STUDIA MAZOWIECKIE

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Investment and innovation: Creating the future on farms in the Ciechanów district

Innovation on farms is a requirement of the modern market. Innovative activity is extremely important in the modernisation of Polish agriculture, it is associated with the introduction of changes, the dissemination of any novelties, the improvement of existing states, in order to increase production efficiency, reduce its costs. Innovations in agricultural holdings focus mainly on the purchase of new equipment and agricultural machinery, the use of more efficient plant varieties, the adaptation of plant protection products or the selection of appropriate animal breeds to the prevailing conditions and the appropriate management of water consumption. The main objective of the research was to identify and characterise the innovations implemented and how they are managed on farms. The research tool was a survey questionnaire. A pilot survey was conducted in 2023 among 52 farm owners in the Ciechanów district. The results showed that for a large proportion of respondents, innovations implemented on farms are associated with improving the farm's capabilities and increasing its competitiveness on the market. In addition, innovative activities enable an increase in production, which can result in higher income on a given farm. The main reasons indicated by respondents for implementing innovative solutions on farms are the desire to introduce more efficient solutions, increase farm income and reduce farm costs. The most frequently implemented innovation in the surveyed farms was the purchase of new machinery and equipment. When characterising the number and type of innovations implemented by farmers, special attention had to be paid to factors that discourage or prevent the use of the solutions in question on farms. Nearly one-third of respondents indicated the high cost of implementing innovations and the low level of government support as a key external

barrier. Innovation in the agricultural sector, especially the purchase of new machinery and equipment, is often characterised by the need for high financial outlays. Innovation is a factor that allows for better production results, which is very important in the context of decreasing natural resources on the one hand and increasing food supply on the other. The surveyed farmers running farms in the Ciechanów district showed a pro-innovation approach. Farmers are constantly seeking modern solutions to enhance the quality of work on farms and their development.

Keywords: investment, innovation, farm, development

Inwestycje i innowacje. Kreowanie przyszłości w gospodarstwach rolnych w powiecie ciechanowskim

Innowacyjność w gospodarstwach rolnych jest wymogiem współczesnego rynku. Działalność innowacyjna jest niezwykle ważna w modernizacji polskiego rolnictwa, wiąże się z wprowadzaniem zmian, upowszechnianiem wszelkich nowości, doskonaleniem istniejących stanów, w celu zwiększenia efektywności produkcji, obniżenia jej kosztów. Innowacje w gospodarstwach rolnych koncentrują się głównie na zakupie nowego sprzętu i maszyn rolniczych, stosowaniu wydajniejszych odmian roślin, dostosowaniu środków ochrony roślin czy doborze odpowiednich ras zwierząt do panujących warunków oraz odpowiednim gospodarowaniu zużyciem wody. Głównym celem badań była identyfikacja i charakterystyka wdrażanych innowacji oraz sposobu zarządzania nimi w gospodarstwach rolnych. Narzędziem badawczym był kwestionariusz ankiety. Pilotażowe badanie przeprowadzono w 2023 r. wśród 52 właścicieli gospodarstw rolnych w powiecie ciechanowskim. Wyniki pokazały, że dla dużej części respondentów innowacje wdrażane w gospodarstwach rolnych wiążą się z poprawą możliwości gospodarstwa i zwiększeniem jego konkurencyjności na rynku. Ponadto działania innowacyjne umożliwiają zwiększenie produkcji, co może skutkować wyższymi dochodami w danym gospodarstwie. Główne wskazywane przez respondentów powody wdrażania innowacyjnych rozwiązań w gospodarstwach rolnych to chęć wprowadzenia bardziej efektywnych rozwiązań, zwiększenie dochodów gospodarstwa oraz obniżenie kosztów gospodarstwa. Najczęściej wdrażaną innowacją w badanych gospodarstwach był zakup nowych maszyn i urządzeń. Charakteryzując liczbę i rodzaj wdrażanych przez rolników innowacji, należało zwrócić szczególną uwagę na czynniki, które zniechęcają lub uniemożliwiają stosowanie omawianych rozwiązań w gospodarstwach rolnych. Blisko jedna trzecia respondentów jako kluczową barierę zewnętrzną wskazała wysokie koszty wdrażania innowacji oraz niski poziom wsparcia rządowego. Innowacje w sektorze rolniczym, w szczególności zakup nowych maszyn i urządzeń, często charak-

teryzują się koniecznością ponoszenia wysokich nakładów finansowych. Innowacyjność jest czynnikiem pozwalającym na osiąganie lepszych wyników produkcyjnych, co jest bardzo istotne w kontekście z jednej strony zmniejszających się zasobów naturalnych, a z drugiej zwiększającej się podaży żywności. Badani rolnicy prowadzący gospodarstwa rolne w powiecie ciechanowskim wykazali się podejściem proinnowacyjnym. Rolnicy stale poszukują możliwych nowoczesnych rozwiązań poprawiających jakość pracy w gospodarstwach i ich rozwój.

Słowa kluczowe: inwestycje, innowacje, gospodarstwo rolne, rozwój

Introduction

Today, significant changes are taking place in rural areas regarding both the type and scale of agricultural production. Investments in farm innovations have become an indispensable element of modern agriculture. These activities are of great importance for the modernisation of the agricultural sector in Poland, enabling the achievement of additional financial benefits from on-farm activities. The advancement of innovation and investment in protective farming must integrate the increasing emphasis on sustainable development, particularly in response to global environmental challenges and evolving societal demands. Recent years have witnessed significant progress in the development of technologies that fundamentally transform farm management practices. Concurrently, environmental innovation has emerged as a critical component within the strategic frameworks of agricultural production, reflecting the sector's alignment with sustainability objectives and the mitigation of ecological impacts.

Farms, as sustainable production units, not only contribute to protecting biodiversity and improving soil quality, but also respond to the growing demand for healthy food. In the context of these challenges, investments in modern technologies such as data management systems, process automation or innovative farming methods become essential.

The objective of this research was to evaluate the influence of technological innovations and investment strategies on the future development of agricultural holdings. The study analysed the extent to which the adoption of modern solutions enhances production efficiency while promoting the sustainability of farming operations. This research aimed to generate insights that contribute to shaping the future of sustainable agriculture, addressing contemporary global challenges and aligning with the principles of environmental and economic resilience.

Innovation is a very broad concept and refers to all spheres of social, economic and cultural life. This issue assumes particular importance in agriculture, where it must take into account the specific characteristics of the sector. It is primarily associated with modernisation, the introduction of changes and improvements within the entire agricultural holding, the dissemination of new organisational solutions, increasing the productivity and

efficiency of production, as well as the introduction of new plant varieties, the use of new pesticides, fertilisers[1].

Innovation plays a special role in the agricultural industry. The path of its development through innovation (increasing technical progress) and increasing resource productivity (induced innovation model[2] leads through the continuous implementation of technical progress as an adaptive process and a method of overcoming the barrier to growth resulting from resource limitation. Technical progress can be generated by innovative farmers with a relatively high level of education, research and advisory institutions working for agriculture, and enterprises producing agricultural inputs[3].

The use of modern solutions is an integral part of farm development. Innovation management in agriculture focuses on improving the competitiveness of farms on the market and increasing the level of production efficiency. In addition, it must take into account the optimisation of costs incurred during a given process, the lack of negative impact on the environment and ensuring biodiversity. Innovation on farms focuses primarily on the purchase of new agricultural equipment and machinery, the use of more efficient plant varieties, the adaptation of plant protection products to the prevailing conditions and the appropriate management of water consumption[4].

Material and methods

The main objective of the research was to identify and characterise the innovations implemented and how they are managed on farms.

A survey technique was used to realise the main objective and collect primary data, and an author's survey questionnaire, consisting of 25 closed questions (single and multiple choice), was used as a research tool. The survey was conducted in 2023 among 52 people owning a farm in the Ciechanów district. The research had a pilot character.

Discussion of the results

Analysis of the data (Fig. 1) on the level of education among farmers in different age groups shows that in the 18–25 age group, 46% of respondents had secondary education,

1 Z. Wójcicki, *Problemy modernizacji gospodarstw rolniczych*, „Problemy Inżynierii Rolniczej" 2000, no. 3, pp. 25–27.

2 Y. Hayami, R. Vernon, *Rozwój rolnictwa. An international perspective*, The Johns Hopkins Press, Baltimore, London 1971, https://www.academia.edu/23638693/Agricultural_development_An_international_perspective_Yujiro_Hayami_and_Vernon_W_Ruttan_Johns_Hopkins_University_Press_Baltimore_MD_1985_pp_512_39_50_hardcover_18_95_paperback [dostęp: 10.08.2024].

3 J. Wilkin, *Współczesna kwestia agrarna* (The contemporary agrarian question), PWN, Warszawa 1986; R. Marks-Bielska, *Rynek ziemi rolniczej w Polsce – uwarunkowania i tendencje rozwoju Agricultural land market in Poland – conditions and development trends*, Wydawnictwo UWM w Olsztynie, Olsztyn 2010; K. Babuchowska, R. Marks-Bielska, *Determinanty innowacyjności gospodarstw mlecznych w Polsce*, „European Research Studies Journal" 2021, no. XXIV(1), pp. 1223–1232.

4 R. Marks-Bielska, M. Marks, K. Babuchowska, B. Rychcik, *Wpływ postępu naukowo-technicznego na agroekosystemy*, [w:] Materiały konferencyjne. Konferencja i Wystawa Systemów Informacji Geograficznej „GIS ODYSSEY 2017", 4–8 września 2017, Trento–Vattaro, Włochy, 2017.

which is a significant percentage among younger farmers. In the 26–30 age group, this percentage decreases to 21%, which may indicate changes in educational trends or access to education in this age group. Among farmers aged 31–40, only 13% had secondary education. For farmers over 40, the percentage is only 6%, which may reflect differences in access to education in the past or other life priorities. It is interesting to note that 6% of farmers in the youngest age group (18–25 age group) had a tertiary education, which may indicate the increasing value of higher education in modern agriculture. In the 26–30 age group, 6% of farmers also had a university degree, which is in line with the observed trend. In addition, 2% of respondents aged 31–40 had primary education, and 2% of farmers in the 18–25 and over 40 age groups had vocational education. These figures may be indicative of the diversity of educational and occupational pathways in agriculture.

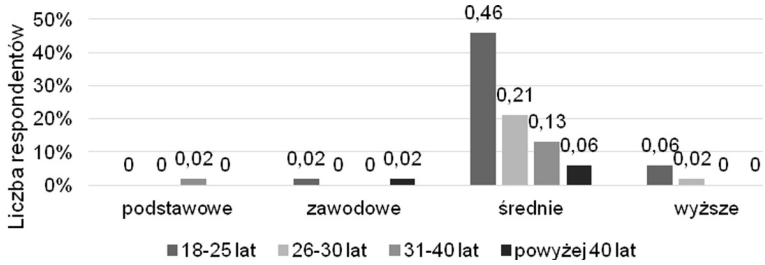

Figure 1. Age and education of respondents

Source: own study.

The most frequently indicated factors which, in the opinion of respondents, were important for implemented investments and innovations (Fig. 2) were the chance for farm development – 35%, uncertainty and risk – 19%, large financial outlays – 16%. Based on the results obtained, it can be concluded that for a large proportion of respondents, innovations implemented on farms are associated with improving the farm's capabilities and increasing its competitiveness on the market. Also important is the fact that innovative activity makes it possible to increase production, which can result in higher income on a given farm.

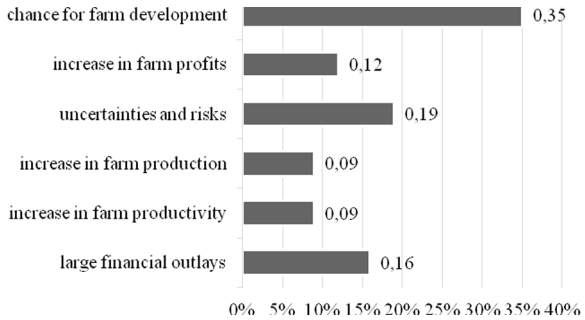

Figure 2. Factors related to the introduction of innovation according to the respondents' opinions

Source: own study.

In order to examine farmers' motivation to implement innovative solutions, respondents were asked to indicate the reasons for using such solutions, the results are presented in Figure 3. The analysis of the collected data shows that one in four respondents indicated a desire to introduce more effective solutions, one in five declared an increase in farm income and a reduction in the costs of their activities. There is a noticeable trend in the agricultural sector that large farms, which generate high income, are the most competitive on the market. Therefore, it is becoming crucial to implement modern solutions that allow higher yields to be achieved without having to increase farmland. It is also important to take into account the ecological aspects of sustainability and the reduction of labour intensity. Farm owners who decide to expand their farms often buy new machinery, which enables them to manage the entire production process without the need to employ additional staff.

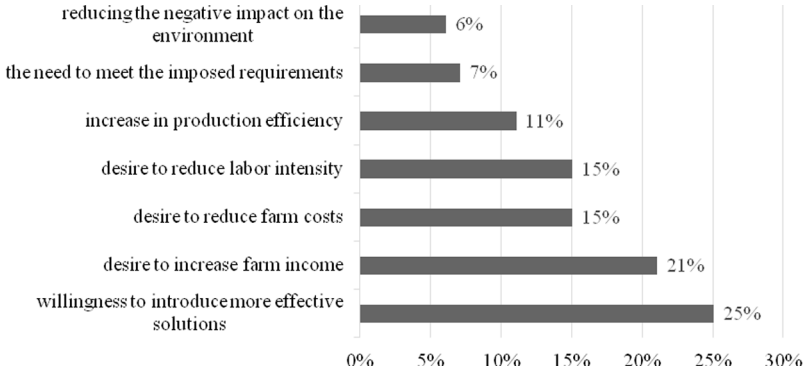

Figure 3. Main reasons for introducing innovations in the farms of the respondents

Source: own study.

Figure 4 shows the results for the most frequently implemented innovations on the surveyed farms. Nearly 35% of the surveyed farmers indicated the purchase of new machinery and equipment. In every fifth farm, new plant protection products and new plant varieties were used. Based on the results, it can be concluded that farmers in their activities aim to improve the quality of their crops, protect against unpredictable weather conditions and improve the organisation of their farms. One of the organisational innovations implemented by 9% of respondents is a new way of organisation on the farm, which contributes to more effective and efficient work.

Analysis of the data (Fig. 5) on examples of implemented innovative solutions on the surveyed farms shows that 96% of the respondents purchased new production machinery such as harvesters, tractors, ploughs, seed drills and GPS devices to facilitate work on large farms. In 44% of the surveyed farms, new or expanded existing agricultural buildings and introduced new crop varieties. Nearly 40% of farmers decided to purchase and install solar panels to reduce their electricity bills and environmental impact. Only 13% of farms purchased new equipment to reduce the labour intensity of milking cows and introduced new, more efficient breeds of beef and dairy cattle.

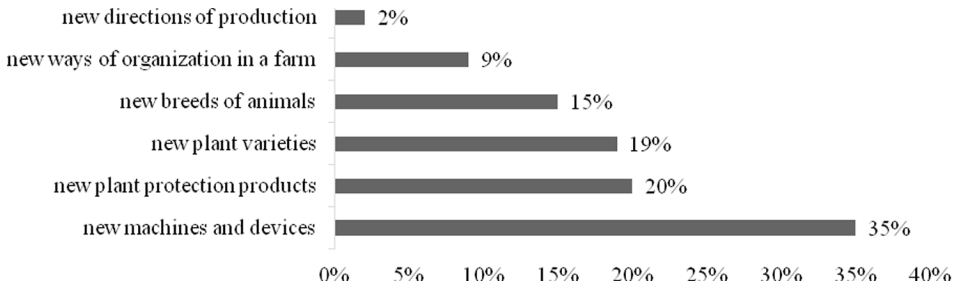

Figure 4. Types of implemented innovations on farms

Source: own study.

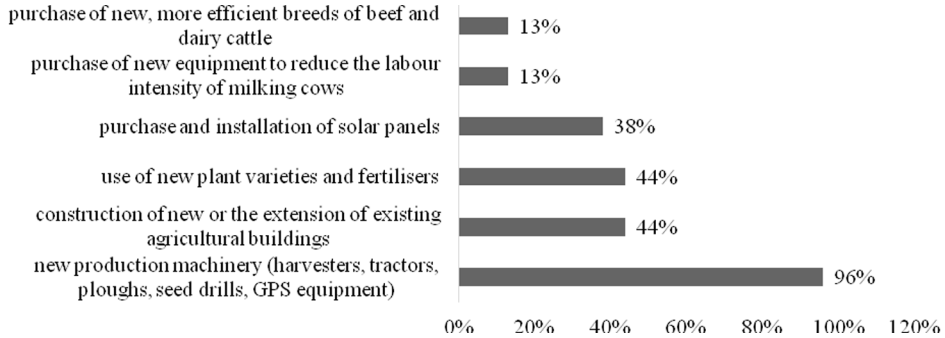

Figure 5. Examples of implemented innovative solutions on surveyed farms

Source: own study.

In characterizing the innovations adopted by farmers, it is essential to systematically examine the factors that inhibit or constrain the implementation of specific solutions within agricultural operations. The reasons for the low level of innovativeness in agriculture are the barriers inhibiting the implementation of new solutions, such as: the high average age of farmers, the low level of education of farm owners[5] and the still lack of financial resources for the implementation of innovative solutions[6]. In the prepared survey questionnaire, the respondents were asked to indicate the key external barriers occurring in the process of innovation creation, the results are presented in Figure 6. Nearly one third of the respondents indicated the high costs of innovation implementation and the low level of government support as a key external barrier. According to the opinion of farmers participating in the survey, the level of support for innovative solutions from the government is insufficient, which hinders the implementation of innovative solutions on farms. In addition, the government determines the level of subsidies for farmers and the amount of subsidies that could

[5] C.G. Gabińska, *Uwarunkowania innowacyjności obszarów wiejskich*, [w:] *Innowacyjność i przedsiębiorczość w rozwoju społeczno-gospodarczym*, Wydawnictwo Uniwersytetu w Białymstoku, Białystok 2013, pp. 47–59.

[6] T. Miś, *Proinnowacyjna rola doradztwa w rozwoju przedsiębiorczości*, [w:] A. Czudec (red.), *Innowacje jako czynnik rozwoju przedsiębiorczości na obszarach wiejskich*, Wyd. Oświatowe FOSZE, Rzeszów 2007, pp. 225–237.

contribute to greater investment in the agricultural sector. The government's decisions also influence the legal regulations for agricultural activities, which, according to about 12% of respondents, change too often. Innovation in the agricultural industry, especially the purchase of new machinery and equipment, often involves high financial outlays. In order to meet these financial requirements, farmers are forced to take out a loan or apply for a grant, which 9% of the respondents consider to be a significant barrier.

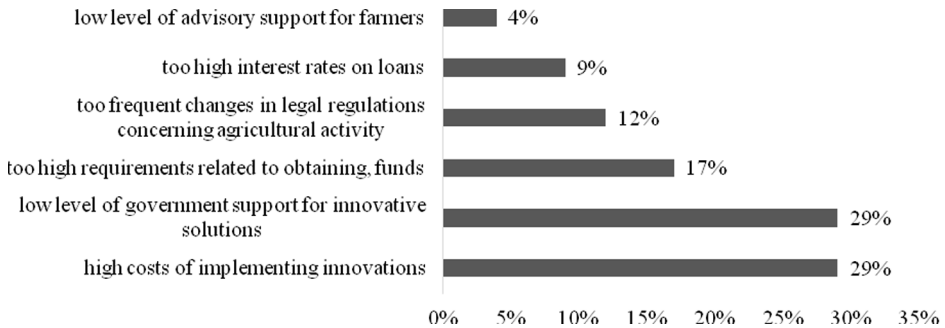

Figure 6. Significant external barriers when trying to implement innovations, indicated by the respondents

Source: own study.

Investing in and implementing innovative solutions are processes that often require decision-making, both autonomous and dependent on external factors. These decisions can be shaped by a variety of aspects, such as the availability of information, organisational structure or cooperation with other actors, which affect the efficiency and results of the actions taken.

A broad set of objectives for farms, consisting of as many as sixteen determinants of decision-making was presented in 1982. These are: maximising income, earning a satisfactory income, securing income for the future, gaining recognition for one's work, feeling a sense of belonging to the farming community, continuing family traditions, working with other family members, watching children doing important activities, feeling pride of ownership, gaining self-respect through valuable work, exercising special skills and abilities, facing challenges and achieving goals, satisfaction with fulfilling tasks, preferring a healthy lifestyle, a sense of meaningful work resulting from the value of hard work, and independence, freedom from supervision[7].

Figure 7 shows the results of the research on self-efficacy in production and investment decisions in the context of farms. Analysis of the data shows that the majority of investment decisions are made in consultation with parents – 40% or other family members – 26%, suggesting the dominance of the collective approach in this area. Only 23% of decisions are made independently by respondents, indicating a limited level of independence in the decision-making process. Additionally, in terms of investment decisions, it was noted that

[7] J.W. Cary, W.E. Holmes, *Relationships among farmers' goals and farm adjustment strategies: some empirics of a multidimensional approach*, "Australian Journal of Agricultural Economics" 1982, no. 26, p. 02.

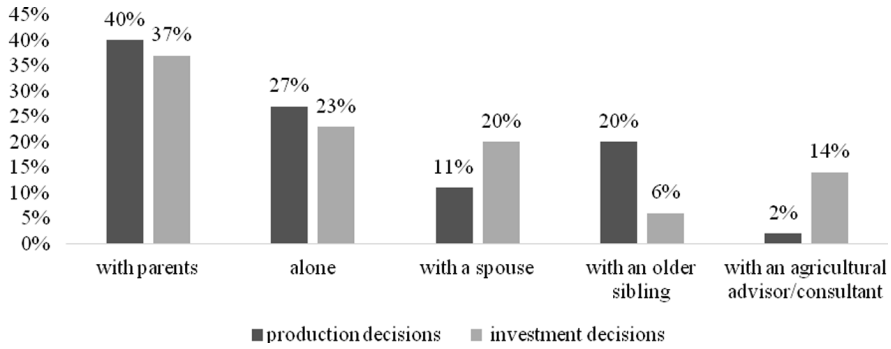

Figure 7. Production and investment decision-making on surveyed farms

Source: own study.

these are more often made in collaboration with an agricultural advisor, highlighting the importance of expert support in the process of making key economic decisions. These findings may have important implications for educational strategies and programmes to support the development of decision-making skills among young farmers.

Summary

Innovation is an indispensable factor in the development of agricultural holdings and their adaptation to ever-increasing consumer demands. Innovation is a factor allowing to achieve better production results, which is very important in the context of decreasing natural resources on the one hand and increasing food supply on the other.

The surveyed farmers running farms in the Ciechanów district show a pro-innovation approach. Young farmers show greater openness to innovation and are more likely to invest in modern technologies. Financial support programmes, such as premiums for young farmers, encourage them to invest in innovative solutions, which contributes to the modernisation of farms.

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