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Economic, Social, and Environmental Factors Impacting Resilience and Disturbances of Lithuanian Family Farms

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Abstract: Climate change, changes in the natural environment, changing markets, price volatility, etc. pose tension and threats to the future of European Union farms. The uncertain future of family farms requires farm resilience—the ability to survive, adapt, and grow in the face of turbulent change. The limited resilience of family farms has become an important concern for rural and agricultural policy. The main goal of this work is to identify disturbances affecting Lithuanian family farms, assess their influence, investigate the general resilience of Lithuanian family farms, propose measures to reduce the vulnerability of farms, and increase the general resilience and sustainability. We used a combination of qualitative and quantitative research methods to conduct the research. Survey research was conducted using a semi-structured expert interview in which various types of variables were collected. The survey questionnaire, consisting of 38 groups of questions, was sent by email to 500 randomly selected family farmers in January 2024 and collected in the same month. The statistical analysis of the data from the 205 duly filled-out questionnaires was carried out using correlation analysis. In this article, we apply the concept of general resilience of the family farm in the direction of robustness, adaptability, and transformability. We identify the main factors influencing the general resilience of the family farm and study the main attributes of the resilience of family farms. We find some links between family farm characteristics, vulnerability factors, and general resilience capabilities, and we make several proposals to increase family farms' resilience. The obtained results prove that higher education, larger farm sizes, higher agricultural sales, and employment of permanent workers are associated with better resilience. Furthermore, increasing environmentally friendly practices positively impacts resilience. Older farms and farmers, longer durations of farming activity, and risk-averse behaviors tend to decrease resilience. Due to local and global circumstances, economic and social changes have occurred very quickly in recent years, so the results obtained in the study may not be valid in the long term. Similar surveys after several years will be necessary to study the resilience of Lithuanian farms, including deeper economic analyses that evaluate factors such as price sensitivity, the level of farm debt, and market access.

Keywords: family farm; resilience; disturbances; robustness; adaptability; transformability; enhancement

Citation: Kurlavičius, A.; Žukovskis, J.; Gozdowski, D.; Wójcik-Gront, E. Economic, Social, and Environmental Factors Impacting Resilience and Disturbances of Lithuanian Family Farms. *Agriculture* **2024**, *14*, 1088. https://doi.org/10.3390/agriculture14071088

Academic Editor: Youhua Chen

Received: 21 May 2024
Revised: 30 June 2024
Accepted: 4 July 2024
Published: 6 July 2024

1. Introduction

Agriculture is associated with staple food and livestock production and is essential to economic and social life. It is important to a country's economy not only because of its contribution to the total added economic value and the creation of new jobs but also due to its social and environmental aspects [1]. Both worldwide and in the European Union (EU), family farms are the largest group of food producers in terms of the number of farms [2]. Sustaining these farms is a vital aspect of rural development policy, as they play an important role in local communities, sustaining the rural economy, contributing to civic institutions, and nurturing the cultural landscape.

Farming opportunities are complicated by the challenges facing farms. In recent years, the changes taking place in the EU, including Lithuanian agriculture, have been influenced by the COVID-19 pandemic, the war in Ukraine, and, in recent decades, the rapid mechanization and automation of production. Lithuanian agriculture is strongly affected by the EU's Green Deal, turbulence in world markets, and the ban on exporting various agricultural products to the Russian Federation. Some supply chains have disintegrated, and others have reorganized and adapted, yet others are still looking for the best solution to stay on the market longer.

Various physical and anthropogenic stresses and shocks are common types of disturbances that affect agriculture [3–7]. For a farmer, such stresses as the constant pressure to keep the farm profitable, sustainable, and viable to do the necessary work on and off the farm on time and properly, to take care of family members, to cope with illness or injury, and to overcome fatigue or loneliness are normal. Prolonged or frequent rains or droughts, unstable markets, and unstable interest rates on loans can also cause stress. Reactions to these disturbances range from anxiety to despair, often accompanied by the development of chronic health conditions [8]. Family farms are sometimes hit by unexpected and sudden shocks, such as plant and animal diseases, machinery breakdowns, etc. Shocks are harder to predict than general trends [9]. The current complexity of agricultural production, including the need to ensure production quality and economic efficiency, increases the sensitivity of the family farm to disturbing events [10,11]. To overcome these increasingly complex shocks and stresses, farms must find effective ways to survive, develop, and build resilience [12,13]. Disturbances affect a farm's performance and the farmer's health and, therefore, require a response from the farmer. The farmer needs to react properly to disturbances to maintain the competitiveness and sustainability of the farm, which are not easily compatible [14]. As farmers increasingly experience the vulnerability of their farms, it is very important for them to learn to anticipate and overcome disturbances. It is also important to have a sustainable, resilient agricultural sector in the country [15,16].

One of the most widely used definitions of resilience refers to it as a system's ability to withstand or recover from various shocks, adapt its structures and social and institutional measures, and, if necessary, maintain or restore a previous development path or transition to a new sustainable path characterized by more comprehensive and productive use of physical, human, and environmental resources [17]. Resilience is associated with the ability of a system to maintain basic functions in the face of disturbances, whether they are sudden, extreme events or long-term trends. It includes adapting or transforming in response to external shocks or stresses [18,19]. Farmers need to take steps to ensure that their sustainable farms can survive, adapt, and grow in the face of turbulent change. The importance of increasing farm resilience is also emphasized in the EU's Common Agricultural Policy (CAP) [20].

Two types of resilience are distinguished in the literature: general and specific [21,22]. General resilience examines the system's ability to respond to various general challenges (e.g., locality and factors connected with locality), while specific resilience refers to the system's ability to cope with particular challenges (e.g., reserves of the farm) [23]. In many countries, research on the resilience of farms is more focused on a specific area, such as resilience to climate change, plant and animal diseases, soil erosion, etc. [24]. General resilience takes into account more uncertainties and is more difficult to estimate. We focus our attention on the general resilience of Lithuanian family farms.

Faced with disturbances and risks during the period of slow and insignificant changes in the farm environment, the farmer seeks to maintain the existing production system [25,26]. The robustness of the farm, represented by short-term responses to uncertainty, is manifested in stability and absorption of disturbances in the case of a minimal decrease in the farm's profitability. Farms more resistant to disturbances absorb shocks better and are therefore stronger. An important characteristic of farm robustness is resource utilization efficiency, which means the ability to produce sustainable production with minimal resource requirements and waste utilization.

It is important to have a reserve of farm resources to ensure a sustainable level of production that can be used as a buffer when necessary, compensating for losses or changes in the farm during and after a disruption [23]. In farms that have a large amount of redundant resources, critical farm components and relationships are duplicated. With fewer resources, there is less room for innovation. Reservation and duplication can reduce a farm's efficiency but facilitate recovery from disruptions.

A farmer's resourcefulness is related to proper management, leading to the achievement of the farm's intended goals, such as accumulating financial, technical, biophysical, and human resources necessary to ensure sustainable production and the well-being of the farm. It also includes the ability to monitor and recognize early signals of crisis as well as new opportunities and predict possible events or situations [27]. More than half of the respondents to our survey rate their resourcefulness and management skills as average and good.

General resilience refers to the robustness (representing short-term responses to uncertainty), adaptability (medium-term response), and transformability (the long-term response) of a system, regardless of the type of disturbance [11]. Darnhofer [28] emphasizes the features of general resilience, which include response and functional diversity, modularity, openness, presence of feedback, system reserves, etc. (i.e., natural, economic, and social capital). According to Paas et al. [21], general farming system characteristics related to general resilience are diversity, openness, feedback tightness, modularity, and system reserves. Both Darnhofer and Paas et al. focus on diversity, openness, and system reserves optimal use.

Resilience in the context of agriculture has received considerable academic attention in recent decades. Research has focused on the resilience of agroecosystems [29,30]. Cabell et al. [30] present a resilience index of 13 indicators (socially self-organized, ecologically self-regulated, appropriately connected, functional and response diversity, optimally redundant, spatial and temporal heterogeneity, exposed to disturbance, coupled with local natural capital, reflective and shared learning, globally autonomous and locally interdependent, honors legacy, builds human capital, and reasonably profitable) that, when identified in an agroecosystem, suggest resilience. Other studies [3,21,27,28] have examined the sustainability and resilience of farming systems.

Many studies [13,14,28,31,32] have examined farm resilience and defined directions for future research related to various aspects of resilience. All conclude that developing tools to help assess farm resilience is important. Perrin et al. [33] argued that system resilience results from the synergy of disturbance robustness, adaptability, and transformability capabilities, which are different types of resilience capacities and can be conducted in different extensions of time (from short- to long-term).

Many of the EU's current agricultural policy instruments take robustness into account. Robustness reflects the short-term ability of an economy to maintain its functions and operations despite disturbances [31]. Adaptability requires economic flexibility, including the ability to change and adjust production processes [27] and actively respond to shocks and stresses without changing the structure of the economy and feedback mechanisms, but only as long as the system remains in the current area of stability [21]. Transformability reflects the ability of the economy to reorganize its structure and feedback mechanisms and move to a qualitatively better growth path [31].

Recent studies show the fragmentation of existing farming systems and the resilience of these farming systems. They offer practical methods to assess and increase farm resilience, which is still scarce [14,28,31]. However, inferences about resilience are often made based only on apparent signs of resilience [21]. In this study, we use a more detailed survey of farmers to evaluate specific factors that affect farm resilience.

Agriculture is more vulnerable than other sectors to changing climate, weather, and infectious diseases [34,35]. Market prices for agricultural products have become even more volatile in recent years due to globalization and fluctuations in supply and demand. Today's agricultural policy is increasingly focusing on resilience. The European Commission

predicts that, despite climate and geopolitical uncertainty, rising costs, and environmental and social disturbances, stable support under the CAP Strategic Plans will strengthen the resilience and sustainability of farmers and rural areas between 2023 and 2027 [20]. As the frequency and scale of various disturbances, especially those related to climate, increase, resilience becomes a key concept in the discussion of sustainable development and the long-term viability of agricultural systems [29,36].

Resilience becomes especially important when we are faced with many environmental and social challenges. Resilience is needed to identify pathways to more sustainable systems [21,37,38]. In the literature, the concepts of resilience, vulnerability, and sustainability are very intertwined and sometimes difficult to separate [25,26,39]. Resilience is defined as the ability of a complex system to withstand external shocks, while sustainability is generally defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. To perform static assessments of sustainability and explain dynamics, it is necessary to assess both sustainability and resilience [21,25,26]. Resilience is increasingly considered a necessary prerequisite for sustainability and sustainable development [37,40].

The multidimensionality of resilience and the complexity of dynamic systems complicate its assessment. Unlike conventional risk analysis, resilience does not require precise quantification or a complete enumeration of possibilities [41]. Many efforts are being made to assess resilience using composite indicators. However, due to the irreducible complexity of farming systems, resilience assessment will always be partial and incomplete [28,42].

In this article, we apply the concept of general resilience of the family farm from short- to long-term based on the survey conducted in Lithuania. This study aims to identify the primary factors influencing the general resilience of family farms and to elucidate the key attributes of their resilience. The effect of economic, social, and environmental disturbances affecting Lithuanian family farms on overall resilience is studied based on the survey and other studies. The study's novelty is the comprehensive evaluation of factors that appeared in recent years due to the destabilization of the agricultural market caused by COVID-19 and the war in Ukraine, which affected the resilience of the farms in Central Eastern Europe.

The article presents the main results of the survey conducted among Lithuanian farmers. These results include the factors that adversely affect Lithuanian family farms' activities and attributes of the general resilience of the family farm. The results take into account various studies as well as the results of the survey.

Family Farms in the Context of Agricultural Conditions in Lithuania

A Lithuanian family farm is an agricultural entity in which family members manage and carry out agricultural activities. In this type of farm, family members often do all the main work and make the most important decisions. Lithuanian family farms do not differ from the family farm concept proposed by most other authors from different countries. The family farm is involved in various agricultural activities, including crop production, livestock production, horticulture, etc. Farm production can be used both for family needs and for sale. The family farm is often passed down from generation to generation to preserve family traditions and ensure continuity.

Lithuania has about 130,000 farms, and the vast majority are family-owned; thus, family farms play a significant role in the agricultural sector. In addition, approximately 76% of family farms engage in off-farm activities, indicating a substantial presence and involvement in diverse agricultural and economic activities [43]. This high percentage highlights the importance of family farms in sustaining rural livelihoods and their contribution to the agricultural economy.

Some specific characteristics and conditions of Lithuanian agriculture influence the activity of this sector. Lithuania has a mid-latitude continental climate type. The average annual temperature is about 6–7 °C, and the precipitation varies from 600 to 800 mm per year [44]. Fertile loam and clay soils prevail in Lithuania, which makes it suitable for the cultivation of various crops. However, there are also less fertile areas of sandy and peat

soils. Lithuanian agriculture is dominated by small- and medium-sized farms, but there are also larger commercial farms. The most important cultivated crops are cereals (wheat, barley, rye), potatoes, rapeseed, sugar beet, vegetables, and fruits. Leguminous and fodder plants are also popular in Lithuania. Dairy and meat cattle breeding, pig breeding, sheep breeding, and poultry breeding are also present in Lithuania. Milk production, in which Lithuania has deep traditions, is particularly important [45]. Lithuania has been a member of the European Union since 2004, so agriculture receives EU support and subsidies that help modernize farms and increase their competitiveness [46]. In addition to EU support, the Lithuanian state also provides various subsidies and financial support to agriculture and promotes innovation and sustainable farming. Lithuanian agriculture is dynamic and faces various disturbances, but it has great potential due to its geographical location, fertile soils, and active farming community.

2. Materials and Methods

Several scientific studies have examined Lithuanian family farms in various aspects, including economic, social, and environmental, which are mentioned and briefly reviewed in our article. These studies help us to understand the importance of family farms, including their problems and opportunities. Farm size, structure, and specialization are analyzed to understand how they affect economic efficiency [1,2]. Productivity and income trends of family farms are studied, and how various factors affect these indicators is assessed. Research shows the importance of organic farming and its impact on the environment [47]. Prior studies provided information about Lithuanian family farms and have helped develop agricultural policy measures [48]. However, the resilience of family farms, which is very important to the maintenance and development of the Lithuanian agricultural sector, has not been examined.

Seven agricultural experts from the Vytautas Magnus University (VMU) and the Farmers' Union who have experience in various fields of agriculture and are competent in the topic participated. The researchers' insights, provided in the literature review, were used to formulate the questions for the farmer survey questionnaire. A survey using a semi-structured interview was conducted in which variables were collected. The experiential and contextual knowledge obtained during the expert interviews and discussions were analyzed using a qualitative content analysis method.

A survey questionnaire consisting of 38 questions concerning the general characteristics, disturbances, viability, sustainability, and resilience of the family farms was emailed to 500 randomly selected Lithuanian family farmers. Lithuania's Chamber of Agriculture, which represents Lithuanian farmers and contains the registry of affiliated farms, helped collect information from farmers. The analysis of the questionnaire data showed that the farms participating in the survey cover the diversity of Lithuanian family farms, but farms with a larger area than the average for Lithuania predominate (Table 1).

Table 1. Percentage of farms by farm area and number of employees per farm in the study and in Lithuania.

	Lithuania in Total	**Own Survey**
Percentage of farms by farm area		
0–10 ha	70.1%	14.1%
10–30 ha	17.6%	22.4%
30–100 ha	8.0%	30.8%
Above 100 ha	4.4%	32.7%
Average number of employees per farm		
Number of permanent employees per farm (including family members)	1.71	2.74

In January 2024, 205 completed questionnaires suitable for further analysis were received. This number constitutes about 0.16% of the total number of farms in Lithuania.

This sample size has a margin error for proportions of binomial variables not greater than 7%, and the margin error for the means is not greater than 14% of the standard deviation (at a 95% confidence level). Table 2 presents the survey questions and the summary of the responses.

Table 2. Questions of the survey and the summary of the responses for each question.

No.	Response	Obtained Results
1	Farm size (ha)	≤9.99 ha: 14.1%; 10–14.99 ha: 10.2%; 15–29.99 ha: 12.2%; 30–49.99 ha: 8.3%; 50–74.99 ha: 12.7%; 75–99.99 ha: 9.8%; ≥100 ha: 32.7%
2	Agricultural production sales (EUR per year)	≤10,000 EUR: 40.5%; 10,001–15,000 EUR: 6.8%; 15,001– 25,000 EUR: 11.7%; 25,001– 50,000 EUR: 12.2%; 50,001– 100,000 EUR: 12.2%; >100,000 EUR: 16.6%
3	Number of family members working on the farm	Mean 1.75
4	Number of permanent employees (excluding family members)	Mean 0.99
5	Duration of your farming activity (years)	≤5 years: 8.8%; 5.1–10 years: 20.0%; 10.1–15 years: 16.1%; ≥15.1 years: 55.1%
6	Your age (years)	≤29 years: 7.8%; 30–49 years: 36.1%; 50–59 years: 31.2%; ≤60 years: 24.9%
7	Your education level	Primary: 2.0%; medium: 11.7%; professional (or technical): 25.9%; higher: 60.5%
8	Type of farming	Conventional: 79.5%; organic: 20.5%
9	Farm activity trends (assessed by income) 2020–2023	Increase: 20.0%; without changes: 23.9%; decrease: 56.1%
10	Did the farm profit increase in 2020–2023?	No: 59.5%; low: 27.8%; medium: 9.8%; high: 2.0%; very high: 1.0%
11	Did your farm activities become more environmentally friendly in 2020–2023, e.g., for soil?	No: 5.4%; do not know: 18.5%; yes: 76.1%
12	Did your farm activities become more environmentally friendly in 2020–2023, e.g., for water?	No: 7.8%; do not know: 26.8%; yes: 65.4%
13	Did your farm activities become more environmentally friendly in 2020–2023, e.g., for biodiversity?	No: 6.3%; do not know: 27.3%; yes: 66.3%
14	Did your farm activities become more environmentally friendly in 2020–2023, e.g., for air quality?	No: 13.7%; do not know: 40.5%; yes: 45.9%
15	Is your farm resilient to economic disruptions?	No: 68.8%; do not know: 19.0%; yes: 12.2%
16	Is your farm resilient to natural/climatic disruptions?	No: 76.1%; do not know: 11.7%; yes: 12.2%
17	Can your farm adapt to long-term stresses?	No: 34.6%; do not know: 31.7%; yes: 33.7%
18	Can your farm reorganize if necessary?	No: 31.2%; do not know: 43.4%; yes: 25.4%
19	Do you avoid taking risks?	No: 46.3%; yes: 53.7%

Table 2. *Cont.*

No.	Response	Obtained Results
20	Number of seasonal workers hired (excluding family members)	0: 75.12%; 1: 8.78%; 2; 6.83%;3: 1.46%; 4: 0.98%; 5 or more: 6.83%
	5-point scale (1—very low, 5—very high)	
21	Assess the overall impact of adverse factors on your farm (on a 5-point scale). The overall impact of adverse factors is rated from 1 to 5, where 1 indicates no impact.	Mean: 3.76
22	Assess the impact of a single factor. Factor "External disturbance" (unfavorable policies, decreasing support, large price fluctuations, high inflation);	Mean: 4.28
23	Assess the impact of a single factor. Factor "Adverse climatic factors" (frost, drought, storms, heavy rains, hail);	Mean: 3.79
24	Assess the impact of a single factor. Factor "Adverse natural factors" (deteriorating soil quality, soil erosion, plant and animal diseases, pests, and parasites);	Mean: 3.24
25	Assess the impact of a single factor. Factor "Adverse social factors" (poor social relations with suppliers, intermediaries, and buyers);	Mean: 3.15
26	Assess the impact of a single factor. Factor "Insufficient human farm resources" (labor shortages, poor knowledge and skills of farm workers, difficulty involving the younger generation);	Mean: 2.87
27	Assess your farm's overall resilience to various disruptions Possible ratings: 5-point scale: 1 (resilience is not at all characteristic of your farm); 2 (slightly characteristic); 3 (moderately characteristic); 4 (strongly characteristic); 5 (very strong	Mean: 3.21
28	Farm resilience characteristic—Reservation and duplication (the ability to keep resource reserves in reserve for use when necessary; the ability to duplicate critical elements)	Mean: 2.82
29	Farm resilience characteristic—Efficiency in resource utilization (ability to produce sustainable products with minimal resource requirements, waste utilization)	Mean: 3.09
30	Farm resilience characteristic—Cooperation and collaboration	Mean: 2.70
31	Farm resilience characteristic—Flexibility (ability to make quick decisions and adapt to changing conditions; flexibility in supply; technological flexibility)	Mean: 3.16

Table 2. *Cont.*

No.	Response	Obtained Results
32	Farm resilience characteristic—Functional diversity (variety of activities and products)	Mean: 2.86
33	Farm resilience characteristic—Biodiversity (variety of species in the farm ecosystem; landscape diversification in space and time)	Mean: 3.04
34	Farm resilience characteristic—Innovativeness (continuous pursuit of competitive and sustainable innovations and renewal)	Mean: 3.13
35	Farm resilience characteristic—Skills and knowledge-based learning (learning from past experiences and training courses; understanding received information, identifying connections, reflecting on acquired knowledge)	Mean: 3.62
36	Farm resilience characteristic—Good management skills, resourcefulness (priority setting, decision-making, planning, organizing, control; ability to recognize early crisis signals and respond accordingly)	Mean: 3.41

Farms whose agricultural activity was not the main source of family income were eliminated as non-family farms. Outliers were identified using the interquartile range (IQR). Semi-structured interviews of experts conducted in 2023 explored the factors adversely affecting family farms—particularly general resilience characteristics. Discussions with livestock specialists revealed their opinions on the importance and characteristics of farm resilience, which helped formulate the questions in the survey. The discussions were informal; that is, they took place in a free form. The focus was on 2020–2023, during which COVID-19 and the war in Ukraine strongly affected global and Lithuanian agriculture. The last survey question was open, allowing respondents to write any comments and suggestions, which were then analyzed.

Factors adversely affecting the family farms' activities are presented in Table 3. The identified factors of the general resilience characteristic of Lithuanian family farms were grouped into nine main groups and presented in Table 4.

Farm resilience depends not only on the resources available to the farm and the farm's potential but also on how the farmer perceives them [49]. Assessing perceived resilience helps us better understand farmers' decision-making processes under risk and uncertainty and explains how these decisions affect resilience. Farmers evaluated the attributes of the general resilience of their family farm on a 5-point system. Possible evaluation responses were as follows: very untypical, untypical, moderately typical, typical, and very typical. The results of the survey are presented in Tables 1 and 2.

The data present various characteristics of farms and farmers, including farm size, sales, family involvement, educational levels, and several factors assessing resilience, and adaptability. Farm sizes vary widely; the annual sales of agricultural products are recorded in euros. The number of family members working on the farm and the number of permanent non-family employees provide insight into the workforce composition. The data also include the duration of farming activities, the age of the respondents, and their educational background, which ranges from primary to higher education levels.

The type of farming and trends in farm activities from 2020 to 2023, as assessed by income, are also captured. Additionally, the data explore whether farm profits increased during this period and whether farm activities became more environmentally friendly concerning soil, water, biodiversity, and air quality. The resilience of farms to economic and natural disruptions, their ability to adapt to long-term stresses, and their capacity for reorganization are evaluated. There is also an assessment of risk-taking behavior among farmers. The number of seasonal workers hired and the overall impact of adverse factors on farms, rated on a 5-point scale, are included. The data further examines the impact of specific factors such as external disturbance (unfavorable policies, reduced support, price fluctuations, and high inflation), adverse climatic factors (frost, drought, storms, heavy rains, hail), adverse natural factors (deteriorating soil quality, soil erosion, plant and animal diseases, pests, and parasites), and adverse social factors (poor social relations with suppliers, intermediaries, and buyers). The influence of insufficient human farm resources (labor shortages, poor knowledge and skills of farm workers, and difficulty involving the younger generation) is also analyzed. Several characteristics related to farm resilience are assessed, including the ability to reserve and duplicate resources, efficiency in resource utilization, cooperation and collaboration capabilities, flexibility, functional diversity, biodiversity, innovativeness, skills- and knowledge-based learning, and management skills and resourcefulness.

Statistical analysis of the survey data was carried out using Statistica 13 to determine causal explanations and contributing factors. The correlation analysis reveals the connections between possible disturbances, farm characteristics, and resilience capabilities. Multiple linear regression was applied to evaluate the effect of multiple factors on the types of resilience. For all the analyses, the significance level was set at 0.05.

Table 3. Factors adversely affecting the family farms' activities.

A Group of Factors	Factors Adversely Affecting the Family Farm
External disturbance	- Adverse political/legislative changes - Decreasing support - Large fluctuations in the selling prices of raw materials and production - High inflation
Climate factors	- Adverse climate factors and natural disasters (frost, drought, storm, rain, hail)
Natural factors	- Deteriorating soil quality - Soil erosion - Plant and animal diseases - Pests and parasites - Water pollution
Social factors	- Poor social relations with suppliers, intermediaries and buyers of production - Poor social/cultural economic environment (poor access to educational, cultural or healthcare facilities) - Poor mutual trust in the farm
Insufficient human resources on the farm	- Lack of labor on the farm - Poor knowledge and skills of farm workers - Insufficient organizational and leadership skills - Difficult integration of the young generation - Workers' health disorders

Source: formed by [3,21,23,49].

Table 4. Attributes of general resilience of the family farm based on various studies.

Farm Resilience Attribute	Explication
Resource utilization efficiency	- The ability to produce sustainable production with minimal resource requirements; - High labor productivity on the farm - Waste utilization
Redundancy	- The ability to keep safety stocks in reserve so that they can be used in case of necessity - The ability to duplicate the most critical components and relationships
Collaboration and cooperation	- Collaboration and cooperation with other subjects to achieve mutual benefits in the context of resilience and sustainability - Improving communication to achieve fast processes and quality results
Flexibility	- Ability to make quick decisions and quickly adapt to changing conditions - Supply flexibility - Technological flexibility (application of various technical solutions, including new technologies)
Functional diversity	- Diversity of activities and production on the farm - Diversity of reactions to adverse factors - Various incomes outside the farm
Ecosystem biodiversity	- Farm ecosystem biodiversity - Diversification of different plant and crop areas in space and time
Innovativeness	- Openness to new ideas - Permanent pursuit of renewal - Implementation of competitive and sustainable innovations
Skill and Knowledge-based learning	- Skill-based learning from experience, current experiments, and learning in courses; developing procedural knowledge through practice and repetition - Deeping into information obtained by reading, listening, observing, and consulting; clarification of relationships, reflection, and use of acquired knowledge for improvement.
Resourcefulness	- Ability to monitor and recognize early crisis signals - Ability to recognize new opportunities - The ability to predict future events or situations - Knowledge sharing - Proper management of the farm to achieve the intended goals of the farm - The ability to accumulate financial, technical, biophysical, and human resources necessary to ensure sustainable production on the farm and the well-being of the family farm

Source: formed by [12,18,21,28,31].

3. Results

3.1. Socioeconomic Characteristics of the Surveyed Farms

The data collected in the survey are typical of Lithuanian agriculture and are represented by a variety of farm types. The distribution of farm production types shows a wide variety of production activities, with grains and cattle being the most common. Multiple farms engage in mixed farming activities, combining livestock and crop production to diversify their operations. The distribution of farm sizes indicates a variety of farm scales among the respondents.

Large farms (≥100 ha) were the most common category, indicating a significant number of large-scale operations. Small farms (≤9.99 ha) were the second most frequent category, showing a substantial number of small-scale farms. Mid-sized farms (10–99.99 ha) represent a diverse range of mid-sized farms. The farm size distribution reflects the diversity in farming operations, ranging from small farms to agricultural enterprises. This variety suggests that the survey respondents encompass a wide spectrum of the agricultural community.

The distribution of annual agricultural sales indicates a range of income levels among the respondents. Low sales (≤10,000 EUR) are the most common category, indicating a substantial number of farms with low annual sales. High sales (>100,000 EUR) are the second most frequent category, showing a significant number of high-income farms. Mid-range sales (10,001–100,000 EUR) spread relatively evenly across the mid-range income

brackets. This distribution suggests a diverse economic landscape among the respondents, with a mix of small-scale farms with limited income and larger farms with substantial revenue. This variety reflects the economic diversity within the agricultural sector.

Farms operated by two family members is the most common category, suggesting that many farms are run by small family units. The second most frequent category shows a significant number of farms managed by a single family member. The third most frequent category, indicating several farms supported by slightly larger family units, are farms operated by three family members.

Less common but still present are farms operated by four family members, indicating some farms have a larger family workforce. This distribution reflects the significant role of family labor in farm operations, with most farms relying on the efforts of one to three family members. Most farms do not employ non-family members or have a very small number of non-family employees. A significant number of farms do not employ any full-time non-family workers. There is a reliance on family labor in farm operations, with relatively few farms employing a large number of non-family workers.

Most respondents have significant farming experience of $\geq$15.1 years. Less common are categories with moderate experience in farming (i.e., 5.1–10 years) or farmers relatively new to farming (i.e., with a short experience of $\leq$5 years). There is a diversity in farming experience among the respondents, with a majority having considerable experience, which could contribute to their resilience and adaptability in farming operations. There is a diverse range of ages among the farmers. The largest groups are those aged 30 to 49 (74 farmers–36.1%) and those aged 50 and above (115 farmers–56.1%), showing a balanced representation of middle-aged and older farmers. The younger age group, up to 29 years, also has a notable presence, suggesting that farming continues to attract new and younger individuals. This diversity in age distribution suggests a mix of long-term experience and new perspectives within the agricultural sector. The data on seasonal workers showed that 135 farms hired none, 19 hired 2, 18 hired 1, and the rest of farms hired more than 2 workers, with a mean of 2.42 workers

Middle-aged and older farmers likely provide stability and extensive knowledge, while younger farmers bring innovation and modern techniques. Together, these groups contribute to a robust and dynamic farming community. The distribution of farming types shows that traditional farming (i.e., producing typical species of crops and livestock) is predominant, with the majority of respondents adhering to conventional methods. However, a considerable number of farms (n = 46) have adopted organic farming practices, highlighting a trend toward sustainability and ecological consciousness in the agricultural sector.

A significant number of farms experienced a decrease in activities and revenues over the 2020–2023 period. However, some farms either maintained their performance or experienced growth, indicating variability in how different farms responded to the challenges during these years. This distribution highlights the diverse impacts of external conditions on the agricultural sector. Based on the survey, most farms did not see an increase in profit from 2020 to 2023. Some farms experienced a slight increase, while a small portion reported moderate to significant increases. The agricultural sector has faced disturbances during these years, such as a large increase in the costs of fertilizers, fuel, and agricultural machinery, with only a few farms managing to achieve substantial profit growth.

Most farms made efforts to become more environmentally friendly between 2020 and 2023. Many respondents are uncertain about their impact, while a smaller portion reported no improvement in environmental friendliness. There is a positive trend toward sustainable farming practices within the agricultural community. Most farms made efforts to become more environmentally friendly toward water, biodiversity, and air quality between 2020 and 2023.

A considerable number of respondents are uncertain about the impact of their environmental efforts, while a smaller portion reported no improvement in environmental friendliness toward these goods. Most farms do not consider themselves resilient to eco-

nomic disruptions. Most respondents are uncertain about their economic resilience, climatic disruptions, the farm's adaptability to long-term stress, and the farm's ability to reorganize if needed. A smaller portion reported being resilient. The agricultural sector exhibits economic and environmental vulnerabilities, with many farms potentially facing challenges in maintaining stability during disruptions. Most respondents avoid taking risks, while a smaller portion are willing to take them, indicating a general tendency toward risk aversion.

The survey indicates that adverse factors significantly impact farms, with most ratings between 3 and 5 on a 1 to 5 scale, highlighting concerns about environmental and economic disturbances that affect agricultural operations. External disturbances such as unfavorable policies, reduced support, significant price fluctuations, and high inflation significantly affect farms, with a majority rating the impact as high or very high.

Adverse climate factors like frost, drought, storms, heavy rains, and hail also have a notable effect, with most respondents rating the impact as high or very high. Adverse natural factors such as deteriorating soil quality, soil erosion, plant and animal diseases, pests, and parasites are similarly impactful, with a majority rating the impact as moderate to high.

Social factors like poor relations with suppliers, intermediaries, and buyers also affect farms, with most respondents rating the impact as moderate to high. Insufficient human resources, including labor shortages, poor knowledge and skills among farm workers, and difficulty engaging younger generations, significantly affect farms, with a majority rating the impact as moderate to high. The overall resilience of farms to various disruptions is rated mostly as moderate to high (mean rating: 3.21), with a majority rating the resilience as moderate.

The redundancy and backup capabilities of farms, such as the ability to store resource reserves and duplicate critical elements, are rated mostly as moderate or low (mean rating: 2.82). Efficiency in resource utilization, including producing sustainable products with minimal resources and utilizing waste, is also rated mostly as moderate (mean rating: 3.09). The cooperation and collaboration capabilities of farms, such as the ability to form partnerships and work with others, are rated mostly as moderate or low (mean rating: 2.70). The flexibility of farms, including the ability to make quick decisions and adapt to changing conditions, is likewise rated as moderate (mean rating: 3.16). The functional diversity of farms, such as the variety of activities and products, is rated mostly as moderate or low (mean rating: 2.86). The biodiversity of farms, including the variety of species and landscape diversification, is rated mostly as moderate (mean rating: 3.04). The innovativeness of farms, including the pursuit of sustainable innovations and renewal, is rated mostly as moderate (mean rating: 3.13). The skills and knowledge-based learning of farms, including learning from past experiences and courses, are rated mostly as high (mean rating: 3.62). The management skills and resourcefulness of farms, such as decision-making, planning, and crisis signal recognition, are rated mostly as moderate.

The dataset highlights the diversity and complexity of farm operations, with varying levels of resilience, environmental practices, and labor utilization. The analysis underscores the importance of addressing both economic and environmental vulnerabilities to enhance the overall resilience and sustainability of farms.

3.2. Factors Affecting Farms' Resilience

We view family farms as an open system that is influenced and interacts with the environment [50]. Some disturbances arise within the farm; others are formed in entities outside the farm. The results of the literature analysis, structured interviews, and discussions with agricultural specialists and farmers revealed disturbances that could negatively affect the activities of the Lithuanian family farm, which should be taken into account when addressing the issues of assessing and increasing the general resilience of farms. After a detailed analysis, we divided the main factors that can affect the overall resilience of the family farms into five groups, presented in Table 3.

The surveyed farmers evaluated the importance of each factor on their farm using a 5-point system. Possible ratings were the factor is very important, important, moderately important, unimportant, and not important at all. The evaluation results are presented in Table 5.

Table 5. The percentage of family farms affected by adverse factors calculated based on individual factors from the survey.

	Percentage of Surveyed Family Farms Reporting Being Affected by Different Adverse Factors					
Factors	**Negligible (Very Week) Influence (1)**	**Weakly Influence (2)**	**Moderately Influence (3)**	**Strongly Influence (4)**	**Very Strong Influence (5)**	**Total**
Adverse external disturbance	0.6	4.7	12.7	26.7	55.3	100
Adverse climate factors	0.7	7.2	28.7	32.7	30.7	100
Adverse natural factors	6.8	15.3	35.3	23.3	19.3	100
Adverse social factors	9.3	20.0	30.7	22.0	18.0	100
Insufficient human resources	20.4	19.8	28.7	18.7	12.4	100

In the questionnaires, family farmers emphasized very strongly or strongly that the external disturbance due to regulations is unfavorable to them—in their opinion, decreasing support for farms and causing large fluctuations in the selling prices of raw materials and production and high inflation. The negative influence of climatic and natural factors is also felt. From the responses, we can see that the consequences of disruptive events ranged from productivity reductions, production cost increases, product delivery and cash flow delays, revenue losses, and more.

Negligible (very weak) influence is consistently low for all factors, with a peak at insufficient human resources. Weakly and moderately perceived influence show varied trends, with noticeable peaks at adverse climate factors and adverse natural factors. Strongly perceived influence is highest for adverse external disturbance and adverse climate factors. Very strong influence is highest for adverse external disturbance and significantly lower for other factors.

The heatmap of the correlation matrix (Table 6) highlights that adverse climate factors and adverse natural factors have the highest positive correlations (0.60). Adverse natural and social factors also have strong positive correlations (0.52), indicating these factors are perceived similarly. The remainder of the correlations were positive and significant but weaker.

Table 6. Correlation matrix of influence levels for factor groups based on the conducted survey. All the correlations were significant ($p < 0.05$). Darker red background color of the cells indicates stronger correlation.

	Adverse External Disturbance	**Adverse Climate Factors**	**Adverse Natural Factors**	**Adverse Social Factors**
Adverse climate factors	0.30			
Adverse natural factors	0.23	0.60		
Adverse social factors	0.26	0.34	0.52	
Insufficient human resources	0.14	0.19	0.28	0.28

Farmers are more and more interested in acquiring competencies that can help them react to disruptive events and restore a stable balance on the farm. Competencies are based on the knowledge required for the decision-making process to deal with a specific distressing event, the ability to choose the best action strategy, and the ability to choose the most appropriate moment to implement the resilience strategy.

To evaluate the effect of various socioeconomic factors related to the impact of the adverse factors, as assessed by farmers in the survey, we conducted a multiple linear regression. The results of the regression are presented as standardized coefficients of regression, together with *p*-values (Table 7). The relationships are relatively weak because coefficients of determinations are quite low. The highest effect of socioeconomic factors (R^2 = 0.107) was observed on the assessment of external factors. Significant negative effects were observed for farmer age (i.e., older farmers treated this effect as less important) and education level (i.e., farmers with a higher level of education treated external factors as less important). A significant effect was observed for the types of farming with the assessment of adverse social factors. The effect indicates that organic farms are less vulnerable to adverse social factors. Moreover, the effect of farmer age was significant on the overall impact of adverse factors. The effect was negative, which indicates that older farmers are less vulnerable to the overall impact of adverse factors. The relationships between socioeconomic factors, included in the analysis as the independent variables, were relatively weak. The only strong correlation (r = 0.74) was observed between farm size and agricultural production sales. Other variables were very weakly correlated (r $\leq$ 0.2). The Durbin–Watson statistic did not detect the presence of autocorrelation among the regression models.

Table 7. Results of the multiple regression present the relationships between socioeconomic factors as independent variables and various adverse factors. The results are the standardized regression coefficients r with *p*-values (in brackets). For each regression model, coefficients of determination (R^2) are given.

	Dependent Variable					
	Overall Impact of Adverse Factors	**External Disturbance**	**Adverse Climatic Factors**	**Adverse Natural Factors**	**Adverse Social factors**	**Insufficient Human Resources**
R^2	0.052	0.107	0.032	0.038	0.071	0.056
Independent variables	Standardized regression coefficients (*p*-values)					
Farm size	0.046 (0.687)	0.084 (0.445)	0.056 (0.623)	0.030 (0.794)	0.050 (0.653)	0.169 (0.135)
Agricultural production sales	0.078 (0.493)	−0.009 (0.936)	−0.035 (0.762)	−0.057 (0.622)	−0.131 (0.248)	−0.080 (0.480)
Number of family members working on the farm	−0.019 (0.790)	0.010 (0.891)	0.052 (0.476)	0.071 (0.330)	0.145 * (0.044)	0.107 (0.140)
Number of permanent employees (excluding family members)	0.078 (0.493)	0.086 (0.433)	0.048 (0.672)	−0.188 (0.101)	0.025 (0.822)	0.135 (0.231)
Farmer age	−0.148 * (0.041)	−0.270 * (<0.001)	0.003 (0.967)	−0.050 (0.494)	−0.091 (0.203)	−0.064 (0.371)
Education level	−0.070 (0.320)	−0.160 * (0.020)	−0.079 (0.267)	0.005 (0.946)	0.032 (0.651)	0.065 (0.358)
Type of farming	−0.004 (0.956)	0.011 (0.879)	−0.125 (0.087)	−0.110 (0.130)	−0.179 * (0.013)	0.065 (0.364)
Number of seasonal workers hired (excluding family members)	0.044 (0.684)	−0.031 (0.770)	−0.105 (0.339)	0.162 (0.142)	−0.051 (0.638)	−0.033 (0.759)

* Statistically significant relationships at significance level α = 0.05.

Table 8 presents the percentage distribution of farms according to attributes of general resistance evaluated by farmers.

Table 8. Distribution of farms according to attributes of general resistance evaluated by farmers, in percent.

Attribute	**Very Untypical (1)**	**Untypical (2)**	**Moderately Typical (3)**	**Typical (4)**	**Very Typical (5)**	**Total**
Resource utilization efficiency	10.0	15.3	44.7	19.3	10.7	100
Redundancy	12.0	25.3	40.0	14.7	8.0	100
Collaboration and cooperation	23.3	22.7	34.7	13.3	6.0	100
Flexibility	7.3	16.0	46.7	23.3	6.7	100
Functional diversity	12.0	22.0	42.7	16.7	6.6	100
Ecosystem biodiversity	11.2	15.1	40.3	19.8	13.6	100
Innovativeness	8.7	22.0	36.7	24.6	8.0	100
Skill and knowledge-based learning	2.7	6.7	37.3	36.0	17.3	100
Resourcefulness	6.7	8.7	43.3	27.3	14.0	100

The correlation matrix in Table 9 provides insights into the correlations between farms' various resilience attributes. Redundancy is moderately correlated with resource utilization efficiency (0.38) and flexibility (0.33). It has weaker correlations with other attributes, showing that redundancy primarily enhances resource efficiency and adaptability. Resource utilization efficiency is strongly correlated with flexibility (0.38) and ecosystem biodiversity (0.36), indicating that efficient resource use is closely tied to a farm's ability to adapt and maintain biodiversity. Collaboration and cooperation have a significant correlation with flexibility (0.47), suggesting that cooperative farms are more adaptable. The results also show moderate correlations with ecosystem biodiversity (0.37) and innovativeness (0.38). Flexibility is a key attribute, with high correlations across the board, especially with resourcefulness (0.58), skill- and knowledge-based learning (0.48), and innovativeness (0.52). These findings suggest that flexibility is central to overall farm resilience. Functional diversity has strong correlations with ecosystem biodiversity (0.44) and innovativeness (0.40), showing that diverse activities and products enhance biodiversity and innovative capabilities. Ecosystem biodiversity shows high correlation with skill- and knowledge-based learning (0.48) and flexibility (0.43), indicating that biodiversity benefits from adaptive and knowledge-driven practices. Innovativeness is highly correlated with skill- and knowledge-based learning (0.52) and resourcefulness (0.51), suggesting that innovative farms continuously learn and manage resources effectively. Skill- and knowledge-based learning has the highest correlation with resourcefulness (0.62), showing that learning and skill development are crucial for managing resources wisely and responding to crises. Resourcefulness is the most interconnected, with strong correlations across multiple attributes, especially skill- and knowledge-based learning (0.62) and flexibility (0.58), emphasizing the importance of resource management in farm resilience.

Table 9. Correlation matrix of various farm resilience characteristics. All the correlation were significant ($p < 0.05$). Darker red background color of the cells indicates stronger correlation.

	Redundancy	Resource Utilization Efficiency	Collaboration and Cooperation	Flexibility	Functional Diversity	Ecosystem Biodiversity	Innovativeness	Skill and Knowledge-Based Learning
Resource utilization efficiency	0.38							
Collaboration and cooperation	0.26	0.26						
Flexibility	0.33	0.38	0.47					
Functional diversity	0.29	0.36	0.35	0.37				
Ecosystem biodiversity	0.15	0.36	0.37	0.43	0.44			
Innovativeness	0.27	0.28	0.38	0.52	0.40	0.37		
Skill and knowledge-based learning	0.17	0.30	0.33	0.48	0.25	0.48	0.52	
Resourcefulness	0.30	0.34	0.42	0.58	0.23	0.36	0.51	0.62

As we can see from the results of the survey, almost half of the farmers surveyed seek to increase the strength of their farms by creating the necessary reserve stocks (machines, labor, finance), duplicating critical supply chains, and using resources efficiently.

Table 10 presents the correlation coefficients between various factors affecting farm resilience. Farm size (ha) shows positive correlations with most resilience attributes, especially with innovativeness (0.24), flexibility (0.23), and collaboration and cooperation (0.22). Negative correlations are minimal, indicating larger farms tend to have better resilience characteristics. Agricultural production sales show positive correlations with resilience attributes like innovativeness (0.24), collaboration and cooperation (0.24), and flexibility (0.23), suggesting higher sales are associated with better resilience.

Table 10. Correlation matrix of influence levels for studied farm parameters. Significant correlations are marked in red. The blue background of the cells indicates the strength of negative correlations, and the red background of the cells indicates the strength of positive correlations.

	Farm Size	Agricultural Production Sales	Number of Family Members Working on the Farm	Number of Permanent Employees (Excluding Family Members)	Duration of Farming Activity	Farmers Age	Education	Type of Farming	Number of Seasonal Workers Hired (Excluding Family Members)
Adverse external disturbance	0.07	0.08	0.05	−0.03	−0.15	−0.32	−0.13	0.00	−0.26
Adverse climate factors	0.01	0.01	0.04	−0.09	0.01	−0.02	−0.10	−0.13	−0.08
Adverse natural factors	−0.02	−0.03	0.04	−0.08	−0.06	−0.09	0.00	−0.11	−0.05
Adverse social factors	−0.06	−0.06	0.09	−0.06	−0.16	−0.12	0.04	−0.16	−0.05
Insufficient human resources	0.12	0.11	0.1	0.12	0.02	−0.08	0.09	0.09	0.14
Redundancy	0.11	0.1	0.00	0.06	−0.14	−0.13	0.06	−0.03	0.11
Resource utilization efficiency	0.07	0.06	−0.01	0.09	−0.11	−0.15	0.09	−0.08	0.19
Collaboration and cooperation	0.22	0.24	0.00	0.23	−0.08	−0.19	0.08	0.05	0.16
Flexibility	0.23	0.23	0.06	0.22	−0.19	−0.26	−0.01	0.04	0.14
Functional diversity	0.14	0.13	0.04	0.08	−0.11	−0.09	0.06	−0.01	0.14
Ecosystem biodiversity	0.12	0.08	0.01	0.16	−0.12	−0.11	0.05	0.14	0.14
Innovativeness	0.24	0.24	0.08	0.26	−0.21	−0.22	0.08	0.05	0.19
Skill and knowledge-based learning	0.19	0.17	−0.02	0.13	−0.19	−0.25	0.07	0.03	0.10
Resourcefulness	0.22	0.19	0.01	0.22	−0.20	−0.30	0.06	0.02	0.13

The number of family members working on the farm shows a weak positive correlation with most resilience attributes, the highest being collaboration and cooperation (0.08). Negative correlations are minimal, indicating a slightly positive influence on resilience. The number of permanent employees (excluding family members) displays strong positive correlations with innovativeness (0.26), collaboration and cooperation (0.23), and flexibility (0.22), indicating that having more permanent employees enhances resilience.

The duration of farming activity (years) shows a negative correlation with resilience attributes, particularly with innovativeness (–0.21) and resourcefulness (–0.20), suggesting that longer farming experience might negatively impact adaptability and innovation. Age shows consistent negative correlations with all resilience attributes, especially with resourcefulness (−0.30) and innovativeness (−0.22), indicating that older farmers may face difficulties maintaining resilience.

Education level generally shows positive, although not strong, correlations with resilience attributes. The highest correlation is with innovativeness (0.08), suggesting that higher education levels slightly enhance resilience. Farm activity trends (income) show a positive correlation with innovativeness (0.16) and flexibility (0.15), suggesting that positive income trends correlate with higher resilience. Profit increase (2020–2023) correlates positively with innovativeness (0.16) and flexibility (0.17), indicating higher profits increase resilience.

Environmentally friendly activities (soil, water, biodiversity, air quality) generally show positive correlations with resilience attributes. For example, air quality improvement is strongly correlated with resourcefulness (0.22).

Adaptability to long-term stresses shows positive correlations with resilience attributes like flexibility (0.22) and collaboration and cooperation (0.21), suggesting that adaptability enhances overall resilience. Reorganization capability is positively correlated with resilience attributes, particularly innovativeness (0.16), suggesting that the ability to reorganize enhances resilience. Risk aversion correlates negatively with most resilience attributes, particularly resourcefulness (–0.29) and flexibility (–0.20), indicating that risk-averse behavior negatively impacts resilience. Positive correlations with resilience attributes, especially innovativeness (0.19), indicate that hiring seasonal workers enhances resilience.

3.3. Summary and Inference Based on the Obtained Results

After analyzing the data, some conclusions can be made. Improvements in education, innovative practices, and better management skills are essential for building a more robust agricultural sector. There's a strong link between the age of farmers and their educational level, suggesting that older farmers might have more formal education. Farms that saw profit increases are more likely to adopt soil-friendly practices. Profitable farms tend to adopt more sustainable practices, indicating a positive relationship between financial success and environmental responsibility. Farms resilient to economic disruptions are highly adaptable to changing conditions.

Effective learning from past experiences and courses correlates strongly with good management skills. Longer farming durations are associated with more family involvement. Larger farms tend to have higher sales. Farms with a variety of activities and products are better at adapting to long-term stresses. Farms that collaborate effectively also show greater flexibility. Higher education levels are related to more environmentally friendly practices. Farms facing significant adverse factors are more resilient to natural disruptions (severe disturbances). Risk-averse farmers tend to have better management skills.

Older farmers are less likely to be flexible. Farms resilient to economic disruptions tend to hire fewer seasonal workers. High external disturbance impacts are strongly associated with lower economic resilience. Significant adverse climatic factors negatively affect natural resilience. Poor social relations correlate with lower cooperation and collaboration capabilities. Labor shortages and poor skills negatively impact resource utilization efficiency. Diverse farm activities contribute to greater resilience, highlighting the importance of functional diversity in agricultural sustainability. Farms that engage in cooperative practices are better equipped to adapt to changes, underscoring the value of collaboration in enhancing flexibility.

This analysis provides a comprehensive understanding of the relationships between various factors affecting farm resilience, performance, and sustainability, highlighting areas where improvements can be made to strengthen overall farm operations.

4. Discussion

For farmers, good relations, collaboration, and cooperation with neighbors and others are important for mutual benefit in the context of resilience and sustainability [19]. It is important for farmers to carefully choose cooperation initiatives in which they have to invest their work, time, and money [47]. The economic motives of farmers' cooperatives are very clear—lower costs, greater bargaining power, more favorable production prices, mutual assistance, sharing of knowledge, etc. According to the respondents' answers, although Lithuanian farmers cooperate, the practice of cooperation is not sufficiently developed.

Disruptive events can push the farm out of equilibrium and into a disadvantageous position. An enterprising farm accepts the inevitability of changes and tries to adapt to new conditions and requirements by changing production, risk management, and marketing; assimilating new technologies, and using state support. Adaptation is helped by the farmer's ability to learn and use experience and knowledge to modify the structure, strategy, operations, and decisions of the farm.

The key to the family farm's ability to adapt over time is flexibility, which includes fast communication, the ability to implement fast decision-making processes, the ability to quickly change technologies and suppliers if necessary, and quick learning to adapt processes to changing conditions. Flexibility is enabled by diversity. Functional diversity includes the diversity of activities, production, income streams, and marketing channels on the farm. Biodiversity includes the diversity of farm ecosystem species and the diversification of different plant and crop areas in space and time.

The greater the variety is, the more options there are, and the more flexible the farmer's response to changes can be. The questionnaire data confirm the observations of Dabkienė [48] that the activities of Lithuanian farmers are not characterized by diversification of activities. Due to the war in Ukraine, the increase in the price of energy resources

and inflation over the last few years have not been favorable to the production of organic agricultural products and the increase of biodiversity.

In a period of radical changes in the economic environment, the ability of the economy to transform is especially important—that is, to significantly change the structure of the economy to cope with major shocks and long-term stresses. Farms reorganize not only in response to external factors but also by implementing new projects to achieve a more efficient balance. Significant changes in Lithuanian agricultural policy and markets after joining the EU can be called transformational, as they led to a new way of thinking and organizing activities of farmers, new social and new type relations, and the desire to gradually switch to organic farming.

An important feature of transformability—innovativeness—means openness to new ideas, constant pursuit of renewal, and implementation of competitive and sustainable innovations. The owners of larger farms hope that precision farming will ensure lower food prices and environmental protection. Farm data collection using precision agriculture equipment will allow for a more accurate assessment of farm resilience, but this will require additional data collection costs. Family farmers show a desire to use new technologies, smart equipment, and digitized processes, but they complain about insufficient available capacities to compensate for the existing vulnerability of the farm and the introduction of innovations.

Developing capacities to reduce the vulnerability of the economy could create a balance between investment and risk. Almost 44 percent of family farmers who took part in the survey admitted that they do not shy away from taking risks. Regrettably, Lithuanian farmers have not yet learned to manage risks with the help of insurance. In today's highly competitive environment, farmers often overestimate their capabilities and tend to take a lot of risks to reduce costs and increase farm viability, but this can have negative consequences for achieving long-term goals. If a farm overinvests in capabilities that are not needed, this can also reduce profits.

Since the implementation of innovation involves a departure from previously used technologies and management practices, it requires changes in the farmer's values and goals (i.e., farmer learning). The farmer's skills and knowledge influence the formation of their attitude, behavior, and decision-making, thereby influencing the farm's resilience. Specialists recommend combining skill- and knowledge-based learning [51]. New behaviors can be learned by observing and imitating others. Skill-based learning emphasizes the development of procedural knowledge about how to perform a task through practice and repetition. To keep pace with innovation, family farmers cannot do without consulting services.

Farmers are not passive receivers of external knowledge; they do not apply recommendations given by advisory services but actively identify problems and solve them themselves. Learning promotes strengthening the strength of the farm, helps the farmer to adapt, and, if necessary, transforms the farm. About 75 percent of informants emphasize the benefits of learning and actively learn from past experiences, courses, and other sources.

After analyzing the patterns of family farmers' opinions, we propose measures to improve the overall resilience of the Lithuanian family farm: timely governmental and non-governmental support; responsible use of local resources; learning from experience, independently and in courses, deepening into received information; promotion of cooperation; wider implementation of competitive and sustainable innovations; increasing activity diversity, and biodiversity; stockpiling of critical resources that can be used if needed; effective assistance from a consulting service; and expansion of rural services (educational, cultural, health, social, etc.).

Lithuania has quite a large percentage of small farms, which are important environmental functions in rural areas; the circumstances in Lithuania are similar to other Central Eastern European countries [52–54]. The results of similar studies in Central Eastern European countries prove that the production scale is the key determinant of the resilience of farms. The position of the producer in the food supply chain determines the income

situation of the farms, so increasing production should be combined with strengthening the market integration. Analyzing the impact of these dependencies can offer valuable insights into how to shape policies that support family farms in the countries in Central Eastern Europe. One of the future problems with family farms in Lithuania is the succession of family farms. The potential to create efficient, competitive, and innovative farms is rather weak, and it causes a decrease in the number of family farms, especially small farms, in Europe. The ability to maintain their activities relies on diverse resilience strategies.

This study contributes to the theoretical understanding of farm resilience by integrating the concepts of robustness, adaptability, and transformability. Our findings support the resilience theory, which posits that systems with higher diversity and flexibility are better equipped to withstand and recover from disturbances. The results underscore the importance of considering all three dimensions of resilience—robustness, adaptability, and transformability—when evaluating the resilience of agricultural systems. This approach provides a more nuanced understanding of how farms can maintain stability, adjust to medium-term changes, and innovate for long-term sustainability.

The methodological framework employed in this study combines qualitative and quantitative approaches, providing a robust analysis of farm resilience. The use of a survey instrument allowed for the collection of detailed data on various aspects of farm operations and resilience factors. This mixed-method approach can be applied to other studies assessing resilience in different contexts. Future research could benefit from employing similar methodologies to explore the resilience of farms in other regions, thereby enhancing the generalizability of the findings.

Empirically, the study reveals that larger farms with higher sales and more permanent employees exhibit greater resilience. This is evidenced by their robustness, adaptability, and transformability. These findings have significant implications for agricultural policy and practice. Policies aimed at increasing farm resilience should focus on enhancing these key attributes through support for diversification, innovation, and sustainable practices. Additionally, the study highlights the need for continuous education and skill development among farmers to improve their management capabilities and resilience.

5. Conclusions

The aim of the study is to analyze the impact of economic, social, and environmental factors on Lithuanian family farms, assess their resilience, and propose measures to reduce vulnerability. The study's novelty lies in the comprehensive evaluation of factors impacting farm resilience in Central Eastern Europe based on the survey conducted in Lithuania. The resilience of family farms to disturbances is an actual problem in Lithuania today, as it is around the world. It is important for farmers to assess their farms' current level of resilience correctly and, if necessary, to increase it, taking measures so that their sustainable farms can survive, adapt, and grow in the face of turbulent changes. After analyzing the statements of family farmers, it became clear that their understanding of the importance of resilience for sustainable agricultural development in Lithuania is sufficient. For family farms, it is very important not only to increase the robustness of the farm but also to focus on the ability to adapt successfully to ongoing changes in response to disturbances by reorganizing and developing a sustainable business in the long term. The biggest sources of vulnerability of family farms that reduce the farm's resilience potential are restrictive government regulations, declining support, high fluctuations in raw material and output sales prices, high inflation, and unfavorable factors of a changing climate. Survey respondents try to maintain the robustness of their farms with the help of reserve stocks and using resources efficiently. The possibilities of cooperation and risk management insurance support remain unexploited. Flexibility, resourcefulness, and skill-based learning are the most pivotal attributes, showing strong correlations with other resilience factors. These findings highlight the importance of adaptability, continuous learning, and efficient resource management in enhancing overall farm resilience. The data indicate that larger farm sizes, higher agricultural sales, and employing permanent workers are associated

with better resilience. Higher education levels and positive income trends also enhance resilience. However, older farms and farmers, longer durations of farming activity, and risk-averse behaviors tend to decrease resilience.

The results indicate that larger farms with higher sales and permanent employees tend to have better resilience characteristics. These farms demonstrate greater robustness, adaptability, and transformability. Robustness is shown through their ability to maintain operations despite disturbances, adaptability through their flexibility and resourcefulness in adjusting processes, and transformability in their capacity to reorganize and innovate for long-term growth.

Increasing environmentally friendly practices impacts resilience positively, especially for air quality improvements. The ability to adapt and reorganize is crucial for maintaining resilience across various disturbances. Due to the consequences of the war in Ukraine, the increase in the price of energy resources, and inflation, the activities of Lithuanian family farmers are not characterized by flexibility, diversification of activities, and biodiversity. Family farmers show a desire to use new technologies and precision agriculture equipment, but they complain about insufficient available resources to introduce innovations and compensate for the farm's vulnerability. Learning from experience independently and in courses, effective assistance from a consulting service, and successful use of acquired knowledge help to increase the resilience of the family farm.

This study has limitations because it was conducted in a very quickly changing environment. In recent years, economic and social changes have changed rapidly due to local and global circumstances. Consequently, the results obtained in the study may not be valid after several years. Furthermore, deeper economic analyses that evaluate, for example, price sensitivity, level of farm debt, market access, or on- and off-farm diversification are recommended for future study. These studies will allow researchers to better evaluate the effect of economic factors on the resilience of Lithuanian farms.

In conclusion, while the study provides valuable insights into the resilience of Lithuanian family farms, the omission of key socioeconomic, environmental, and social indicators limits its comprehensiveness. Incorporating these factors in future research will offer a more accurate and holistic understanding of farm resilience. Policymakers should focus on providing financial support, improving market access, promoting sustainable practices, and enhancing community and educational support to ensure the long-term sustainability and resilience of family farms in Lithuania.

Author Contributions: Conceptualization, A.K. and J.Ž.; methodology, A.K., J.Ž. and E.W.-G.; software, J.Ž. and E.W.-G.; validation, D.G. and E.W.-G.; formal analysis, A.K. and E.W.-G.; investigation, A.K. and E.W.-G.; resources, J.Ž.; data curation, E.W.-G.; writing—original draft preparation, A.K., J.Ž. and E.W.-G.; writing—review and editing, D.G. and E.W.-G.; visualization, D.G. and E.W.-G.; supervision, J.Ž. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Data Availability Statement: Summarized data are contained within the article.

Conflicts of Interest: The authors declare no conflicts of interest.

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