Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 24, Issue 3, 2024
PRINT ISSN 2284-7995, E-ISSN 2285-3952

METHODS OF OPTIMIZING THE MANAGEMENT OF AGRICULTURAL FARMS OF MEDIUM ECONOMIC DIMENSIONS- A REVIEW

Iuliana Mirela PINȚĂ

University of Agricultural Sciences and Veterinary Medicine Bucharest, 59 Marasti, District 1, 11464, Bucharest, Romania, Phone/Fax: 00 40 744 6474 10; E-mail: mirela.pinta@usamv.ro

Corresponding author: mirela.pinta@usamv.ro

Abstract

In the context of modern agriculture, medium-sized farms play a crucial role in ensuring economic sustainability and food security. These farms are large enough to benefit from modern technologies and economies of scale, but still small enough to be flexible and innovative. However, they face specific challenges, including access to finance, technology and markets, resource and labour management, and adaptation to climate change and government regulations. Optimizing the management of these farms is essential to ensure long-term productivity, sustainability and profitability. This article aims to explore management optimization methods for medium-sized farms, as well as a SWOT analysis of these methods based on which we will provide a series of conclusions for improving their performance. Agricultural management optimization requires as farmers to integrate new technologies and sustainable practices, to adapt to market and environmental changes, to invest in innovation and development. Only in this way, medium-sized agricultural farms can become models of efficiency and sustainability, contributing significantly to food security and environmental protection.

Key words**:** *farm management, economic optimum, medium-sized farm*

INTRODUCTION

Medium-sized farms are those agricultural holdings that, by their size and production capacity, have sufficient resources to benefit from economies of scale and invest in modern technologies, but do not have the same financial resources and infrastructure as large corporations agricultural. In the context of modern agriculture, the efficient management of an agricultural farm of medium economic size is essential to ensure long-term sustainability and profitability [14, 18].

Management optimization methods in agriculture include a combination of technological, organizational and ecological strategies aimed at increasing operational efficiency, reducing costs and improving product quality [4, 6].

Modern agriculture faces multiple challenges, including climate change, volatile markets and pressure on natural resources [2]. In this context, the adoption of effective management methods becomes crucial to respond to market demands and maintain competitiveness.

Advanced technologies such as precision agriculture, digitization, use of data [9], and application of sustainable practices play a vital role in transforming medium-sized farms into a sustainable and innovative business model [10]. Data-driven decisions enable optimal use of resources, reducing costs and waste. The use of advanced technologies allows precise monitoring and management of variability within the farm [20, 21].

Sustainable practices such as crop rotation improve soil fertility and reduce the risk of erosion.

The use of renewable energy and the reduction of dependence on fossil resources contribute to reducing the carbon footprint and protecting the environment [1].

Precision agriculture focuses on the precise application of agricultural inputs, reducing waste and maximizing crop yields. Digital marketing and social media help increase farm visibility and connect directly with consumers, which can lead to increased sales and customer loyalty.

The purpose of the paper is to explore management optimization methods for medium-sized farms, as well as a SWOT analysis of these methods based on which we

will provide a series of conclusions for improving their performance.

MATERIALS AND METHODS

To achieve the main purpose of the work, the qualitative analysis method was used regarding the collection and analysis of non-numerical data regarding the context and phenomena related to the application of management optimization methods in agricultural farms. A SWOT analysis was also carried out, which provided the premise of a superior understanding of the management of farms of medium economic size, which provided the basis for the formulation of relevant conclusions.

RESULTS AND DISCUSSIONS

Characteristics of the medium-sized farms

Medium-sized economic farms have several specific characteristics: usually, medium-sized farms have a diverse range of crops and/or livestock, which gives them the advantage of optimizing the use of resources. Due to the annual income they can have (up to EUR 250,000), these farms have sufficient financial resources to invest in modern technologies such as irrigation equipment, high-performance agricultural machinery and farm management software. Medium-sized farms tend to be more efficient than small farms because they can implement more advanced farming practices, have the flexibility to adapt to market changes, and do not have the same infrastructure constraints as large farms. Thus, we can affirm the fact that medium-sized farms play an important role in the rural economy, contributing to the creation of jobs and the development of local communities.

Farm classification is essential to understand the agricultural structure of a region and to develop appropriate agricultural policies. This varies according to the local and economic context, but common criteria include agricultural area, income, number of employees and value of production.

Based on these specific characteristics, a series of methods can be established to optimize the management applied to them:

1. Organizational structure and human resources management

Medium-sized farms need a well-defined organizational structure to ensure operational efficiency and facilitate strategic decision-making. The main aspects of the organizational structure include:

- *Functional departments*: the creation of specific departments for production, technology, finance, human resources and marketing. This allows for a more efficient management of activities and a clear allocation of responsibilities.
- *Training and professional development*: investment in the continuous training of employees to ensure the necessary skills to use modern technologies and implement sustainable agricultural practices.
- *Employee motivation and retention*: offering attractive benefits packages and creating a positive work environment to keep employees motivated and engaged.

2. Use of advanced technologies

- *Precision farming* involves using modern technologies to monitor and manage variability within a farm. This includes the use of sensors, drones and GPS systems to collect data on soil, plant and climate conditions. This information allows farmers to make informed decisions, optimizing resource use and maximizing crop yields [11].
- *Digitization and use of data*: the implementation of farm management IT systems helps to collect, store and analyze data on agricultural activities. These systems facilitate the tracking of daily operations, inventory management and production planning. Using historical data and predictive analytics helps improve decision-making processes and anticipate potential problems [19].
- *Automating agricultural processes* such as irrigation, fertilization and harvesting reduces the need for manual labour and increases operational efficiency. The use of agricultural robots and automated equipment helps to improve the accuracy and speed of task execution while reducing labour costs [15].
- *Modern technologies* can play a crucial role in optimizing the management of medium-sized farms. Their implementation can

improve productivity, reduce costs and minimize environmental impact. The main relevant technologies include precision technologies: the use of GPS systems, drones and sensors for precise monitoring and management of crops and resources [7].

Modern technologies allow precise application of fertilizers, pesticides and water, thus reducing waste and costs; agricultural management software. Implementation of IT solutions for monitoring agricultural operations, inventory management, data analysis and informed decision-making. This software can integrate data on weather conditions, crop health and financial performance; modern equipment: Investing in advanced farm equipment such as state-of-the-art tractors and combines that can increase efficiency and productivity.

3. Resource management strategies

- *Water management*: water management is essential for agricultural sustainability. Implementing efficient irrigation systems, such as drip irrigation and the use of moisture sensors, helps to reduce water consumption and ensure an even distribution of water. Also, the collection and use of rainwater is an ecological and efficient method of managing water resources [17].

- *Fertilization and soil management*: the use of soil analysis to determine the exact nutrient requirements and the precise application of fertilizers contribute to the optimization of fertilization. Crop rotation practices and the use of cover crops improve soil structure and fertility while reducing the risk of soil erosion and degradation [16].

- *Renewable energy and resources*: The adoption of renewable energy sources such as solar and wind power helps reduce dependence on fossil energy sources and lower operational costs. Installing solar panels to power farm equipment and using bioenergy from agricultural waste are examples of sustainable energy management practices [3].

- *Planning and crop rotation* are essential to maintain soil fertility, prevent disease and pests and maximize yields. Annual planning: establishing a detailed plan that includes crop selection, crop rotation and the calendar of activities. This plan must take into account the specifics of the soil, climatic conditions and market requirements.

Crop rotation: implementing crop rotation to prevent soil depletion and reduce the risk of disease and pests. Proper rotation can improve soil structure and biodiversity [16].

- *Soil conservation practices*: adoption of conservation agriculture practices, such as covering the soil with cover crops and minimizing tillage, to protect the soil and maintain its fertility [5].

4. Organizational and marketing approaches

- *Diversification of crops and agricultural products* helps reduce the risks associated with market fluctuations and adverse climatic conditions. Farms that diversify production can benefit from multiple sources of income and varied market opportunities, thus ensuring greater financial stability [13].

- *Cooperation and partnerships*: the formation of agricultural cooperatives and partnerships between farmers contributes to increasing bargaining power in the market and access to resources and advanced technologies. Cooperation allows costs and risks to be shared while facilitating access to larger markets and more favourable trading conditions [8].

- *Marketing, branding*: developing an effective marketing and branding strategy is essential to attract and retain customers. Promoting local, organic and sustainable agricultural products can increase their perceived value and provide a competitive advantage in the market. Using digital marketing channels and social media helps increase visibility and connect directly with consumers [12].

- *Access to markets and the development of effective marketing strategies* are essential to ensure the sale of agricultural products at competitive prices. Key approaches include diversifying sales channels: using local, regional and online markets to reduce reliance on intermediaries and increase profit margins; certifications and branding: obtaining ecological certifications and developing your brand to access premium product markets and benefit from higher prices; direct contracts: concluding direct contracts with retail chains, restaurants and other entities to ensure a

constant and stable market for agricultural products [13].

SWOT analysis of the role of technology application in agricultural farm management

Strengths

1. Increased operational efficiency:

- Implementation of advanced technologies and modernized management practices lead to more efficient use of resources and reduction of losses.
- Automation and precise monitoring allow for improving the productivity and quality of agricultural products.

2. Cost reduction:

- Optimizing processes and using resource-saving technologies such as drip irrigation and precision fertilization help reduce operational costs.
- Crop diversification and crop rotation minimize risks and protect the soil, which reduces the need for costly long-term interventions.

3. Adaptability and resilience:

- Optimization methods allow the farm to be more flexible and adaptable to market changes and climatic conditions.
- Sustainable and ecological practices improve the long-term resilience of the farm.

4. Access to markets and certifications:

- The use of modern technologies and effective management methods can help to obtain quality and ecological certifications, facilitating access to premium markets.
- Digital marketing and branding strategies can increase the visibility and appeal of agricultural products.

Weaknesses

1. High initial costs:

- Investments in technological equipment and staff training can be significant and difficult to bear for medium-sized farms.
- The initial costs for implementing advanced management systems can be a barrier for some farms.

2. Complexity of implementation:

- Integrating and coordinating different technologies and practices requires careful planning and specialized technical skills.
- Change management can be difficult, requiring considerable effort to change traditional practices and adopt new methods.

3. Dependence on technology and infrastructure:

- Technology reliability and access to the necessary infrastructure (internet, electricity) are essential for the success of optimization methods.
- Technical failures and connectivity issues can adversely affect farm operations.

4. Risks related to data security:

- The use of digital platforms involves risks related to data protection and security.
- Effective cyber security management requires additional measures and may involve additional costs.

Opportunities

1. Continuous innovation and technological development:

- Continuous technological progress provides opportunities for the continuous improvement of farm management and the adoption of new innovative solutions.
- Partnerships with research institutions and collaborative development can lead to the implementation of the latest technologies.

2. Access to funding and subsidies:

- There are numerous funding programs and grants available to farmers who wish to adopt advanced management methods.
- Government and international organization support can facilitate access to resources and funds needed for optimization.

3. Increasing demand for sustainable products:

- Consumers are becoming increasingly concerned about the sustainability and quality of food products, which creates an opportunity for farmers who adopt sustainable practices.
- Marketing and branding of organic and local products can attract new market segments and increase profitability.

4. Improving relations with the community and the environment:

- The implementation of sustainable management practices contributes to the protection of the environment and the development of the local community.
- Community engagement and education programs can improve public perception and create positive relationships with consumers and local partners.

Threats

1. Market volatility:
- Price fluctuations of agricultural inputs and final products can affect the profitability and sustainability of investments in advanced management methods.
- Uncertain economic and business conditions can negatively influence long-term profitability.

2. Climate change and extreme weather conditions:
- Extreme weather events such as drought, floods and extreme temperatures can adversely affect crops and productivity.
- Adaptation to climate change requires additional investment and long-term planning.

3. Regulations and compliance:
- Changes in agricultural legislation and environmental regulations can create uncertainty and additional costs for farmers.
- Compliance with new regulations and standards may require significant adaptations and financial resources.

4. Resistance to change and cultural barriers:
- Conservatism and reluctance to adopt new technologies and practices can delay the implementation of optimization methods.
- Lack of adequate education and training in the use of modern technologies can limit the efficiency and success of their implementation.

CONCLUSIONS

Optimizing the management of an agricultural farm of medium economic size requires an integrated approach that combines advanced technologies, efficient management of resources and innovative organizational and marketing strategies. Precision agriculture, digitization and use of data, automation, sustainable water and soil management, adoption of renewable energy sources, production diversification, cooperation and partnerships, as well as effective marketing and branding strategies are key elements in this process.

The implementation of these methods not only improves the efficiency and profitability of the farm but also contributes to the long-term sustainability of agriculture, reducing the negative impact on the environment and ensuring the necessary resources for future generations. Farmers who adopt these practices will be better prepared to face future challenges and capitalize on the opportunities offered by an ever-evolving agricultural market.

In conclusion, we can state that the success of agricultural management optimization depends on the ability of farmers to integrate new technologies and sustainable practices into their daily operations, continuously adapting to market and environmental changes. By investing in innovation and development, medium-sized agricultural farms can become models of efficiency and sustainability, contributing significantly to food security and environmental protection.

REFERENCES

[1]Capitanescu, F., Marvuglia, A., Navarrete Gutiérrez, T., Benetto, E., 2017, Multi-stage farm management optimization under environmental and crop rotation constraints, Journal of Cleaner Production, Vol.147, 197-205

[2]Condratchi, L., 2013, Logistics alternative in simulation and optimization the supply chain. Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 13(1), 87-90.

[3]De Jesus Acosta-Silva, Y., Torres-Pacheco, I., Matsumoto, Y., Toledano0Ayala, M., Soto-Zarazua, G.M., Zelaya-Angel, O., Mendez-Lopez, A., 2019, Applications of solar and wind renewable energy in agriculture: A review. Science Progress, Vol.102(2), 127-140.

[4]Emirhüseyinoğlu, G., Ryan, S. M., 2022, Farm management optimization under uncertainty with impacts on water quality and economic risk. IISE Transactions, 54(12), 1143–1160.

[5]Farmaha, B.S., Sekaran, U., Franzluebbers, A.J., 2021, Cover cropping and conservation tillage improve soil health in the southeastern United States, Agronomy Journal, https://doi.org/10.1002/agj2.20865

[6]Ionitescu, S., Popescu, A., Ionitescu, E., Dumitru, E., Gudanescu, N.L., 2023, Models for agricultural production optimization. Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 23(3), 373-386.

[7]Kushwaha, M., Singh, S., Singh, V., Dwivedi, S., 2024, Precision Farming: A Review of Methods, Technologies, and Future Prospects, International Journal of Environment, Agriculture and Biotechnology Vol.9(2), 242-253. Mar-Apr, 2024.

[8]Leite, A.R., Machado Padilha, A.C., Binotto, E., 2021, Cooperation challenges in agricultural cooperatives, Revista de Administração da UFSM, Vol. 14(4), 809-826.

[9]Liao, W.T., Rodríguez, L.F., Diesner, J., Lin, T., 2015, Improving farm management optimization:

Application of text data analysis and semantic networks. In 2015 ASABE Annual International Meeting. American Society of Agricultural and Biological Engineers.
[10]Moghaddam, K.S., DePuy, G.W. 2011, Farm management optimization using chance constrained programming method, Computers and Electronics in Agriculture, Vol. 77(2), 229-237.
[11]Monteiro, A., Santos, S., Goncalves, P., 2021, precision agriculture for crop and livestock farming—brief review, Animals (Basel), 11(8), 2345.
[12]Pay, C., White, M.R., Zwart, A.C., 1996, The Role and Importance of Branding in Agricultural Marketing, Lincoln Univresity Canterbury, New Zealand. https://core.ac.uk/reader/35460140, Accessed on September 10, 2024.
[13]Perosa, B.B, da Silva, R.F.B., Batistella, M., 2024, Market Access and Agricultural Diversification: An Analysis of Brazilian Municipalities, Land, 13*(*1), 61; https://doi.org/10.3390/land13010061
[14]Romero, J., Smith, K., 2016, Crop profit optimization for farmers, in IEEE Systems and Information Engineering Design Symposium (SIEDS 2016), pg. 289–291.
[15]Sahu, S., 2023, Automation in Agriculture: The Use of Automated Farming Emphasizing Smart Farm Machinery, In book: Automation in Agriculture: The Use of Automated Farming Emphasizing Smart Farm Machinery, pp.01-20, Renu Publisher.
[16]Sharma, P. , Singh, A. , Kahlon, C. , Brar, A. , Grover, K. , Dia, M., Steiner, R., 2018, The Role of Cover Crops towards Sustainable Soil Health and Agriculture—A Review Paper. American Journal of Plant Sciences, 9, 1935-1951. doi: 10.4236/ajps.2018.99140.
[17]Shit, P.K., Adhikary, P.P., Bera, B., Rajput, V.D., 2024, Resilient and sustainable water management in agriculture, Environmental Science and Pollution Research, Vol.31, pp.54020-54025.
[18]Surca, D.E., 2021, Increasing economic performances using optimization. Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 21(1), 745-752.
[19]Tang, Y., Chen, M., 2022, The impact of agricultural digitization on the high-quality development of agriculture: an empirical test based on provincial panel data, Land 2022, 11*(*12), 2152; https://doi.org/10.3390/land11122152
[20]Varma, A., Nath, A.S., Regikumar, V., 2012, An agricultural resources optimization model, IEEE India Conf. INDICON 2012, pp. 1278–1283.
[21]Zaród, J., 2018, The usage of optimization models in farm management. In 8th International Conference On Management, pg. 688-693.