and rural development indicators (Kamakaula, 2024). Together, these tools support evidence-based decision-making, performance monitoring, and continuous improvement of agricultural management practices.

From a management perspective, circular economy principles have become an important component of sustainable agricultural development. Circular approaches encourage the efficient use of resources, reduce waste, promote the recycling of agricultural by-products, and improve energy management. By integrating these practices into farm operations and strategic planning, agricultural managers can improve resource efficiency, reduce costs, and enhance the long-term sustainability and competitiveness of agricultural enterprises.

2.2. Current Situation and Challenges

Agriculture is undergoing a significant transformation driven by environmental concerns, technological advancements, changing consumer preferences, and evolving policy frameworks. Sustainable agricultural management has become a strategic priority at both global and European levels, as agricultural systems are expected to ensure food security while simultaneously reducing environmental impacts and supporting rural development. The increasing importance of sustainability is reflected in major policy initiatives such as the European Green Deal, the Farm-to-Fork Strategy, and the Common Agricultural Policy (CAP) 2023–2027, all of which encourage more sustainable and resource-efficient agricultural practices (European Commission, 2019; European Commission, 2020; European Commission, 2021).

In the Western Balkans, agriculture continues to play an important economic and social role, particularly in rural areas where it contributes significantly to employment, income generation, and food production (Županić et al., 2021). However, the sector faces



numerous structural challenges that limit its long-term sustainability and competitiveness. These challenges include fragmented land ownership, limited investment capacity, low levels of digitalisation, insufficient access to modern technologies, and vulnerability to climate-related risks. As countries in the region continue aligning their agricultural policies with European Union standards, the adoption of sustainable management practices is becoming increasingly important for improving productivity, environmental performance, and market competitiveness (Đokić et al., 2022).

The transition towards sustainable agricultural management requires farmers, agricultural advisors, educators, and policymakers to adopt new approaches that integrate environmental protection, economic viability, and social responsibility (Ingram & Morris, 2007). While significant progress has been made in promoting sustainable farming systems, numerous environmental, economic, and social barriers continue to hinder the widespread implementation of sustainable management practices.

2.2.1 Environmental Challenges

Environmental challenges are among the most significant factors influencing agricultural management today (Gunarathne et al., 2023). Climate change, soil degradation, biodiversity loss, water scarcity, and increasingly stringent environmental regulations are reshaping how agricultural activities are planned and managed. As a result, agricultural managers are required to make more complex decisions regarding resource allocation, production planning, risk management, and long-term sustainability.

Climate change is among the most pressing environmental challenges affecting the agricultural sector (H. A. Prajapati et al., 2024). Increasing temperatures, changing precipitation patterns, more frequent droughts, floods, and extreme weather events can significantly reduce agricultural productivity and increase production uncertainty. For agricultural managers, these changes create additional pressure to develop adaptive management strategies that minimise risks while maintaining farm profitability and operational efficiency. These challenges are particularly relevant in the Western Balkans, where agriculture remains an important source of income and employment in



rural areas. Studies indicate that the region is highly vulnerable to climate change, with projections suggesting a temperature increase of up to 4°C in the coming decades, accompanied by reduced precipitation, more frequent droughts, and greater pressure on water resources. Such changes may significantly affect agricultural productivity, food security, biodiversity, and the long-term sustainability of rural livelihoods (Županić et al., 2021). In this context, agricultural managers must increasingly focus on risk assessment, climate adaptation planning, efficient water management, and the adoption of resilient production systems that can operate under uncertain environmental conditions (Martinovska Stojcheska et al., 2024).

Soil degradation represents another major environmental challenge affecting the long-term sustainability of agricultural systems. Soil erosion, loss of organic matter, nutrient depletion, compaction, and unsustainable land-use practices can significantly reduce soil fertility and agricultural productivity. Intensive farming methods and inadequate soil management practices often intensify these issues. From a management perspective, declining soil quality increases production risks and may require additional investments in soil restoration, fertilisation, and conservation measures (Bateman & Muñoz-Rojas, 2019). Sustainable agricultural management therefore promotes practices such as crop rotation, cover cropping, reduced tillage, and integrated nutrient management to maintain soil health, improve resource efficiency, and support long-term farm productivity. In the Western Balkans, soil management is further complicated by fragmented farm structures, limited investment capacity, and increasing climate-related pressures, which make long-term soil conservation and sustainable land management essential components of agricultural planning and decision-making (Martinovska Stojcheska et al., 2024)

Water scarcity and inefficient water use are becoming increasingly important challenges for agricultural management (Saad et al., 2020). Agriculture is one of the largest consumers of freshwater resources, making effective water management essential for sustainable production. Increasing drought frequency, changing rainfall patterns, and growing competition for water resources create additional pressure on agricultural systems, particularly in climate-sensitive regions. Agricultural managers are therefore required to implement efficient irrigation systems, monitor water



consumption, and adopt technologies that optimise water use while maintaining productivity. Effective water management not only improves resource efficiency but also strengthens resilience to climate-related risks and production uncertainty. In the Western Balkans, projected reductions in precipitation and increasing drought frequency are expected to intensify pressures on agricultural water resources, making water management a strategic priority for farm managers. As a result, decisions related to irrigation planning, water-use efficiency, infrastructure investments, and climate adaptation are becoming increasingly important for maintaining productivity and long-term farm sustainability (Županić et al., 2021)

Biodiversity loss represents an additional environmental challenge with important implications for agricultural management (Schmid & Schöb, 2023). The decline of pollinators, reduction of natural habitats, and simplification of agricultural landscapes can negatively affect ecosystem services that support agricultural production. Sustainable management practices increasingly encourage integrating biodiversity protection measures into farm planning and land management strategies. These measures may include maintaining ecological buffer zones, promoting crop diversification, preserving natural habitats, and reducing excessive dependence on chemical inputs. Protecting biodiversity contributes not only to environmental sustainability but also to the long-term stability and resilience of agricultural production systems (Schmid & Schöb, 2023). Biodiversity conservation is particularly important in the Western Balkans, a region characterised by diverse ecosystems, valuable natural resources, and rich agricultural heritage. However, climate change, land-use changes, habitat loss, and unsustainable agricultural practices increasingly threaten biodiversity and ecosystem stability. Studies indicate that the region faces growing risks related to the loss of agrobiodiversity, including the decline of traditional crop varieties and local genetic resources that are essential for agricultural resilience and long-term sustainability (Županić et al., 2021). Agricultural managers, therefore, play an important role in integrating biodiversity protection measures into farm planning and land management practices to preserve ecosystem services and strengthen the resilience of agricultural systems (Martinovska Stojcheska et al., 2024).



Collectively, these environmental challenges require agricultural managers to adopt proactive and long-term management approaches that balance productivity goals with environmental stewardship. Effective environmental management has become a critical factor in ensuring the sustainability, competitiveness, and resilience of modern agricultural systems. Furthermore, these objectives are closely aligned with the European Green Deal and the Farm-to-Fork Strategy, which encourage the transition towards more sustainable, resource-efficient, and climate-resilient agricultural systems across Europe.

2.2.2 Economic Challenges

Economic factors play a crucial role in shaping agricultural management and the long-term sustainability of agricultural enterprises (Thakur, Ratnam, et al., 2024). Modern agriculture operates in an increasingly complex economic environment characterised by rising production costs, market volatility, changing consumer demands, and growing sustainability requirements. These factors require agricultural managers to make strategic decisions that balance profitability, productivity, and long-term business resilience.

Rising production costs represent one of the most persistent economic pressures facing the agricultural sector (Thakur, Wasnik, et al., 2024). Increasing prices of fuel, energy, fertilisers, feed, machinery, and other agricultural inputs can significantly affect farm profitability and financial stability. For agricultural managers, higher operating costs require more efficient resource allocation, careful financial planning, and the adoption of management practices that improve operational efficiency while reducing unnecessary expenditures.

Market volatility has become an increasingly important challenge for agricultural enterprises (Waluyo, 2024). Fluctuations in commodity prices, changing market conditions, supply chain disruptions, and global economic uncertainties can significantly affect farm profitability and business performance. Such conditions increase uncertainty and complicate long-term planning, investment decisions, and resource allocation. As a result, agricultural managers must adopt proactive



management strategies (Thakur, Ratnam, et al., 2024), including diversifying production, monitoring markets, assessing risks, and developing alternative marketing channels to improve business resilience and competitiveness.

Access to finance and investment capital is equally important for the long-term development of agricultural enterprises. The adoption of modern technologies, sustainable production practices, and climate adaptation measures often requires substantial financial resources. However, many farmers, particularly small and medium-sized producers, face difficulties in securing funding for investments and business development. From a management perspective, access to financial resources is essential for supporting innovation, improving productivity, and ensuring the long-term competitiveness of agricultural enterprises (Thakur, Wasnik, et al., 2024).

These challenges are particularly evident in the Western Balkans, where agricultural production is largely dominated by small-scale farms with limited investment capacity and restricted access to modern technologies. The region continues to face structural constraints, including fragmented agricultural land, weak value-chain organisation, slow productivity growth, and limited access to productive assets (Martinovska Stojcheska et al., 2024). These factors can reduce competitiveness and make it more difficult for agricultural businesses to adapt to changing market conditions and sustainability requirements.

In response to these economic challenges, agricultural managers are increasingly required to adopt strategic management approaches that support financial sustainability, resource efficiency, innovation, and long-term business development (Waluyo, 2024). Effective economic management has therefore become a key component of sustainable agricultural systems (Thakur, Ratnam, et al., 2024), contributing to both farm competitiveness and resilience in a rapidly changing agricultural environment.



2.2.3 Social Challenges and Capacity Gaps

Social challenges and capacity gaps increasingly influence the sustainability and effective management of agricultural systems (Kabir et al., 2024). In addition to environmental and economic pressures, agricultural enterprises must respond to demographic changes, labour shortages, evolving skill requirements, and the growing need for knowledge and innovation. These factors directly affect farmers' and agricultural managers' ability to adopt sustainable practices, implement new technologies, and maintain the long-term viability of agricultural businesses.

The ageing farming population represents a growing concern across many agricultural regions (C. S. Prajapati et al., 2025). In rural areas, younger generations are increasingly moving towards urban centres in search of education and employment opportunities, resulting in a declining agricultural workforce. This demographic trend creates difficulties in maintaining agricultural production, transferring knowledge between generations, and ensuring the continuity of farming activities. From a management perspective, succession planning and attracting younger generations to agriculture have become key priorities for agricultural enterprises seeking long-term stability and growth (Latino et al., 2023).

Rural depopulation and labour shortages further affect the development of agricultural communities. The migration of rural populations reduces the availability of skilled labour, limits local economic development, and weakens social infrastructure (Siebrecht, 2020). These trends can negatively affect farm operations and reduce the capacity of agricultural businesses to expand, innovate, and remain competitive. Agricultural managers are therefore increasingly required to improve workforce planning, invest in employee development, and explore technological solutions that reduce labour dependency.

Knowledge, education, and capacity building are equally essential for the successful transition towards sustainable agricultural management (Dammak et al., 2024). Farmers are expected to continuously update their knowledge and develop competencies related to environmental management, digital technologies, climate adaptation, financial planning, and regulatory compliance. However, access to training



opportunities, advisory services, and specialised educational resources remains uneven across many agricultural regions (C. S. Prajapati et al., 2025).

These issues are particularly evident in the Western Balkans, where rural areas continue to experience out-migration, ageing populations, and limited access to agricultural knowledge and innovation systems. Studies indicate that many agricultural producers in the region face barriers related to technology adoption, access to information, and participation in knowledge-transfer initiatives, which can slow the implementation of sustainable management practices (Martinovska Stojcheska et al., 2024). Strengthening education, advisory support, and cooperation between farmers, educators, research institutions, and policymakers is therefore essential for improving the resilience and competitiveness of the agricultural sector.

Educators also have a central role in addressing these capacity gaps. The increasing complexity of sustainable agricultural management requires training programmes that combine technical knowledge with management, digital, environmental, and business competencies (Latino et al., 2023). Developing accessible and practice-oriented educational materials can support both current and future agricultural professionals in responding effectively to the demands of modern agriculture.

Taken together, these social challenges underline the need for continuous investment in human capital, knowledge transfer, and lifelong learning within the agricultural sector. Addressing social and capacity-related issues through effective management contributes to stronger rural communities, greater innovation uptake, and the long-term sustainability of agricultural systems

2.3. Best Practices and Methodologies

The transition to sustainable agricultural management requires adopting practices that balance environmental protection, economic viability, and social responsibility (Thakur, Ratnam, et al., 2024). Effective management approaches help agricultural enterprises respond to environmental and economic challenges while maintaining productivity and long-term competitiveness. Sustainable agricultural management therefore combines



strategic planning, efficient resource use, risk management, and continuous improvement of production systems (Mirzaei et al., 2022).

One of the most effective approaches is strategic farm planning (Baker et al., 2025). Sustainable agricultural management begins with a comprehensive assessment of the current situation, including available resources, production systems, environmental conditions, and business objectives. Based on this assessment, agricultural managers can identify strengths and weaknesses, establish sustainability goals, and develop action plans that support long-term development. Continuous monitoring and evaluation of results are essential for measuring progress and adapting management decisions when necessary (Latino et al., 2023).

Efficient resource management represents another key element of sustainable agricultural systems. (Thakur, Ratnam, et al., 2024). Agricultural enterprises increasingly adopt practices that improve the use of soil, water, energy, and other production inputs while reducing environmental impacts. Common techniques include crop rotation, cover cropping, integrated nutrient management, reduced tillage, and efficient irrigation systems. These practices contribute to improved soil health, greater resource efficiency, reduced production costs, and increased resilience to environmental pressures.

Climate adaptation and risk management have also become central components of modern agricultural management (M. V. K. Sivakumar & Stefanski, 2009). Farmers and agricultural managers are increasingly required to anticipate climate-related risks and implement measures that reduce vulnerability to droughts, floods, extreme temperatures, and other environmental disturbances. Effective adaptation strategies may include diversifying production, improving water management, monitoring climate, and using resilient crop varieties (M. Sivakumar, 2021). Integrating risk assessment into farm planning allows managers to make more informed decisions and strengthen the long-term stability of agricultural enterprises.

Digital technologies are increasingly supporting sustainable agricultural management by improving decision-making and operational efficiency (Dibbern et al., 2024). Farm management software, digital monitoring systems, sensors, remote sensing technologies, and precision agriculture tools provide valuable information for managing



resources and optimising production processes. These technologies enable agricultural managers to monitor performance, reduce waste, improve input efficiency, and respond more effectively to changing environmental and market conditions.

The implementation of sustainable management practices is particularly important in the Western Balkans, where many agricultural enterprises operate under conditions of limited resources, fragmented land ownership, and increasing climate-related pressures (Županić et al., 2021). In this context, sustainable management does not necessarily require large-scale investments. Many practices can be introduced gradually through improved planning, more efficient resource use, knowledge sharing, and cooperation among farmers, advisory services, and local communities. Such approaches can strengthen the resilience, competitiveness, and sustainability of agricultural systems across the region.

2.4. Case Studies

The following case studies provide practical examples of sustainable management practices implemented in agricultural systems. They demonstrate how environmental, economic, and social challenges can be addressed through strategic planning, efficient resource management, innovation, and collaboration. The selected cases highlight valuable lessons that can support the adoption of sustainable management approaches in different agricultural contexts, including the Western Balkans.

2.4.1. Organic Agriculture as a Sustainable Management Strategy (Serbia)⁴

- **Background**

Serbia possesses favourable natural conditions and a long agricultural tradition, creating strong potential for the development of sustainable farming systems. Despite these advantages, conventional agricultural production has historically dominated the sector, while alternative approaches such as organic agriculture have developed more

⁴ Case study source: Information presented in this case study has been adapted from Šeremešić et al. (2024), who examined the role of organic agriculture in supporting sustainable development and agricultural transformation in Serbia



gradually. Growing environmental concerns, rising demand for safe, high-quality food, and alignment with European sustainability policies have driven greater interest in organic farming. As a result, organic agriculture has become an important example of how sustainable management practices can contribute to agricultural development, environmental protection, and rural revitalisation.

- **Problem identified**

Although Serbia has significant potential for organic agriculture, the sector has faced several development barriers. These include limited consumer awareness, insufficient domestic market demand, financial constraints, and challenges related to certification and knowledge transfer. In addition, many farmers have been reluctant to move away from conventional production systems due to perceived economic risks and uncertainty regarding market opportunities. These factors have slowed the wider adoption of sustainable agricultural practices.

- **Solution implemented**

To support the growth of organic agriculture, Serbia introduced policies and strategic measures to strengthen the sector. These efforts included developing legal and institutional frameworks, supporting certification processes, promoting environmentally friendly farming methods, and encouraging cooperation among producers. Farmers gradually adopted management practices focused on sustainable resource use, biodiversity conservation, soil protection, and reduced dependence on synthetic inputs.

- **Outcomes**

The implementation of these measures contributed to the gradual expansion of organic agriculture nationwide. The area under organic production increased significantly, while the number of certified producers and organic products available on domestic and international markets continued to grow. Organic farming also contributed to environmental protection, improved management of natural resources, and promoted sustainable rural development. At the same time, the sector strengthened Serbia's progress towards broader sustainability objectives.

- **Lessons learned**

The experience of Serbia demonstrates that a successful transition to more sustainable agricultural systems requires long-term commitment, supportive policies,



farmer education, and effective stakeholder cooperation. Sustainable agricultural development cannot rely solely on environmental measures but must also address economic viability, market development, and knowledge transfer. The case highlights the importance of strategic management, institutional support, and continuous innovation in achieving long-term sustainability goals.

2.4.2. Towards Data-Driven Precision Crop Management of Potato (Netherlands)⁵

- **Background**

The Netherlands is recognised as one of Europe's leading countries in agricultural innovation and precision farming. Increasing environmental requirements, the need for efficient resource use, and growing sustainability expectations have encouraged the adoption of data-driven management approaches within the agricultural sector. In potato production, precision agriculture has become an important tool for improving productivity while reducing environmental impacts. Through the integration of digital technologies, sensors, satellite imagery, and advanced decision-support systems, farmers are increasingly able to manage agricultural operations more accurately and efficiently.

- **Problem identified**

Agricultural producers face growing pressure to increase productivity while simultaneously reducing the use of water, fertilisers, pesticides, and other agricultural inputs. In addition, compliance with environmental regulations and sustainability standards has become increasingly important. Despite the potential benefits of precision agriculture, many farmers have been hesitant to adopt these technologies due to high investment costs, uncertainty about economic returns, technological complexity, and challenges with data management and interoperability across different digital systems.

⁵ Case study source: Information presented in this case study has been adapted from (Kempenaar et al., 2026), who analysed the role of data-driven precision agriculture technologies in improving resource efficiency, sustainability, and decision-making in Dutch crop production.



- **Solution implemented**

To address these challenges, Dutch farmers and agricultural organisations increasingly adopted precision agriculture technologies and data-driven management systems. These included farm management information systems, satellite monitoring, GNSS-based navigation, soil and crop sensors, artificial intelligence tools, and digital decision-support platforms. The implementation of these technologies enabled more precise monitoring of crop conditions and more efficient application of fertilisers, pesticides, irrigation, and other production inputs. Several pilot projects and innovation programmes also supported the practical adoption of these technologies at the farm level.

- **Outcomes**

The adoption of precision agriculture technologies improved resource efficiency and enabled more sustainable production practices. Farmers optimised the use of agricultural inputs, reduced waste, and improved decision-making processes using real-time data. Experiences from Dutch precision farming initiatives demonstrated measurable reductions in water, fertiliser, pesticides, and other inputs while maintaining productivity and crop performance. The technologies also contributed to better environmental management and increased compliance with sustainability requirements.

- **Lessons learned**

The Dutch experience demonstrates that digital technologies can play a significant role in supporting sustainable agricultural management when combined with appropriate knowledge, training, and organisational support. Successful implementation requires not only technological investments but also the development of digital skills, effective data management, and cooperation among farmers, technology providers, researchers, and policymakers. The case further highlights that precision agriculture can improve both environmental and economic performance, making it a valuable component of modern sustainable agricultural systems.



2.5. Useful Tools and Resources

The implementation of sustainable management practices in agriculture can be supported through a variety of technologies, educational resources, knowledge-sharing platforms, and practical training materials. As agricultural systems become increasingly complex, farmers and agricultural managers require access to reliable information and tools that support informed decision-making, resource efficiency, and long-term sustainability. Digital technologies, educational resources, and collaborative platforms are increasingly recognised as important enablers of sustainable agricultural management (Dibbern et al., 2024).

Modern agricultural management increasingly relies on digital technologies that support data-driven decision-making and improve operational efficiency. Farm Management Information Systems (FMIS), precision agriculture technologies, satellite monitoring systems, sensors, drones, and artificial intelligence applications enable farmers to monitor crop performance, optimise the use of water, fertilisers, and pesticides, and improve resource allocation. These technologies contribute to greater productivity, reduced environmental impacts, and more sustainable agricultural production systems (Kempenaar et al., 2026).

In addition to technological solutions, practical guides and manuals provide valuable support for the implementation of sustainable agricultural practices. Resources developed by organisations such as the Food and Agriculture Organisation (FAO) and the European Commission offer guidance on climate-smart agriculture, integrated pest management, biodiversity conservation, sustainable soil management, and climate adaptation. These materials help farmers and agricultural advisors translate sustainability principles into practical management actions while supporting compliance with environmental and agricultural policies ((Food and Agriculture Organisation of the United Nations (FAO), 2017); European Commission, 2021).

Knowledge-sharing platforms further support sustainable agricultural development by facilitating access to information, training opportunities, research findings, and examples of good practice. Initiatives such as the EU CAP Network and the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) promote cooperation among farmers, researchers, educators, advisors, and



policymakers. Through knowledge and experience exchange, these platforms contribute to innovation, capacity building, and the wider adoption of sustainable management practices across the agricultural sector (European Commission, 2024).

Supporting materials such as case studies, technical fact sheets, webinars, training videos, sustainability assessment tools, and farm planning templates can further strengthen the implementation of sustainable agricultural management. These resources help farmers, agricultural managers, and educators develop practical skills, improve decision-making processes, and continuously update their knowledge. Continuous access to educational and training materials remains essential for addressing the environmental, economic, and social challenges facing modern agriculture.

The effective use of technologies, educational resources, knowledge-sharing platforms, and supporting materials can significantly improve the implementation of sustainable agricultural management practices. Access to reliable information and continuous learning enables agricultural managers to strengthen farm performance, improve sustainability outcomes, and increase the long-term resilience and competitiveness of agricultural enterprises.

2.6. Practical Activities

Practical activities provide learners with an opportunity to apply the concepts, principles, and management approaches presented throughout this module. While the previous sections focused on theoretical foundations, sustainability challenges, best practices, and case studies, the activities encourage participants to apply this knowledge in practical decision-making contexts.

The activities are designed to strengthen analytical thinking, problem-solving skills, and the ability to evaluate agricultural systems from environmental, economic, and social perspectives. By engaging in practical exercises, learners can better understand how sustainable management principles can be applied in real agricultural contexts and how management decisions influence the long-term sustainability and resilience of agricultural enterprises.



The following activities can be implemented individually or in groups and may be adapted to different educational settings, levels of experience, and agricultural contexts.

2.6.1. Farm Sustainability Assessment

- **Objective**

The objective of this activity is to help learners assess the sustainability performance of an agricultural enterprise by applying environmental, economic, and social sustainability criteria. Participants will analyse how management decisions influence farm performance and identify areas where sustainable management practices can be strengthened. The activity encourages learners to think critically about resource use, environmental protection, economic viability, and social responsibility within agricultural systems. By completing the assessment, participants will gain practical experience in evaluating sustainability challenges and developing recommendations that support long-term farm resilience and competitiveness.

- **Required materials**

- Farm sustainability assessment worksheet (*A detailed Farm Sustainability Assessment Worksheet is provided in Appendix 1*)
- Pen or digital device
- Farm description, case study, or real farm data (if available)

Note on Timing

The proposed time frame is indicative and may be adjusted based on the group size, available materials, the learning context, and participants' prior experience. Trainers and learners may adjust the duration of each step based on their needs and available resources.

- **Step-by-step instructions with time**

1. Select a farm, agricultural enterprise, or one of the case studies presented in this module (10 minutes).



2. Review the available information and identify the main farming activities, management practices, available resources, and sustainability objectives. Consider how the farm currently manages environmental, economic, and social aspects of its operations (10 minutes).
3. Assess environmental sustainability by evaluating soil management practices, water use efficiency, biodiversity protection measures, waste management practices, and climate adaptation strategies. Consider whether the farm applies sustainable practices that contribute to environmental protection and long-term resource conservation (15 minutes).
4. Assess economic sustainability by examining profitability, productivity, resource efficiency, production costs, investment capacity, market opportunities, and risk management practices. Consider whether the farm is financially capable of maintaining operations and adapting to future challenges (15 minutes).
5. Assess social sustainability by evaluating labour conditions, access to education and training, community involvement, knowledge transfer, and long-term succession planning. Consider how the farm contributes to the well-being of employees, local communities, and future generations of farmers (10 minutes).
6. Complete the sustainability assessment worksheet and assign ratings for each criterion. Based on the assessment results, identify at least three strengths and three areas where improvements could be made (10 minutes).
7. Develop practical recommendations that could improve the farm's sustainability performance. Discuss the proposed actions with other participants or the instructor and explain how these recommendations could contribute to environmental, economic, and social sustainability (10 minutes)

- **Evaluation criteria**

The following criteria may be used to evaluate participant performance:

- Ability to identify environmental, economic, and social sustainability issues
- Quality and completeness of the sustainability assessment
- Relevance and feasibility of proposed management improvements
- Application of sustainable management concepts and analytical thinking
- Participation in discussion, reflection, and recommendation development



2.6.2. Developing a Sustainable Farm Management Plan

- **Objective**

The objective of this activity is to help learners apply sustainable management principles by developing a practical improvement plan for an agricultural enterprise. Participants will analyse sustainability challenges, prioritise management actions, and design realistic measures that can improve environmental performance, economic viability, and social sustainability. Through this exercise, learners will strengthen their planning, decision-making, and problem-solving skills while exploring how sustainable management practices can be integrated into everyday farm operations.

- **Required materials**

- Farm Management Plan Template (*A detailed Farm Management Plan Template is provided in Appendix 2*)
- Results from the Farm Sustainability Assessment (Activity 1) or a selected case study
- Pen or digital device
- Calculator (optional)

Note on Timing

The proposed time frame is indicative and may be adjusted based on the group size, available materials, the learning context, and participants' prior experience. Trainers and learners may adjust the duration of each step based on their needs and available resources.

- **Step-by-step instructions with time**

1. Select a farm, agricultural enterprise, or case study that will serve as the basis for the management plan (10 minutes).
2. Review the sustainability assessment results or available farm information and identify the main environmental, economic, and social challenges affecting the enterprise (10 minutes).
3. Prioritise the identified challenges and select at least three areas that require management intervention or improvement (10 minutes).



4. Develop practical management actions that could address the identified challenges. Consider measures related to resource efficiency, environmental protection, financial performance, risk management, technology adoption, education, or community engagement (20 minutes).
5. For each proposed action, identify the expected benefits, potential barriers, required resources, and implementation priorities (15 minutes).
6. Prepare a short Sustainable Farm Management Plan summarising the proposed actions and explaining how they contribute to long-term sustainability and resilience (15 minutes).
7. Present the management plan to other participants or the instructor and discuss the feasibility of the proposed recommendations (10 minutes).

- **Evaluation criteria**

The following criteria may be used to evaluate participant performance:

- Ability to identify and prioritise sustainability challenges
- Quality and feasibility of proposed management actions
- Application of sustainable management principles
- Integration of environmental, economic, and social considerations
- Clarity and completeness of the management plan
- Participation in discussion and reflection activities

3. Conclusion

Sustainable management practices have become an essential component of modern agricultural development. As agriculture faces increasing environmental, economic, and social challenges, agricultural managers must adopt integrated approaches that support productivity, resource efficiency, resilience, and long-term sustainability. Effective agricultural management today extends beyond production planning and increasingly incorporates environmental stewardship, innovation, financial sustainability, risk management, and continuous adaptation to changing conditions.

This module introduced the key concepts and theoretical foundations of sustainable agricultural management and explored the major challenges affecting agricultural systems. Particular attention was given to environmental issues such as climate



change, soil degradation, water scarcity, and biodiversity loss, as well as economic and social factors that influence the sustainability and competitiveness of agricultural enterprises. The module also presented practical methodologies, examples of good practice, and case studies demonstrating how sustainable management principles can be applied in different agricultural contexts.

The practical relevance of sustainable agricultural management lies in its ability to support informed decision-making and improve the long-term performance of agricultural enterprises. Sustainable management practices help farmers and agricultural managers optimise resource use, strengthen resilience to environmental and market-related challenges, improve environmental performance, and support the long-term viability of rural communities.

Ultimately, the value of sustainable agricultural management lies not only in understanding sustainability principles but also in translating them into everyday practice. The concepts, tools, practical activities, and examples presented throughout this module can support farmers, agricultural managers, educators, and other stakeholders in identifying sustainability challenges, developing improvement strategies, and implementing management practices that contribute to more resilient, resource-efficient, and environmentally responsible agricultural systems. Through continuous learning, innovation, and collaboration, sustainable management practices can play an important role in supporting the long-term sustainability and competitiveness of agriculture in the Western Balkans and beyond.

4. Glossary

- **Agricultural Management:** The process of planning, organising, directing, and controlling agricultural resources and production activities to achieve economic, environmental, and social objectives.
- **Agroecology:** An approach that applies ecological principles to agricultural systems in order to promote sustainability, biodiversity, and resource conservation.
- **Biodiversity:** The variety of living organisms, including plants, animals, and microorganisms, within a particular ecosystem.



- **Climate Adaptation:** Actions and strategies aimed at reducing the negative impacts of climate change and increasing the resilience of agricultural systems.
- **Climate-Smart Agriculture (CSA):** An agricultural approach that seeks to improve productivity, strengthen resilience to climate change, and reduce greenhouse gas emissions.
- **Circular Economy:** An economic model focused on reducing waste, reusing resources, and improving resource efficiency throughout production systems.
- **Farm Management Information System (FMIS):** A digital tool that supports farm planning, monitoring, record-keeping, and decision-making processes.
- **Life Cycle Assessment (LCA):** A methodology used to evaluate the environmental impacts of a product, process, or activity throughout its entire life cycle.
- **Precision Agriculture:** The use of digital technologies, sensors, satellite systems, and data analysis to optimise agricultural production and resource use.
- **Regenerative Agriculture:** A farming approach that aims to restore soil health, improve biodiversity, and strengthen ecosystem resilience.
- **Resource Efficiency:** The effective and sustainable use of natural, financial, and human resources to achieve desired outcomes while minimising waste.
- **Sustainability Indicators:** Measures used to assess the environmental, economic, and social performance of agricultural systems.
- **Sustainable Agriculture:** Agricultural production that meets current needs without compromising the ability of future generations to meet their own needs.
- **Sustainable Food System:** A food production and distribution system that provides safe and nutritious food while supporting environmental protection, economic viability, and social well-being.
- **Sustainable Management Practices:** Management approaches that integrate environmental, economic, and social sustainability into agricultural planning, decision-making, and operations.



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Appendix 1. Farm Sustainability Assessment Worksheet

Farm / Enterprise Name: _____

Location: _____

Date: _____

Evaluator(s): _____

Instructions

Evaluate each criterion using the following scale:

Rating	Description
1	Very poor – no evidence of sustainable practices
2	Limited – sustainability measures are rarely applied
3	Moderate – some sustainability practices are implemented
4	Good – sustainability practices are well integrated
5	Excellent – sustainability is fully integrated and continuously monitored

Environmental Sustainability Assessment

Assessment Criterion	Rating (1–5)	Comments / Evidence
Soil management and soil conservation practices		
Water use efficiency and irrigation management		
Biodiversity protection measures		
Waste management and pollution prevention		
Climate adaptation practices		
Sustainable use of fertilisers and pesticides		

Environmental Strengths:

**Areas for Improvement:**

Economic Sustainability Assessment

Assessment Criterion	Rating (1–5)	Comments / Evidence
Farm profitability and financial stability		
Resource efficiency		
Cost management practices		
Investment and innovation capacity		
Risk management and business planning		
Market competitiveness		

Economic Strengths:

Areas for Improvement:

Social Sustainability Assessment

Assessment Criterion	Rating (1–5)	Comments / Evidence
Employee welfare and working conditions		
Access to education and training		
Knowledge sharing and capacity building		
Community engagement		
Farm succession planning		
Contribution to rural development		



Social Strengths:

Areas for Improvement:

Overall Sustainability Assessment Three Main Strengths

Three Priority Areas for Improvement

Recommended Management Actions

Action	Expected Benefit	Priority (High/Medium/Low)

Final Reflection

Based on this assessment, what are the most important actions that could improve the long-term sustainability and resilience of the farm?



Appendix 2. Sustainable Farm Management Plan Template

Farm / Enterprise Name: _____

Location: _____

Date: _____

Prepared by: _____

Farm Overview

Main Agricultural Activities

Main Sustainability Challenges

Sustainability Objectives

Sustainable Farm Management Action Plan

Challenge Identified	Proposed Management Action	Expected Benefit	Resources Required	Priority (High/Medium/Low)



Environmental Improvement Actions

Action	Expected Outcome	Time Frame

Examples may include:

- Improving soil management
- Increasing water-use efficiency
- Enhancing biodiversity protection
- Reducing chemical inputs
- Implementing climate adaptation measures

Economic Improvement Actions

Action	Expected Outcome	Time Frame

Examples may include:

- Improving resource efficiency
- Reducing production costs
- Diversifying farm income
- Investing in technology
- Strengthening risk management practices



Social Improvement Actions

Action	Expected Outcome	Time Frame

Examples may include:

- Providing staff training
- Supporting knowledge transfer
- Increasing community engagement
- Improving working conditions
- Developing succession plans

Priority Actions for the Next 12 Months

High Priority

Medium Priority

Long-Term Priorities

Monitoring and Evaluation

How will progress be monitored?



Which indicators will be used to measure success?

Final Reflection

How will the proposed management actions contribute to the environmental, economic, and social sustainability of the farm?



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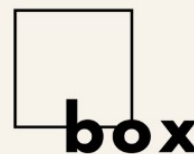
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