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RENATA MARKS-BIELSKA ¹, JUSTYNA BIŁYJ

University of Warmia and Mazury in Olsztyn, Poland

CONDITIONS FOR INTRODUCING INNOVATION ON FARMS

Key words: farm, resources in agriculture, technical progress, innovations, barriers

ABSTRACT. Innovations are an integral element of the development of economic units, including farms. The main aim of the research was to identify and characterize the implemented innovations and methods of managing them on farms. The research was carried out on the basis of an original survey questionnaire addressed to 80 owners of farms from the Warmian-Masurian Voivodeship. The research was carried out between June and November 2020. Research results have shown that innovations in agriculture are implemented mainly for economic reasons. Important reasons for these activities are the desire to achieve higher income, farm development, increase in efficiency and decrease in labor intensity. The most frequently indicated external barriers when trying to implement innovations were difficulties in obtaining the necessary funds, and internal ones: fear of failure and insufficient level of own funds. After implementing the innovation, farmers observed an increase in production capacity and a decrease in labor intensity. Thanks to innovations, many respondents were able to expand the area of their operations and influence the development of their farms.

¹ Corresponding author: renatam@uwm.edu.pl

INTRODUCTION

In the literature, you can find many definitions of the concept of innovation, which are united by the idea of newness. The classic definition is that proposed by Joseph Schumpeter [1960], according to which innovation is associated with, among others, the creation of a new product, the implementation of a production method that has not been used before, the finding of other sources of previously used raw materials, the opening of newly discovered product markets and a change in the organization.

The definition of innovation is often reduced to introducing new or significantly improved products to the market or finding better ways (thanks to new or significantly improved processes and methods) of introducing products to the market [OECD 2015, Central Statistical Office 2020]. According to the Oslo Manual [GUS 2020], there are four types of innovation: product, process, marketing and organizational.

The expected effect of innovation is a diametrical change in the market situation, allowing the entity that implemented the innovation to gain a periodic competitive advantage [D'Aveni 2010]. The constantly growing complexity and dynamics of occurring phenomena influence changes in the nature of innovative processes. There are five generations of models of these processes known in the theory of innovation. In linear approaches (1950s and 1960s), the great importance of scientific achievements was emphasized, especially R&D activities (1st generation – science-driven model) and market needs (2nd generation – market-driven model – 1960s and 1970s, 20th century). The coupled model was characteristic of the early 1970s and 1980s (third generation). The next one is an integrated model (4th generation), parallel model (1980s and 1990s). At the end of the 1990s, the fifth generation concept pointed to network connections between institutions participating in the processes of creating innovations and the systemic nature of these processes (integrated, network model) [O'Sullivan, Dooley 2009].

Everett Rogers [2003] defined innovation as an idea, practice or project that is perceived as new by an individual or other entity willing to implement this novelty. According to the cited author's innovation diffusion model, the rejection or adoption of an innovation by market entities depends on:

- 1) the relative convenience of the innovation (it is expected that it will ensure an increase in socio-economic efficiency and will be more convenient than current solutions);
- 2) compatibility (an incompatible innovation is irrelevant and incomprehensible and, consequently, will be rejected, but if it is consistent with existing norms, values and experiences, it has a chance of being disseminated);
- 3) comprehensiveness (determined by the degree of difficulty in understanding, adopting and applying the new solution);

- 4) divisibility (possibility of gradually introducing or adopting innovative solutions);
- 5) accessibility (the nature and process of using the innovation is understandable and easy to present).

Innovations play a special role in the agricultural industry. The path of its development through innovation (increase in technical progress) and increasing the productivity of resources (induced innovation model [Hayami, Ruttan 1971]) leads through the constant implementation of technical progress as an adaptive process and a method of overcoming the growth barrier resulting from the limited resources. Technical progress can be generated by innovative farmers with a relatively high level of education, research and advisory institutions working for the needs of agriculture, and companies producing means of production for agriculture [Wilkin 1996, Marks-Bielska 2010, Babuchowska 2021, Babuchowska, Marks-Bielska 2021].

The use of modern solutions is an inherent element of the development of agricultural farms. Innovation management in agriculture focuses on improving the competitiveness of farms on the market and increasing the level of production efficiency. Additionally, it must take into account the optimization of costs incurred during a given process, the lack of negative impact on the natural environment and ensuring biodiversity. Innovations on farms focus primarily on the purchase of new agricultural equipment and machines, the use of more effective plant varieties, adapting plant protection measures to the prevailing conditions and appropriate management of water consumption [Marks-Bielska et al. 2017]. Additionally, innovative solutions are often used in animal production, including: when implementing precision feeding or selecting appropriate animal breeds for specific conditions.

In the literature on innovation, the issue of the ability of agricultural enterprises (farms) to independently introduce innovations is relatively rarely discussed (in relation to enterprises from other industries) [e.g. Läßle et al. 2015, Alarcón, Sánchez 2016, Babuchowska 2021, Babuchowska, Marks-Bielska 2021, Bjerke, Johansson 2022]. Agricultural enterprises are most often described as entities implementing innovations, not as their creators. According to the still dominant view, the agricultural sector belongs to a separate case of general theories of innovation. Traditional innovation literature describes agriculture as a sector with limited opportunities to generate innovations [Bjerke, Johansson 2022].

The outlined research problem and the identification of the research gap in this area contributed to the preparation and conduct of the research. An attempt was made to identify innovative activities undertaken by farmers on farms.

RESEARCH MATERIAL AND METHODOLOGY

The main aim of the research was to identify and characterize the implemented innovations and methods of managing them on farms. While achieving the aim, it was necessary, among others, to: presenting examples of innovations implemented by farm managers and their sources of financing, as well as identifying the main barriers that occurred when trying to implement innovations.

In order to analyse the level of innovation on farms, the following research questions were asked:

1. What are the most frequently used methods of financing implemented innovations and what methods of managing them are most often used?
2. What barriers do farmers encounter when implementing innovations on farms?

The research was carried out from June to November 2020. The subjective scope of the research included people owning agricultural farms, and the territorial scope – the Warmian -Masurian Voivodeship. The research was conducted using the diagnostic survey method, observational-comparative method, and literature analysis and criticism.

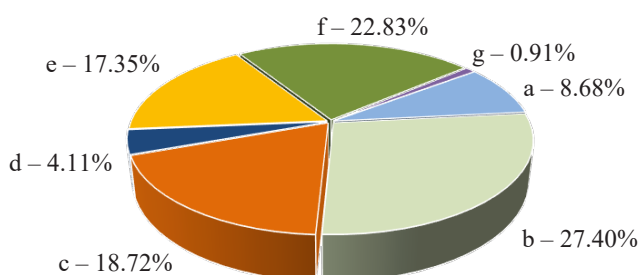
To achieve the main goal and collect primary data, a survey technique was used, and an original survey questionnaire was used as a research tool, consisting of 25 closed questions (single and multiple choice) and semi-open questions, as well as details. The survey was conducted in 2020 among 80 people who own a farm in the Warmian-Masurian Voivodeship. Farmers were selected for the study on the basis of information obtained during previous research on the agricultural land market [Marks-Bielska 2020]. Some of the studies (over 60%) were carried out using the CATI method, by making personal visits to farms. The remaining part of the survey was conducted using the CAWI method, by placing the questionnaire on internet forums bringing together farmers from the Warmian-Masurian Voivodeship.

MANAGING INNOVATION ON FARMS IN THE LIGHT OF RESEARCH RESULTS

Men constituted 71.25% of the study group. The largest number of respondents were aged 26-35 (24 people), then 46-55 (20 people), 36-45 (16 people), 18-25 (14 people). The number of people over 56 years of age was relatively small (6 people). The largest percentage of respondents (28.75%) were people with secondary agricultural education, followed by higher non-agricultural education (26.25%), higher agricultural education (21.25%), secondary non-agricultural education (11.25%) and 6.25% of respondents declared agricultural and non-agricultural vocational education. Respondents most often ran farms with an area of up to 25 ha (48.75%) and between 25 and 50 ha (25%), followed by farms above 100 ha (12.50 ha), 76-100 ha (8.75%) and 56-75 ha (5%).

The income achieved by farms depends on many factors. These include, among others: the economic situation of a given country, the European Union, the general situation of the agricultural industry [Babuchowska, Marks-Bielska 2021]. The type of production carried out on a given farm, which respondents were asked about in the survey questionnaire, is also important. The surveyed farmers mainly produced industrial plants and raised dairy and beef cattle.

Respondents were asked to indicate the factors that, in their opinion, are related to the introduction of innovations. The factors most frequently indicated by respondents were: increase in labor productivity (27.40%), opportunity for farm development (22.83%) and increase in production on the farm (18.72%) (Figure 1).



The respondent could select more than one answer

Legend: a – large financial outlays, b – increase in farm productivity, c – increase in farm production, d – uncertainties and risks, e – increase in farm profits, f – chance for farm development, g – project impossible to implement, h – other

Figure 1. Factors related to the introduction of innovation according to the respondents' opinions

Source: own study based on conducted research

Based on the results obtained, it can be concluded that for a large part of the respondents, innovations implemented on farms are associated with improving the farm's capabilities and increasing its competitiveness on the market. Additionally, innovative activities enable an increase in production, which may result in higher income on a given farm.

The survey asked whether respondents had introduced innovations on their farms in the last 5 years. More than half of them (51.25%) indicated that they had implemented innovative solutions and provided examples of them. Farmers most often mentioned the purchase of new production machines (27 indications), such as combines, tractors, plows, seeders and GPS devices that facilitate work over a large area. Additionally, the respondents also mentioned the construction of new or expansion of existing agricultural buildings (18 indications), the purchase and installation of solar panels, which enable reducing electricity bills and reducing the negative impact on the environment (14 indications),

the use of new varieties of plants and fertilizers (12 indications each), purchase of new equipment that reduces the level of labor consumption during milking cows (10 indications) and purchase of new, more efficient breeds of beef cattle (8 indications) and dairy cattle (6 indications).

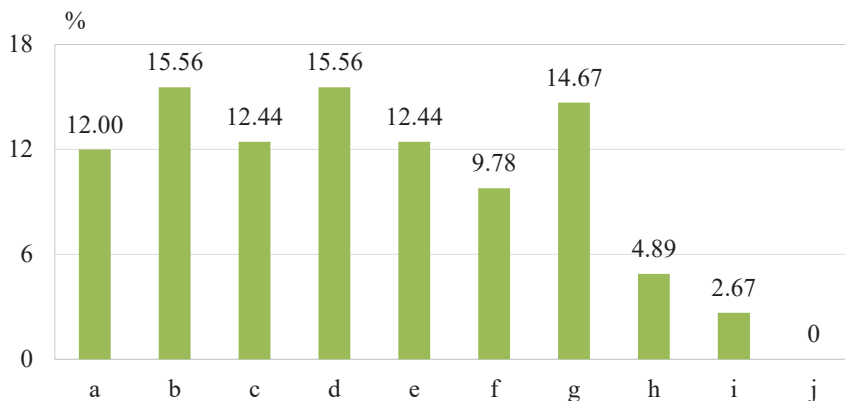
The research results confirm the views existing in the literature on the subject, supported by the results of conducted research [e.g.: Wilkin 1996, Hayami, Ruttan 1971, Marks-Bielska 2010, Babuchowska 2021, Babuchowska, Marks-Bielska 2021] that introducing innovations on farms is of a special nature, because most of them are not solutions created independently. The results of scientific research conducted throughout Poland by Karolina Babuchowska [2021], among 1.047 milk producers, showed that less than 1/4 respondents introduced changes to their farms, the originators of which were the farmers themselves.

In the research, the results of which were presented in the study, the questionnaire also asked about the planned implementation of innovative solutions in the next few years. About 60% of respondents indicated that they planned to use innovations on their farm, mainly in order to further develop it and improve efficiency and reduce labor intensity. Approximately 12% of respondents do not plan to implement innovative solutions because they base their agricultural production on current possibilities or they have already implemented innovative solutions over the last few years and currently do not plan any more, and 28% of respondents were unable to determine their plans for implementing innovative solutions on farms.

In order to examine farmers' motivation to implement innovative solutions, respondents were asked to indicate the reasons for using such solutions. The percentage of reasons given for implementing innovations on respondents' farms was quite evenly distributed. The three main reasons indicated by the respondents were: the desire to increase income, reduce labor intensity and farm development (Figure 2).

In the agricultural industry, a tendency can be observed that the most competitive on the market are large and high-income farms. It is therefore important to implement new innovative solutions in order to achieve higher yields without increasing the farm area, keeping in mind the ecological pillar of sustainable development, or to reduce the level of labor intensity [Marks-Bielska et al. 2017]. Farmers who decide to enlarge their farm often purchase new machines that enable them to handle the entire production without the need to hire new employees.

The most frequently implemented innovation in the surveyed farms was the purchase of new machinery and equipment, because almost 31% of respondents indicated this answer. Another type of implemented innovation, chosen by the respondents, was the use of new methods of organization on a farm. An example of such solutions may be, for example, improving the ways in which agricultural produce is stored on a given farm. Additionally, a large group of respondents indicated that frequent innovations on farms are new protection products and plant varieties (Figure 3).

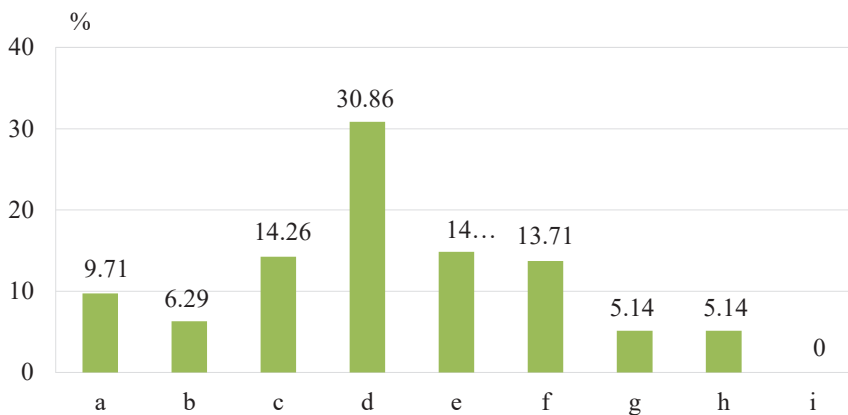


The respondent could select more than one answer

Legend: a – willingness to introduce more effective solutions, b – desire to increase farm income, c – desire to reduce farm costs, d – desire to reduce labor intensity, e – increase in production efficiency, f – increase in efficiency, g – farm development, h – the need to meet the imposed requirements, i – reducing the negative impact on the environment, j – other

Figure 2. Main reasons for introducing innovations in the farms of the respondents

Source: own study based on conducted research



The respondent could select more than one answer

Legend: a – new products, b – new directions of production, c – new ways of organization in a farm, d – new machines and devices, e – new plant protection products, f – new plant varieties, g – new breeds of animals, h – new information technologies in management, i – other

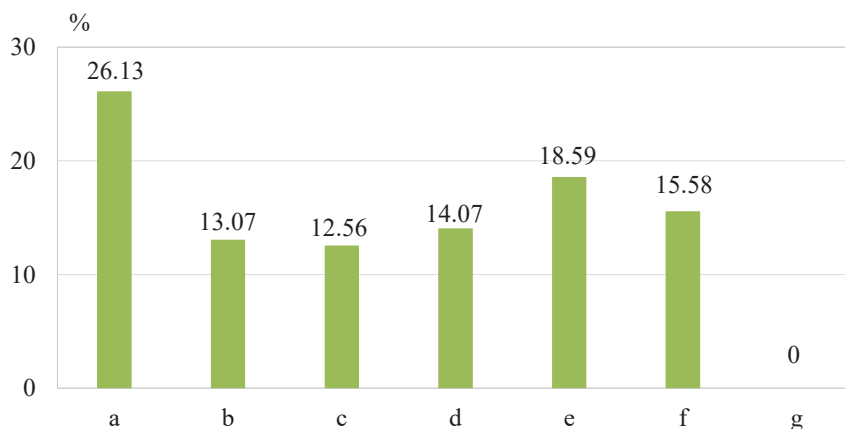
Figure 3. Types of implemented innovations on farms

Source: own study based on conducted research

Based on the results obtained, it can be concluded that farmers strive to improve the quality of their crops, protect them against unpredictable weather conditions and improve the organization of their farms. One of the organizational innovations is, for example, changing the layout of agricultural rooms, which contributes to more effective and efficient work.

Agricultural producers managing farms most often look for information regarding innovations via mass media, e.g. on the Internet and on television (Figure 4). This type of sources is very popular mainly due to its high availability. Additionally, via the Internet, farmers can not only obtain information about possible types of innovations, but also check opinions on given solutions and share experiences regarding a given innovation with other farmers. Research on innovations in groups of agricultural producers and groups/organizations of fruit and vegetable producers by Krystyna Krzyżanowska [2016] also showed that the Internet was the most important source of information about innovations, followed by the press and participation in professional development. As Everett Rogers [2003] pointed out, the ability to use the Internet has accelerated the process of innovation diffusion. Moreover, the Internet is changing the very nature of the diffusion of innovations, reducing the importance of physical distance between people.

Due to the implementation of innovations in agriculture, advisors and sales representatives are very popular, whose knowledge was used by approximately 1/3 of the



The respondent could select more than one answer

Legend: a – mass media (internet, television), b – work, magazines, c – family, neighbors, d – self-knowledge, e – advisers, f – sellers, sales representatives, g – other

Figure 4. Sources used by respondents when searching for information on the possibility of introducing innovative solutions on the farm

Source: own study based on con

respondents. Farm owners often ask for the opinion of advisors, especially in the case of innovations involving high financial outlays. Sellers and sales representatives share their knowledge regarding innovations related to new plant varieties or fertilizers. New products in this area appear on the market very often, so a sales representative can be very helpful to a farmer who wants to increase the quality and quantity of crops.

The analyses of Stefania Olszewska-Kuźniarska [2009] show that the needs and expectations of clients who use consulting in a modern system of advisory services reflect very diverse problems, often going beyond the scope of issues directly related to agricultural production. The author emphasized that advisory services will be a response to demand, not supply, and farmers will use the services of those institutions that will best meet their needs.

Many authors [e.g. Klerkx et al. 2009, Cofre-Bravo et al. 2019, Sweden Food Arena 2021] are convinced that advisors in the field of innovative solutions in agriculture must be very carefully prepared for work (have extensive knowledge, skills and competences) for the innovation implementation process to be successful. Lina Bjerke and Sara Johansson [2022] pointed out that the enablers of innovation, in many respects, do not differ between agriculture and other sectors. There is a lack of understanding of the specific conditions related to agricultural production.

In the next part of the survey, respondents were asked to indicate the sources of financial resources that enabled them to implement innovative solutions on farms, 50.41% of respondents financed innovations on farms with their own capital. Most often, these innovations concerned the use of new varieties of plants, fertilizers, methods of organization or inexpensive machines and devices.

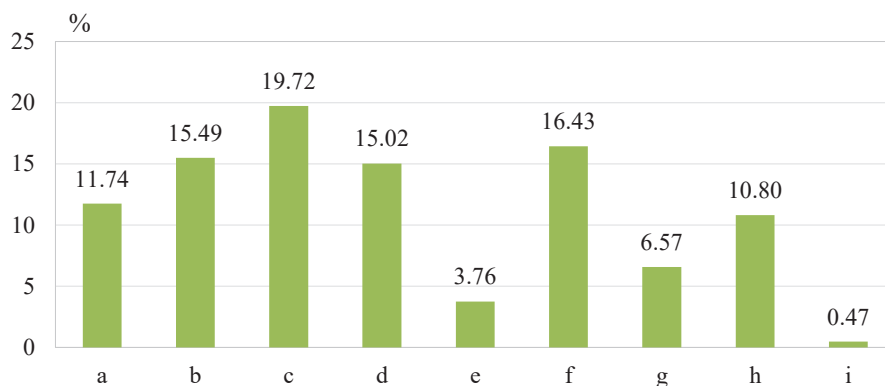
As many as 31.71% respondents indicated that high-cost innovations, e.g. building a new barn or purchasing an expensive machine, required taking out a bank loan, 6.5% of responses concerned funds borrowed from family or friends, and 5.69% – leasing as a source of financing. Also 5.69% of respondents' indications concerned other sources, including: subsidies from government agencies and from the European Union budget.

The prepared survey questionnaire also included questions about financial support from Polish government agencies and assistance provided to farmers from the European Union budget, 46.25% of respondents indicated that they applied for funding from Polish government agencies for the innovative activities of their own agricultural farm, of which 78.75% of people managed to obtain the funding. For many farmers, funds from government agencies were an opportunity to develop their farm, expand its area and purchase new machinery and equipment to facilitate work. Funding from the European Union budget had a similar application. 46.25% of respondents applied for funding for innovative activities on their farm. 89.79% of respondents who applied for them managed to obtain EU subsidies.

When characterizing the number and type of innovations implemented by farmers, special attention should be paid to factors that discourage or prevent the use of given solutions on farms. There are two types of barriers hindering the implementation of innovations in agriculture: external and internal. In the prepared survey questionnaire, respondents were asked to indicate key external barriers that occur during the process of creating innovation.

The largest group of respondents (approximately 20%) indicated the high costs of implementing innovations as a key external barrier. Innovations in the agricultural industry, especially the purchase of new machines and equipment, are often characterized by the need to incur high financial outlays. Additionally, in order to apply innovative solutions on their farms, farmers are forced to take out a loan or submit an application for funding. Excessive requirements related to obtaining funds were also indicated by respondents as one of the key external barriers occurring during the implementation of innovations.

About 15% of respondents believed that the level of support for innovative solutions from the government is too low and this makes it difficult to implement innovations on farms. Additionally, the government determines the level of subsidies for farmers and the amount of subsidies that could support investments in the agricultural industry. Government decisions also affect legal regulations regarding agricultural activities, which, according to approximately 15% of respondents, change too frequently (Figure 5).



The respondent could select more than one answer

Legend: a – low level of advisory support for farmers, b – low level of government support for innovative solutions, c – high costs of implementing innovations, d – too frequent changes in legal regulations concerning agricultural activity, e – too high tax burden, f – too high requirements related to obtaining funds, g – too high interest rates on loans, h – long time associated with obtaining funds, i – other

Figure 5. Significant external barriers when trying to implement innovations, indicated by the respondents

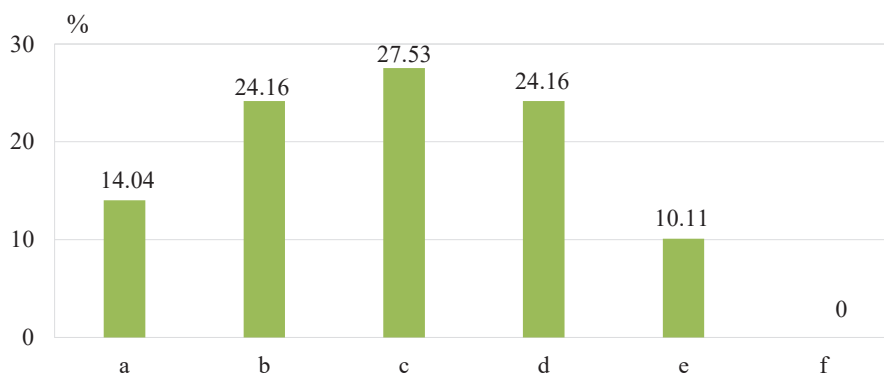
Source: own study based on conducted research

Almost 11% of respondents indicated too long a period related to obtaining the necessary funds as an important external barrier. In the case of the agricultural industry, time is very important because often farmers who want to, for example, purchase a specific machine without having the necessary financial outlays at that moment, give up implementing a specific solution, often being discouraged from using further innovations on their farms.

Another group of barriers that arise when implementing innovations are internal barriers. This is a group of factors influenced by decisions made on a given farm. In the opinion of 27.5% of respondents, the key internal barrier hindering the implementation of innovations is farmers' fear and fear of failure of the implemented innovations (Figure 6). This is significantly related to the developed external barriers, because farm owners, in order to implement innovations, often have to take out high loan amounts or finance expensive innovations with their own capital.

The high risk of failure of a given innovation, the costs of which can only be partially reimbursed, significantly affects farmers' fear of implementing it. Additionally, respondents indicated barriers such as the poor position of the farm on the market and insufficient level of own funds for innovative activities.

The research by Karolina Babuchowska [2021] shows that among the internal barriers to implementing innovations on the farms they used, farmers mentioned the lack of skills



The respondent could select more than one answer

Legend: a – lack or insufficient market information, b – poor financial position of the farm, c – fear of failure of implemented innovations, d – insufficient own funds for innovative activities, e – lack of knowledge about possible innovations, f – other

Figure 6. Significant internal barriers that occur when trying to implement innovations, indicated by the respondents

Source: own study based on conducted research

to operate modern equipment, too small acreage of land used on the farm and high costs of the changes introduced. As the cited author pointed out, both in domestic and foreign literature on the subject, the most frequently indicated barrier to the implementation of innovations are financial (cost) factors. This state of affairs is related to the fact that many innovative solutions, especially at the early stage of their diffusion, generate costs that exceed the financial capabilities of the interested entities. Despite the fact that there are many opportunities to obtain financing for innovations from external sources, the procedures necessary to obtain funds effectively discourage potential interested parties, which is also clear from the research conducted.

SUMMARY

Introducing innovations to farms is a very important element of their development and permanent adaptation to changing conditions in the immediate and distant environment. Innovations implemented by farms most often come from outside. Innovations are a factor that allows for better production results, which is very important in the context of, on the one hand, decreasing natural resources and, on the other hand, the increase in food supply.

Summarizing the conducted research, it can be stated that the surveyed farmers running farms in the Warmian-Masurian Voivodeship demonstrate a pro-innovation approach. Farmers are constantly looking for possible modern solutions to improve the quality of work on farms and their development. They willingly exchange their opinions and experiences on given solutions, which influences the modernization of the entire agricultural industry. Based on the research, it can also be concluded that it is important for agricultural institutions to conduct training and implement subsidy programs for innovative activities in order to provide assistance to farmers running agricultural farms. This results in the modernization of a given activity and the development of rural areas and improvement of the quality of life of their inhabitants.

The search for and implementation of innovative solutions by farmers requires their knowledge, skills, competences, financial resources and risk appetite. Cooperation of agricultural producers and agricultural environment institutions, including those co-financing pro-innovation activities, may contribute to the increase in the innovativeness of agricultural farms not only in the analysed voivodeship, but throughout the country. This is even more important because farmers, like entrepreneurs, operate in a turbulent socio-economic environment, and in addition, the specificity of agricultural activity (especially plant production, strongly dependent on weather conditions) means that farms/agricultural enterprises that want to survive on the market and develop should strive to focus their activities on the search and implementation of new, advanced and effective solutions.

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UWARUNKOWANIA WPROWADZANIA INNOWACJI W GOSPODARSTWACH ROLNYCH

Słowa kluczowe: gospodarstwo rolne, zasoby w rolnictwie, postęp techniczny, innowacje, bariery

ABSTRAKT. Innowacje stanowią nieodłączny element rozwoju jednostek gospodarczych, w tym gospodarstw rolnych. Głównym celem badań było wskazanie i scharakteryzowanie wdrażanych innowacji oraz sposobów zarządzania nimi w gospodarstwach rolnych. Badania zrealizowano na podstawie autorskiego kwestionariusza ankiety, skierowanego do 80 właścicieli gospodarstw rolnych z województwa warmińsko-mazurskiego. Badania zrealizowano od czerwca do listopada 2020 roku. Wyniki badań wykazały, że innowacje w rolnictwie wdrażane są głównie ze względów ekonomicznych. Istotnymi przyczynami danych działań jest chęć osiągnięcia wyższych dochodów, rozwój gospodarstwa, wzrost wydajności oraz spadek pracochłonności. Najczęściej wskazywanymi barierami zewnętrznymi podczas próby wdrożenia innowacji były trudności z uzyskaniem niezbędnych funduszy, natomiast wewnętrznymi – lęk przed niepowodzeniem i niewystarczający poziom środków własnych. Rolnicy po wdrożeniu innowacji, zaobserwowali wzrost możliwości produkcyjnych i spadek pracochłonności. Dzięki innowacjom wielu respondentów mogło powiększyć obszar prowadzonej działalności i wpłynąć na rozwój swoich gospodarstw rolnych.

AUTHORS

RENATA MARKS-BIELSKA, DR HAB. PROF.

ORCID: 0000-0001-7319-1918

University of Warmia and Mazury in Olsztyn

e-mail: renatam@uwm.edu.pl

JUSTYNA BIŁYJ, MSC

ORCID: 0009-0000-4670-9400

University of Warmia and Mazury in Olsztyn

e-mail: justyna-bilyj@wp.pl

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