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THE WAY FORWARD. THINKING ABOUT RESILIENCE: HOW DO FARMERS ADAPT TO CHALLENGES AND ENSURE A BETTER FUTURE?

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Purpose: The purpose of the article is to identify the resilience capabilities of farmers from the Western Pomerania region in response to emerging economic, social and environmental challenges.
Design/methodology/approach: The research used literature studies and quantitative surveys. This study used a set of primary data obtained by direct survey using a structured survey questionnaire. The survey was conducted in 2022. This study focuses on the concept of thinking about resilience.
Findings: The subjective assessment of resilience (past, current and future) as well as its components showed that farm managers are aware of the formation of this economic and organizational category. Resilience was most frequently associated by respondents with adaptive capacity and least frequently indicated a link with transformation. It should be considered as worrying that the same percentage of farmers stated that the farm is and will be resilient to external factors. This indicates that farmers do not treat the category of resilience as a process that changes over time. Methods/techniques for strengthening resilience as one of the three dimensions mainly include those relating to the payment of current liabilities (equating current financial resilience with liquidity), long-term financial resilience, provisioning and the use of insurance (mainly crop insurance).
Research limitations/implications: The research adopted a purposive sampling method, which has its limitations.
Originality/value: The research contributes to the long-standing discussion on identifying pathways to improve the ability of agricultural actors to survive and recover from shocks in the light of the growing challenges of today's world, and to develop strategies and policies for the resilience of agriculture and related systems in the context of economic, social, and environmental challenges.

Keywords: resilience thinking, robustness, adaptation, transformation, farm.
Category of the paper: Research paper.

1. Introduction

Agriculture is part of a complex global food production system, driven by economic, social, and environmental forces beyond farmers' control. These forces are responsible for most of the events that have raised concerns about food security and the sustainability of current agricultural production systems (Gardner, Ramsden, 2019). The global pandemic, climate change, social and political conflicts and unrest, increased inflation, rising input costs and shortages of production means have recently increased uncertainty as to the profitability and future direction of agricultural production not only in Poland but also in the world. The lack of actions to mitigate the adverse effects of events in the short term, combined with the lack of actions to improve the resilience of the agricultural sector, will deepen the problems in agriculture. This will make it significantly more difficult for agriculture to provide desired public and private goods, to the detriment of society and the economy. Farms play a key role in maintaining social cohesion, producing food, providing renewable energy, providing recreational and health care services, and maintaining the cultural landscape. In the longer term, accumulating economic, social, and environmental challenges are expected to significantly disrupt agricultural activities, resulting in reduced investment, erosion of human capital through job loss, farm abandonment, lack of successors, poverty, fragmentation of global trade and links with deliveries (Soliwoda, Kurdyś-Kujawka, 2022). This situation is a major challenge that requires institutional support and action at the farm level to reduce vulnerability and build a shock-resistant agricultural sector in both the short and long term.

Agriculture needs the capacity to withstand and adapt to various shocks and disruptions. This capacity is called agricultural resilience and is defined by USAID as the ability of people, households, communities, countries and systems to mitigate, adapt to, and recover from shocks and stresses in ways that reduce chronic vulnerabilities and facilitate integration growth (USAID, 2012). Building the resilience of the agricultural sector means strengthening the ability of its components to anticipate, absorb, adapt, or recover from the effects of a hazardous event in a timely and effective manner, including by ensuring the preservation, restoration or improvement of its basic structures and functions (IPCC, 2012).

Various solutions are available to build farm resilience. Farmers can protect themselves against future threats through insurance and can obtain loans or credits to adapt to change, e.g., by purchasing appropriate production inputs for climate-smart agriculture. They could also pool resources by working more closely with other farmers. Such pooling could help access financial services, reduce costs, negotiate interest rates, aggregate product sales, etc. (Bolt, 2019).

The need to adapt agriculture to unpredictable challenges is well established in world literature, in Poland there is relatively little research that shows how challenges related to agricultural activity affect farms and how farmers adapt their farms to survive shocks and stand become resistant. This study fills this gap by presenting conclusions from research on the analysis of disruptions in agricultural activities, as well as farmers' attitudes and reactions to emerging challenges. In our study, we focus on the concept of thinking about resilience. Resilience thinking offers a comprehensive approach that can be used to interpret past and present conditions and identify possible futures for agricultural systems (Sincair et al., 2017). Resilience thinking shapes contemporary EU policy and its implementation to increase the ability to respond to crises and future challenges in all areas of human life and activity. We use resilience thinking to identify how farmers adapt to challenges and ensure a better future. The aim of our study is to identify the resilience capabilities of farmers from the Western Pomerania region in response to emerging economic, social and environmental challenges. The research questions we address in this article are:

1) What events have occurred that challenge agricultural activities and how have these challenges generated threats to the farm?
2) How did farmers perceive overall farm resilience?
3) What resilience actions were implemented by farmers in the face of the challenges?

Our research contributes to the long-standing discussion on identifying pathways to improve the ability of agricultural actors to survive and recover from shocks in the light of the growing challenges of today's world, and to develop strategies and policies for the resilience of agriculture and related systems in the context of economic, social, and environmental challenges.

2. Conceptualization of resilience

Changes, although some are intended, can also be triggered by sudden and unexpected events. The impact of such events on agricultural systems is unpredictable and may be far-reaching (Darnhofer, 2021). There can be many sources of unpredictability. Sadowski (2023) indicates, among others, sources of unpredictability of a natural nature (e.g. droughts, floods, pandemics), political (new political solutions, sanctions, wars), technological (new production methods, new energy sources), social (new market preferences, changes in behavior) or economic (changes in prices), emphasizing that this is not a closed list of possible sources of unpredictability in business activities, including agricultural ones. Agricultural systems face increasing challenges from economic, environmental, social, and institutional changes (Meuwissen et al., 2020; Olkiewicz, Wolniak, 2018). This means that the current approach to conducting agricultural activities will no longer be sufficient (Sinclair et al., 2014).

Farm managers will need to implement adaptive or transformational change if they want to secure their future (Viljoen et al., 2008; Wyszomirski, Olkiewicz, 2020; Olkiewicz, Wolniak, 2020).

The increasingly changeable conditions of running a business and functioning of societies are an important reason to explore the category of resilience (Grzelczak et al., 2023). Darnhofer (2021) states that much research on change in agricultural systems has focused on slow, predictable, controlled, planned, and managed changes, with much less attention to their ability to cope with the unexpected, cope with surprises and benefit from unpredictable events. Resilience thinking provides an alternative narrative to the conventional concept of resilience, based on the dynamics of equilibrium and the predictability of change, with the implicit understanding that change must be resisted to maintain stability (Folke, 2016). According to Linkov and Trump (2019), thinking about resilience requires considering potential future threats and developing countermeasures or safeguards to prevent long-term losses, not just immediate losses resulting from historical threats. Resilience thinking is not about mitigating and managing threats based on a snapshot in time, but about seeking flexibility in the support system, ultimately ensuring a "soft landing" and a quick return to pre-event status.

In the context of agriculture, resilience should be understood as the ability to prepare and plan for, absorb, recover from, and more successfully adapt and transform in response to adverse events (NAS, 2012). This is consistent with the definition of resilience developed by The National Academy of Sciences (NAS) and includes all relevant possible adverse events, highlights the multidimensional capabilities needed to achieve resilience, and recognizes that in the long term the system must be able to change in order to survive (OECD, 2020). Folke et al. (2021) agricultural resilience refers to coping with complexity, uncertainty and change and to continuous development in the context of constantly changing environments. Meuwissen et al. (2019) understands resilience as the ability to perform the functions of a farm (i.e., provide public and private goods) in the face of economic, social, environmental, and institutional shocks and stresses by using immune capabilities such as robustness, adaptability, and transformability. These three capabilities are essential for farm resilience (Kuntke et al., 2022)

Robustness is related to traditional risk management strategies, including preventive strategies to reduce exposure to an adverse event, mitigation strategies to reduce the potential impact of an adverse event, and coping strategies to reduce the impact of an adverse event on indirect losses following the occurrence of a risky event (OECD, 2011).

Adaptive ability allows you to adapt to undesirable situations by undergoing certain changes, but without changing internal structures (Meuwissen et al., 2019). It refers to solving current, specific problems, not on integrated solutions (Swart et al., 2023). At the farm level, adaptation involves autonomous "learning by doing" (Vermeulen et al., 2018). Adaptation measures often take the form of adjustments to the organization of production, such as shifting planting dates, adjusting crop composition, adjusting the source of labor, or reducing labor

needs through mechanization or investing in more efficient water use technologies or better seed quality (Ignaciuk, 2015).

Transformability, in turn, means the ability to significantly change internal structures in order to return to normal or improved operation (Meuwissen et al., 2019). Implementing a transformation requires effort to initiate it and then sustain that effort, often over extended periods of time (Kates et al., 2012). Transformation means moving to a new system in which a separate set of factors become important in the design and implementation of shock response activities. This is a change in which the farm adopts new basic operational assumptions, new "rules of the game", i.e., a different logic organizing resource flows and linking activities on the farm and beyond (Folke et al., 2002). In agriculture, transformational change may include large-scale adoption of technologies, business changes to exploit demand for niche or high-value-added products, reorganization of the value chain to better exploit current or future market opportunities, or even exit from agriculture (Kates et al., 2012).

The capacity for resilience will vary depending on farms, their prior preparation before the occurrence of a possible event/shock, through the use of different ex ante strategies that could strengthen some ex-post capacities. Not all farms have the same level of absorption, i.e., the ability to cope with the direct consequences of an unfavorable event, which contributes to their stability. After the shock, farms must rebuild, which in turn requires readiness and flexibility in adaptation and transformation to achieve at least the level of efficiency (productivity, income) before the shock or to achieve higher income or productivity compared to the period before the shock but overall (Sauer, Antón, 2023). This, in turn, may be determined by farmers' attitude towards changes or having sufficient resources (land, labor, capital) to introduce these changes. A graphical presentation of the resilience capacity is shown in Figure 1.

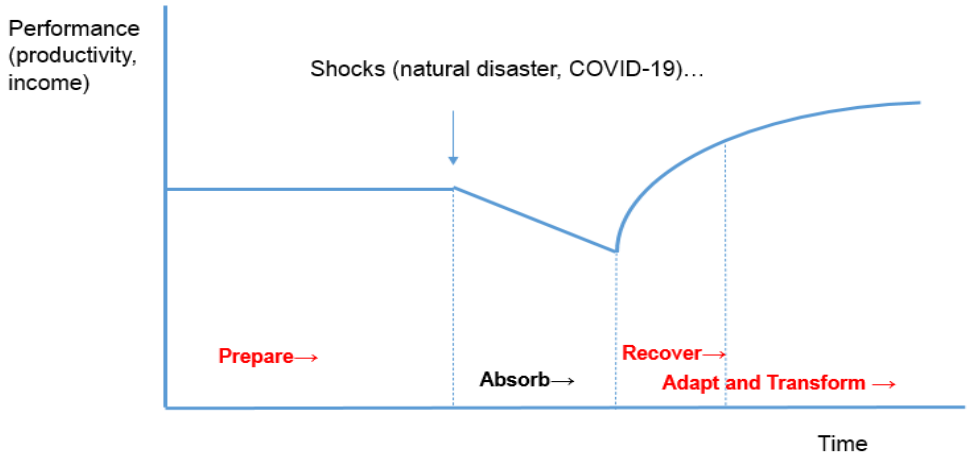

Figure 1. Resilience capacities according to impact of shock on reference performance variable. Source: Sauer, Antón, 2023.

In its most basic form, building resilience in agriculture is about maintaining agricultural productivity despite the inevitable uncertainties that exist. Agricultural resilience ensures that management actions do not push the surrounding landscape beyond its boundaries; future opportunities to produce goods or income will not be lost; and new opportunities are being created that enable manufacturers to go to market, learn, innovate, and adapt when shocks occur (CRAWL, 2023).

Resilience should be treated as a crucial factor for the success of every organization in unstable and uncertain times, allowing it to cope with various types of disruptions, from unfavorable events to major crises (McCann, Selsky, 2012).

3. Methodology

3.1. Data collection and analysis

This study used a set of primary data obtained by direct survey using a structured survey questionnaire. The survey questionnaire was built based on the literature review, including identified research gaps. 380 users of individual farms from the Western Pomerania region took part in the survey. The sample size was determined based on the assumed values: confidence level: 95.00%; maximum estimation error: 5.00%; size of general population: 25,401; fraction size: 0.5. The research was conducted in December 2022. The Western Pomerania region was selected for research deliberately due to the typically agricultural nature of the region. Agriculture in the Western Pomerania region is characterized by dominance of farms focused on market production, large farm area, the lowest percentage of people working in agriculture in the country, a high degree of mechanization and the best conditions for highly commercial production. Constant changes in the structure of farms mean that their average size exceeds 32 ha and is three times higher than the corresponding value for the entire country, even higher than the EU average. This creates the possibility of specialization, concentration of production, as well as the use of the scale effect and the generation of high incomes, as well as the dissemination of the best patterns for large-scale farms (Strategia WZP do 2030, 2019).

3.2. Characteristics of farms

In the analyzed group, the average age of users of individual farms was 49 years. The average age of farmers participating in the study was similar to the average age of a farm user in Poland (50 years), but it was much lower than the average age of an EU farmer (57 years). In terms of age, the analyzed group of farmers did not differ significantly (coefficient of variation: 17.72%). The youngest user of an individual farm was 28 years old, and the oldest was 71 years old. More than half of the farmers managed their farms on their own for 25 years

or more. It can therefore be assumed that the surveyed farmers had quite extensive experience in farm management. The average age at which they took over the farm was twenty-four. Among the users of individual farms, the majority were people with secondary/post-secondary education (45.00%) and vocational education (31.58%). Every fifth farmer surveyed had higher education. A small group were farmers with primary/lower secondary education (2.11%). Over 70% of farmers declared agricultural education. In this group, the highest percentage were farmers with secondary and vocational agricultural education.

Taking into account the agricultural space management system in the field of plant and livestock production, traditional entities based on family labor resources dominated the analyzed farms. A feature of these farms is family solidarity and simultaneous flexibility in the face of periodic crises - the family can respond to them by reducing their needs in the event of lower income (NIKiDW, 2023). 27.89% of farmers followed an agricultural model focused on intensive production using all available means to obtain the highest possible efficiency and profit maximization. 11.05% of users of individual farms used industrial means of production in a moderate way to combine high efficiency with ecology. Such a management system is referred to as integrated plant production, which is a modern food quality system that uses technical and biological progress in a sustainable manner in cultivation, plant protection and fertilization, and pays special attention to environmental protection and human health (MRiRW, 2023). Precision farming based on the use of digital techniques to monitor and optimize agricultural production processes was characteristic of 8.95% of users of individual farms. Pro-environmental farming methods and agrotechnical treatments aimed at protecting the natural environment were used by a small percentage of farmers (3.68%).

The average area of agricultural land in the analyzed farms was 59.11 ha. Most farm users operated on an area exceeding 50 ha (median). In terms of the area of agricultural land, the analyzed group was quite diversified (change rate: 69.47%). The minimum plot on which agricultural activity was conducted is 2.00 ha, and the largest is 300 ha. Farms defined as very small (1-5 ha) constituted a small group of the analyzed farms. The analyzed group was dominated by very large farms (> 50 ha) and medium-sized farms (20-50 ha). In the group of very large farms, the user of an individual farm declared an agricultural area of more than 100 ha (average 139 ha). The basic form of land ownership was private ownership. The share of leased land in the total area of agricultural land on the farm was 22.70%. The average area of leased land was 13.68 ha. In terms of the area of leased land, the analyzed group was very diverse (coefficient of variation:148.79%).

More than 40% of farmers declared that in 2021 they achieved gross revenues from sales of agricultural products and services above PLN 100,000. 12.89% of farmers declared income below PLN 50,000, and every third farmer achieved income between PLN 50,000 up to PLN 100,000. Income from agricultural activities was the main source of income for 89.47% of users of individual farms. In 41.05% of the analyzed farms, its user or a family member conducted non-agricultural activities or worked outside agriculture (Table 1).

Table 1.
Characteristics of farm resources

Specification	Category	%
Farming system	Traditional	48.42
	Conventional	27.89
	Integrated	11.05
	Precision	8.95
	Organic	3.68
Area of agricultural land (ha)	1-5	1.32
	5-15	3.95
	15-20	5.00
	20-50	42.11
	> 50	47.63
Revenues from sales of agricultural products and services in 2021 (PLN)	< 50,000	12.89
	50,000-100,000	28.68
	> 100,000	58.42
Main source of income: income from agricultural activities	Yes	89.47
	No	10.53
Non-agricultural sources of income	Yes	41.05
	No	58.95

Source: own study.

4. Results and discussion

4.1. Challenges of farms

Agricultural systems face a variety of potential short-term shocks and long-term stresses that may undermine their resilience, pose certain risks, and threaten the provision of system functions. These challenges can be differentiated according to their economic, environmental, social, or institutional dimensions (Popp, Nowacka, 2020). The surveyed users of individual farms could assess the current challenges that agricultural activities are exposed to. For this assessment, a 5-point Likert scale was used, where 1 - slight/small challenge, 5 - very serious/very big challenge. As shown in Figure 2, the greatest challenges for users of individual farms in the Western Pomerania region were primarily economic challenges, including the increase in prices of agricultural production inputs (fuels, energy, fertilizers) (average score 4.87) and high inflation (average score 4.80). The Russian invasion of Ukraine in February 2022 significantly disrupted global agricultural markets, leading to a sharp increase in prices of key agricultural products and agricultural inputs. In the first quarter of 2022, the average price of goods and services used in agriculture (excluding investment outlays) increased by 9.5% compared to the fourth quarter of 2021. The prices of artificial fertilizers and other materials used to improve soil quality increased significantly (by 21.1%), the prices of energy carriers and lubricants (by 17.4%) and the prices of animal feed (by 9.2%) (Bank.pl, 2023). This resulted in a significant increase in food prices. According to data from the Central Statistical Office, the prices of consumer goods and services in December 2022 compared to the previous year

increased by 16.6% (GUS, 2022). The increase in prices of production inputs is one of the most important challenges reported by farmers, because it has a direct impact on the costs of agricultural production and ultimately determines its profitability.

Increased prices of agricultural production inputs, high inflation, poor position of farmers in the supply chain, extreme weather phenomena, low market prices of agricultural products, limited use of chemical protection products and biodiversity protection, limited access to bank loans, limited access to labor.

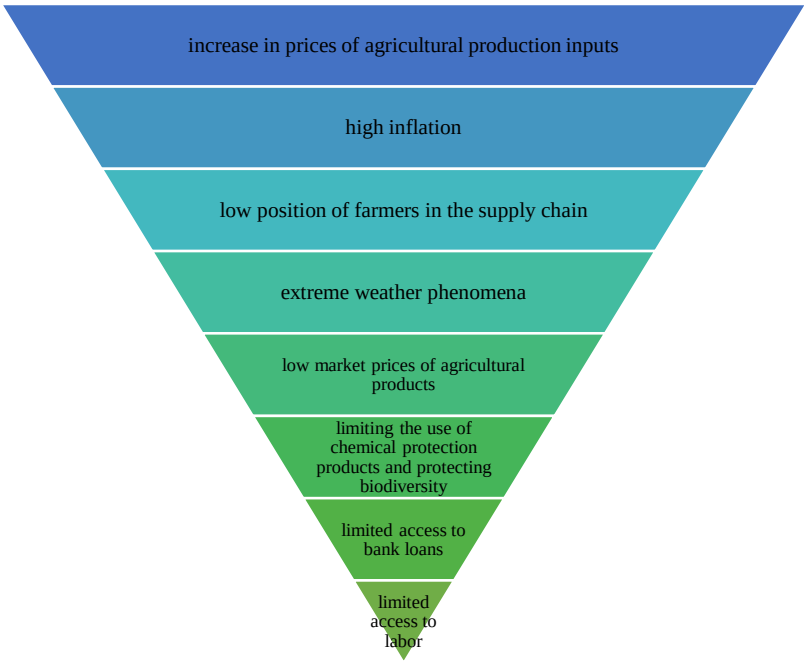

Figure 2. Challenges of farms.

Source: own study.

The low position of farmers in the supply chain was another very serious challenge for the surveyed farmers (average score 4.39), as were extreme weather phenomena (average score 4.27) and low market prices of agricultural products (average score 4.16). According to farmers, a serious challenge was the implementation of regulations under the European Green Deal limiting the use of chemical crop protection products and increasing the protection of biodiversity (average score 3.79). According to farmers, this order will contribute to a decline in yields and a lack of effective protection of production. Limited access to bank loans (lack of creditworthiness) was not considered by farmers to be a serious challenge to running agricultural activities (average score 2.86). This was mainly due to the low interest rates in that period, but also the launch of the Agricultural Guarantee Fund. The social challenge related to limited access to labor force, in the opinion of farmers, was not significant for their agricultural activities (average score 2.84). This resulted from the fact that almost half of the surveyed users of individual farms conducted traditional agriculture based on family labor resources.

4.2. Resilience of farms

Table 2 presents the characteristics of farms in terms of their current resilience, adaptive capacity, transformability, and past and future overall resilience. We based this part of the research on the concept of "subjective" resilience to allow farmers to determine the resilience of their farm based on their own experiences and perspectives. This concept has been used before in research on (Quandt, 2023; Quandt, Paderes, 2022) resistance. 95.00% of users of individual farms indicated that in the last 5 years their farm had experienced difficulties resulting from various external shocks. Despite the existing challenges, mainly of an economic and environmental (climatic) nature, over half of farmers (64.47%) believed that their farms are currently generally resilient, i.e., they have the ability to absorb all disruptions that affect the farm. This state of affairs was influenced by actions taken at the farm level in the past and actions aimed at adapting to the prevailing conditions in response to emerging challenges. As Käyhkö (2019) stated, farm-scale adaptation is often a process that emerges in response to existing challenges, rather than an intentional process. As Rammel and van den Bergh (2003) notes, the ability to cope with changing conditions and the ability to initiate new development trajectories is an indicator of adaptive capacity. Thus, in response to the emerging challenges, 82.11% of farmers took adaptive actions - they changed agricultural practices to better adapt to emerging challenges (mainly falling prices of agricultural products and the occurrence of climate threats). It can be assumed that the challenges occurring in recent years have created space for reorganization, renewal, and innovation, providing an opportunity for new ways of organizing farms, thus increasing the resilience of most of them (Milestad et al., 2012). This is confirmed by the results of our research. In the group of farmers who had made changes to their farming practices, more than half believed that the farm was now generally resistant to shocks. 8.68% of farmers introduced significant changes to their farms in response to challenges occurring over the last 5 years. In this case, the majority were also farmers from farms assessed as generally resistant to shocks. This suggests that farmers on farms that did not have general resilience to shocks were not looking for opportunities to change. Rather, they felt comfortable managing what they already knew. If farmers introduced changes, the vast majority of them were changes enabling them to adapt rather than permanent changes (transformation). This is because transformational changes are associated with larger, more radical and at the same time costly changes in the area of agricultural activity (Soliwoda, Kurdyś-Kujawska, 2022). Moreover, as shown by Wheeler and Lableya (2021) in relation to long-term business planning and farmers' approach to introducing specific significant changes, farmers are reluctant to introduce them because they are not sure that they will meet market requirements and do not know what their real economic benefits will be. Making significant changes is therefore particularly difficult and potentially very risky at the moment. Darnhofer (2014) points out that adaptive changes mean adapting to the changing context, using new technologies, access to new markets, implementing new crops, acquiring new knowledge and

skills, etc. Transformation is triggered by crises and takes place when farmers perceive their farms as dysfunctional units that are unable to ensure the desired production. This may mean that the challenges that farms have been exposed to over the last 5 years have not significantly affected their ability to continue agricultural activities.

Table 2.
Current, past, and future resilience of farms

Resistance category	Specification	Yes	No
Robustness (Current resilience)	Despite many challenges, my farm is characterized by overall resilience.	64.47%	35.53%
Adaptability	Changes have been made to agricultural practices to better adapt to uncertain conditions.	82.11%	17.89%
Transformability	Significant changes (e.g., exclusion of part of the land for non-agricultural purposes, afforestation, changes in the agricultural system) were introduced on the farm in response to various challenges.	8.68%	91.32%
Past resilience	Over the last 5 years, my farm has often experienced negative consequences of agricultural challenges.	95.00%	5.00%
Future resilience	I think that the farm will be resistant to external challenges in the next 5 years.	64.47%	35.53%

Source: own study.

Most farmers were optimistic about the future resilience of their farms. 64.47% of respondents believed that their farm would be resistant to external challenges in the next 5 years. A significant part of the group were farmers who believed that their farms were now also resilient. It can therefore be assumed that the surveyed farmers believe that over time, the conditions in which they conduct agricultural activities will not change significantly and the risk of their activities will not increase. Almost every third farmer surveyed (35.53%) showed a more pessimistic attitude towards the future resilience of the farm. The vast majority in this group (23.68%) were farmers who believed that their farms were currently not stable and resilient. Additionally, it is noted that in the group of farmers who declared the implementation of changes aimed at increasing adaptation to the changing conditions of agricultural activity, the vast majority of them believed that their farm would not be resistant to external shocks in the next 5 years. In turn, in farms where farmers introduced significant transformational changes, the vast majority believed that in the next 5 years the farm would be resistant to economic, social, and environmental challenges.

4.3. Resilience measures

Farms need a range of different measures to ensure their resilience. The possibility of mobilizing these funds will not be the same on all farms. Due to the available financial, technological, human, and physical capital, not all activities can be implemented on the same scale. Farmers from the Western Pomerania region took various actions to face the identified economic, social, and environmental challenges. Table 3 categorizes the resilience measures we identified from our interviews according to their ability to improve overall resilience, adaptability, and transformability.

Table 3.
Farm resilience measures

Robustness Measures	Adaptation Measures	Transformation Measures
- savings, - small debt, - financial liquidity, - ability to service debt, - life insurance, - crop insurance, - loans from friends/family	- new crop varieties, - crop diversification, - cost optimization, - cooperation with other farmers	- off-farm work, - allocating part of the land for commercial purposes, - non-agricultural or agricultural-related activities, - sale/lease of fixed assets

Source: own study.

The measure of the overall strength (resilience) of farms seems to be the way in which farms gain access to financial assets, create and protect them, limit their financial liabilities, and use risk transfer tools. This is tantamount to financial resilience of farms. As pointed out by Birhanu et al. (2017), financial resilience is an important dimension of overall farm resilience because access to credit, the ability to generate savings and other income-generating services are essential to mitigate the costs arising from shocks. In addition to savings, Popp and Nowacka (2020) also point to insurance. In their view, both savings and insurance seem to be the most important measures when it comes to protection against extreme weather, animal disease, liability risks, payment defaults, health problems or other unforeseen shocks. According to Jacobsen (2009), financial resilience allows you to maintain good financial condition, restore your livelihood and prevent financial shocks and failures resulting from various threats. Therefore, financial inclusion, including access to external sources of finance, taking actions to increase financial security at farm level and the use of insurance should be considered as a means to achieve overall farm resilience.

In the analyzed farms, financial liquidity, i.e., the ability to settle current liabilities, was most often indicated by farmers as a measure of the overall resilience of the farm (Figure 3). It should be noted that financial liquidity is a particularly key factor shaping the economic situation of an entity, because it is one of the basic determinants of its economic efficiency (Wędzki, 1995). In the short term, financial liquidity determines the survival of a farm. Loss of liquidity, and not the losses incurred by the entity, are the main cause of their bankruptcy (Ryś-Jurek, 2013). The ability of farms to settle current liabilities is also one of the symptoms of its financial balance. Another important measure to ensure overall farm resilience was the ability to generate savings. As proven by Wieliczko et. al. (2020), savings affect the possibility of using external sources of financing, they are an essential element of maintaining financial liquidity, but they are also considered one of the methods of protection against the risk of unfavorable events (self-insurance method). They also allow farmers to develop and make changes to their business activities. A low level of financial liabilities, and in particular not increasing existing liabilities, according to 58.16% of farmers, increases the chances of surviving shocks and is an important aspect of building resilience. A low level of financial liabilities, especially long-term ones, helps maintain financial security and reduces financial risk. Wasilewski and Mądra (2008) rightly note that the use of bank loans, especially long-term

ones, through investment processes contributes to increasing the production potential, improving labor efficiency, as well as increasing the productivity and profitability of farms. However, stronger, and better organized farms show less interest in bank loans, especially in the conditions of relatively high availability of non-repayable external funds (subsidies, subsidies) that support operational activities as well as modernization and development processes of farms (Kata, 2020). An equally high percentage of farmers indicated increasing overall resilience through crop insurance and debt servicing capacity. The ability to service debt is possible thanks to farmers generating sufficiently high gross profits from agricultural activities. Insurance, in turn, is a means of compensating for losses in agricultural activities, ensuring farmers can continue to operate. A small percentage of farmers believed that loans from friends/family were a means of strengthening their resilience. Farmers are rather focused on strengthening the resilience of their farms mainly based on generated savings and crop insurance.

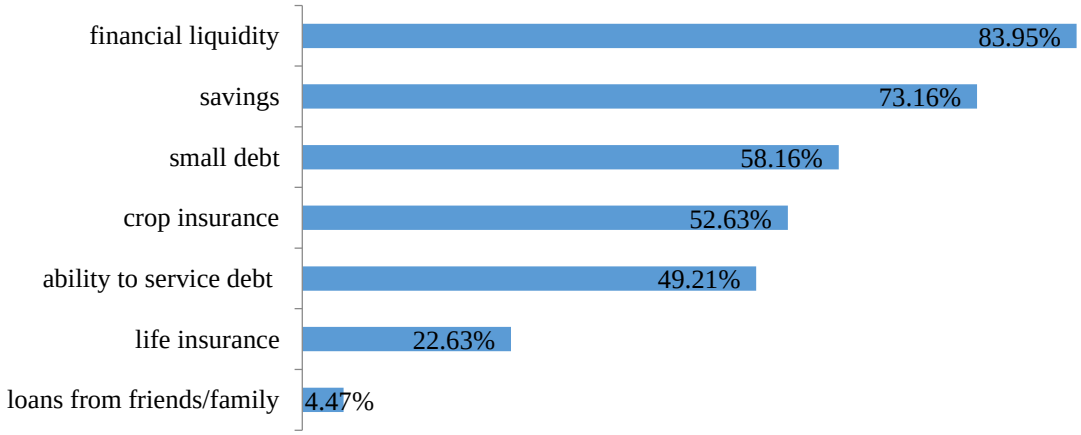

Figure 3. Robustness measures used on farms.

Source: own study.

Measures supporting adaptation include introducing changes to crops that are more profitable and/or more drought-resistant, crop diversification, cost optimization (e.g., leasing instead of purchasing, employment contracts for fixed-term workers) and cooperation with other farmers (e.g., joining to a producer group or cooperative). These are measures to build resilience through adaptation and refer to simple changes in the organization of farms. They do not require high implementation costs, only appropriate knowledge to introduce these changes. They are also not exceptionally durable (they cannot be quickly changed). However, as Leśny (2009) emphasizes, adaptation activities must be implemented in a comprehensive manner to be effective. For example, the introduction of new varieties of crops that are more tolerant to drought should coincide with the simultaneous development of irrigation systems. At the same time, detailed monitoring of the appearance of pests cannot be neglected, introducing more effective and at the same time less harmful methods of plant protection. The most frequently used adaptation measure by the surveyed farmers was crop diversification

(58.16%). This is because increased exposure to adverse risk can be mitigated by aggregating a portfolio of activities that reduces expected losses (Pironon et al., 2019). Moreover, crop diversification enables farmers to manage soil fertility, pests, and diseases, as well as the excessive costs of production inputs (Lovo, Veronesi, 2019). A high percentage of farmers have adapted to changing conditions by introducing new crop varieties that are more profitable and/or more resistant to environmental conditions. Every third farmer surveyed saw increased resilience in cooperation with other farmers (joining a producer group or cooperative), and every fourth farmer took measures to optimize costs related to agricultural activities (Figure 4).

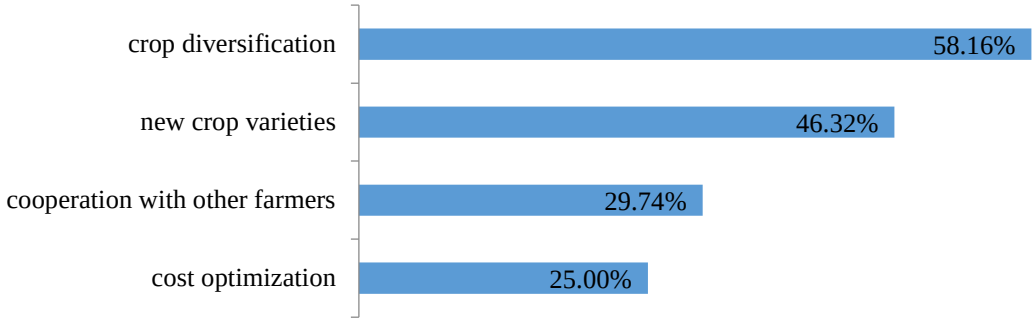

Figure 4. Adaptation measures used on farms.

Source: own study.

Transformation measures, unlike adaptation measures, are related to changes in the farm organization system, e.g., by allocating part of the land for commercial purposes (e.g., for photovoltaic panels, construction plots) or employment outside agriculture. The actions taken are mainly aimed at reducing farmers' vulnerability to threats and switching to a mode of collecting income from sources more stable than agricultural activity. In the long term, these activities may result in a reduction in the share of income from agricultural activities in the income of the farmer's family farm or a complete departure from agriculture. In the analyzed group of farmers, a small percentage of them introduced significant changes to their farm. Mainly farmers sold or leased all or part of fixed assets. 15.00% of farmers found work outside the farm, a slightly smaller percentage were farmers who took up non-agricultural activities and activities related to agriculture (processing of agricultural products, agritourism services, crafts). 12.11% of farmers allocated part of their land for commercial purposes, in particular in the form of long-term lease for photovoltaic farms (Figure 5).

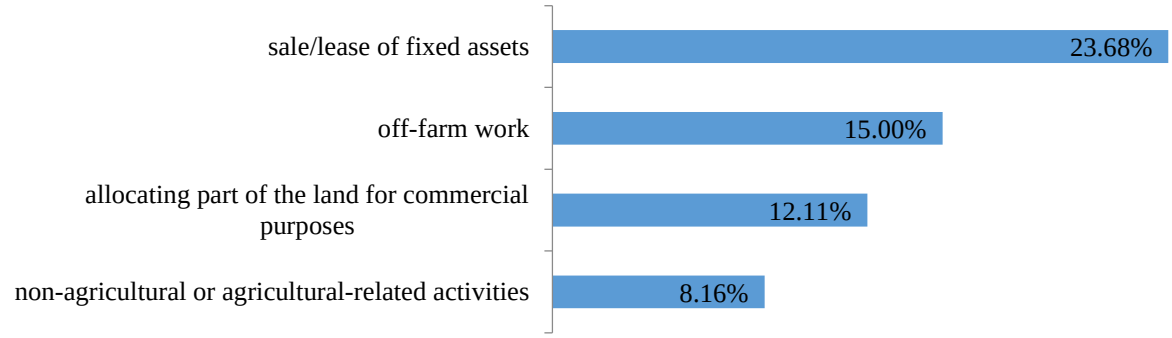

Figure 5. Transformation measures used on farms.

Source: own study.

5. Conclusion

Agriculture is an important economic sector for ensuring food security for the country's citizens. Variable macroeconomic and even geopolitical conditions indicate that agricultural production takes place under conditions of uncertainty and risk. Agriculture, like any other economic sector, needs the capacity to withstand and adapt to various shocks and disruptions, which is referred to as resilience. This is reflected in the definitions of international organisations, including the OECD, FAO or the US Agency for International Development. Farm resilience is directly referred to in one of the strategic objectives of the Common Agricultural Policy, CAP 2023-2027.

There is an acute research gap regarding empirical studies on the perception of resilience, as well as the identification of determinants of resilience and management methods/techniques that build resilience. This is particularly true for Polish agriculture.

The empirical analyses conducted empower the authors to formulate the following conclusions and recommendations:

- The subjective assessment of resilience (past, current and future) as well as its components showed that farm managers are aware of the formation of this economic and organisational category. Resilience was most frequently associated by respondents with adaptive capacity and least frequently indicated a link with transformation. This indicates the need for farmers to deepen their knowledge, e.g. through training offered by agricultural advisory centres, commercial courses or popular science articles, or postgraduate studies for those without an agricultural background.
- It should be considered as worrying that the same percentage of farmers stated that the farm is and will be resilient to external factors. This indicates that farmers do not treat the category of resilience as a process that changes over time. This may be a rationale for deepening even informal education of farmers, particularly in the area of risk management.

- Methods/techniques for strengthening resilience as one of the three dimensions include those relating to the payment of current liabilities (equating current financial resilience with liquidity), long-term financial resilience, provisioning and the use of insurance (mainly crop insurance). It is not surprising that farm financing instruments should be considered in conjunction with production insurance. It would be worthwhile to consider initiatives leading to a deeper knowledge of farmers in the financial-insurance field.
- Less than 60% of the farmers surveyed mainly used crop diversification as their dominant adaptation technique. New crop techniques were used less frequently. The use of cooperative techniques with other farmers by only 30% should be considered a worrying situation. This points to the need to improve the quality of human capital, including in terms of so-called group activities, even informal ones.
- The dissemination of the concept of short supply chains (SSCs) in agriculture can foster the deepening of various forms of cooperation. Cost optimisation skills can be improved, e.g. through various forms of informal education.
- Transformation as a component of resilience can be served by ownership transformation, including the sale/lease of fixed assets. However, it should be noted that the trade in agricultural land is not quite liquid, which is due, among other things, to the inability to treat agricultural land as collateral for bank claims. Ergo: this has contributed to the reduction of farmers' long-term credit debt (Prawo.pl, 2023; KOWR, 2023).

A limitation of the research is the selection of research sample, namely the purposive sampling of the research sample from Western Pomerania. Further research may include the use of a panel approach, which allows the exploration of resilience in a dynamic perspective, which is recommended, inter alia, in reports published by the OECD (Sauer, Antón, 2023).

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