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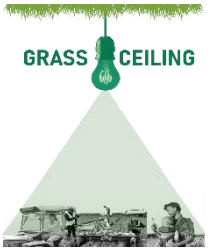
From glass to grass ceiling: Addressing gender barriers in agricultural innovation



Vida Dabkiene, Indre Siksnelyte-Butkiene, Dalia Streimikiene, Vaida Sapolaite, Tomas Balezentis*
Lithuanian Centre for Social Sciences, A. Vivulskio g. 4A-13, LT-03220 Vilnius, Lithuania

Emails: Indre.siksnelyte@knf.vu.lt (I.S.-B.); vida.dabkiene@ekvi.lt (V.D.); dalia.streimikiene@lei.lt (D.S); vaida.sapolaite@ekvi.lt (V.S.); tomas.balezentis@ekvi.lt (T.B.)

*Correspondence: tomas.balezentis@ekvi.lt

Abstract. Gender equality is a fundamental value of the European Union (EU), as reflected in its policy framework. Despite commendable progress, gender disparities persist, particularly in the agricultural sector. Central and Eastern European countries merit particular attention due to their transforming rural areas and the need to ensure social equality. The issues of gender equality in Lithuanian agriculture have not been sufficiently explored, and patriarchal thinking remains prevalent in the country. The main objective of this paper is to determine the gender norms and barriers faced by women innovators in Lithuanian agriculture and to identify opportunities for improvement. This study adopts a three-stage qualitative approach, including focus group discussions (FGDs)—two exclusively for men and two for women—and 14 interviews, with a total of 34 participants from across Lithuania. The research is based on questionnaires and guidelines developed in the GRASS CEILING (Gender Equality in Rural and Agricultural Innovation Systems) Horizon Europe project for 2023–2025. Through FGDs and interviews with agricultural experts, this study unveils the motives, barriers, and differences among male and female innovators in agriculture and identifies the gender norms confronting women agricultural innovators. This research provides a pivotal contribution to understanding gender dynamics in Lithuanian agriculture and offers valuable insights for broader agricultural policy enhancements.

Keywords: gender norms; gender inequality; innovations; women innovators; agricultural policy; Lithuania

1. Introduction

Gender has emerged as an important factor in understanding rural development and agricultural transformation across the globe. The significance of gender equality is explicitly recognized and directly addressed in the United Nations 2030 Agenda for Sustainable Development Goals (SDGs) through SDG 5, "Gender Equality". Achieving gender equality also supports several other SDGs indirectly, including SDG 1: "No Poverty", SDG 2: "Zero Hunger", SDG 8: "Decent Work and Economic Growth", SDG 10: "Reduced Inequalities", SDG 12: "Responsible Consumption and Production", SDG 13: "Climate Action", and SDG 15: "Life on Land" (United Nations, 2015). Against this backdrop, Bock and Shortall (2017) explore international perspectives on how globalization impacts gender dynamics in rural areas, highlighting the diverse challenges faced by women in agricultural systems. Sachs (2019) analyzes changing gender relations in agriculture across Africa, Latin America, and Asia, focusing on agrarian transformations. Sachs et al. (2020) provide a comprehensive examination of gender roles in agriculture, offering insights into both historical and contemporary gender dynamics in rural areas. Research projects have confirmed the importance of engaging both women and men to foster more inclusive and sustainable agricultural practices (Petesch et al., 2018).

Njuki et al. (2023) highlight that achieving gender equality and empowering women in food systems can lead to improved food security, enhanced nutrition, and the creation of more equitable, resilient, and sustainable food systems for all. According to FAO's 2023 report *The Status of Women in Agrifood Systems*, women made up 38% of all agricultural workers globally in crop, livestock, fisheries, and forestry production in 2019. However, there are significant variations across countries in the proportion of women involved in agriculture and how these proportions have changed over time. Generally, women represent a larger share of the agricultural workforce in countries with lower levels of economic development, where factors such as inadequate education, limited access to basic infrastructure and markets, a high burden of unpaid work, and limited rural employment opportunities outside of agriculture significantly restrict rural women's ability to engage in off-farm work (FAO, 2023).

Gender equality is a fundamental value of the European Union (EU), as explicitly stated in its policy documents. Recognized as a principal component of EU social policy, gender equality positions the EU as a global leader in this area. Strategic documents—the 1957 Treaty of Rome, 1996 EU Communication "Incorporating equal opportunities for women and men into all Community policies and activities", and the Gender Equality Strategy 2020–2025—have shaped EU gender equality policies at the institutional level. However, as noted by Shortall and Marangudakis (2024), the practical implementation of these policy documents in the agricultural sector often remains insufficient. Despite significant progress, no EU member state has yet achieved full gender equality. The EU Gender Equality Index stood at 70.2 out of 100 points in 2023 (EIGE, 2023), reflecting an improvement of 7.1 points over the past decade. This indicates both positive changes and challenges that lie ahead in achieving gender equality across the EU.

According to the Gender Equality Index for the EU countries presented by the European Institute for Gender Equality (EIGE, 2023), Lithuania ranked 17th in the EU in 2023 with 64.1 out of 100 points, and its score was 6.1 points below the EU's average. The results of scores across the main domains of the index reveal that the domain of power has most room for improvement (48.6 points), which shows that Lithuania is furthest away from gender equality in economic decision-making and in the domains of knowledge (59.3) and time (62.1), which presents the gender inequalities in the allocation of time spent doing care and domestic work and social activities. According to EIGE (2023), women account for the majority of childcare and/or housework in Lithuania, which limits women's capacity to participate in income-generating activities: the average wage for men was 13.6% higher than for women in 2022; three-quarters of women and only one-quarter of men take childcare leave; twice as many women than men take care of and educate their children or grandchildren, the elderly or people with disabilities on a daily basis; four-fifths of women and only one-third of men do cooking and/or household chores.

The entrepreneurial situation in Lithuania was explored in detail by the Global Entrepreneurship Monitor study (GEM, Global Entrepreneurship Monitor, 2022), where countries were divided into three groups based on GDP per capita. Lithuania was grouped as a middle-income country and was ranked first among other countries in the group. According to this study, Lithuania pays special attention to and strongly supports women's start-ups and innovations. Despite these results, as for the entrepreneurial environment for rural women and for women engaged in agricultural activities, no separate attention is paid in Lithuania. Also, the low involvement of farmers in innovations is reflected in the number of employees in agriculture, forestry and fisheries engaged in R&D (Official Statistics Portal, 2023). It is noteworthy that in practice, as in other areas of entrepreneurship, there is low targeted attention paid to women.

In some areas, gender inequality is particularly pronounced and requires special efforts and attention. One of those sectors is agriculture, where women farmers manage only one-third of farms across the EU (Eurostat, 2023). The Common Agricultural Policy (CAP) agenda (EU CAP network, 2022) underscores the significant role of women in the development and economic growth of rural communities. The agenda highlights that the contributions of women are often invisible and insufficiently recognized. Rural women frequently encounter numerous challenges in their work activities and various decision-making processes, where traditional gender roles perpetuate inequalities between men and women. This situation is particularly evident in the context of rural women in Lithuania.

The necessity of this study is underscored by the statistical data presented above, showing that a significant portion of household responsibilities predominantly fall on women, while their level of decision-making remains low. Lithuania presents a unique case for analysis because, at the EU level, it has the highest proportion of women-led farms. However, these farms are small in both size and production. This situation highlights the importance of investigating how these statistics affect the role of women in agriculture. This study represents the first investigation of its kind in Lithuania, focusing on gender issues within the agricultural sector. Despite the crucial role of women in agriculture, there is a significant scarcity of research exploring their contributions and the specific challenges they face in this context. The findings of this study aim to fill this gap by providing valuable insights in relation to the roles, barriers, and opportunities experienced by women in Lithuanian agriculture. Additionally, it is important to note that the EU allocates substantial funds to the agricultural sector. Ensuring the appropriate utilization of these funds to enhance the implementation of innovations is crucial for society, farmers, and policymakers. Investigating the dynamics of women's contributions to agriculture, particularly in terms of innovation and decision-making, can provide valuable insights for the effective deployment of these funds and the formulation of targeted policy measures.

Research on gender-wise differences in innovation activities of Lithuanian farmers not only addresses gender disparities in agricultural management but also aligns with broader EU goals of fostering sustainable development and economic growth within the agricultural sector. Understanding these aspects can lead to more inclusive and efficient agricultural policies, benefiting the entire community. Thus, this paper aims to determine the gender norms and barriers in Lithuanian agriculture among women innovators and to identify room for improvement. To reach this aim, several tasks have been set. First, the earlier literature and statistics on rural women and women-led innovations in Lithuanian agriculture will be reviewed. Next, the motives for, and barriers to women's active participation in agricultural activities will be explored. The study will also aim to determine the differences between male and female innovators. Additionally, the nature of support required by women agricultural innovators will be identified. Further, the study will examine gender norms that impact women's active participation in agricultural innovations. Finally, the main areas for policy improvement will be identified.

To achieve the main objective of the research, a three-stage qualitative study was conducted: two focus group discussions (FGDs) with male innovators in agriculture, two FGDs with female innovators in agriculture, and interviews with experts. The research performed was based on questionnaires and guidelines developed in the GRASS CEILING project, which is funded by the EU in the frame of Horizon Europe in the period 2023–2025. The GRASS CEILING project, which stands for Gender Equality in Rural and Agricultural Innovation Systems, draws inspiration from the concept of the glass ceiling to address similar barriers faced by women in the agricultural sector. In 1986, the term "glass ceiling" was popularized by the Wall Street Journal to describe the invisible barriers that prevent women and minorities from reaching the top of the corporate hierarchy. Just as the glass ceiling impedes women's progress in corporate settings, the grass ceiling represents the obstacles that prevent women farmers and agricultural innovators from fully participating and advancing in the agricultural industry.

Section 2 reviews the literature on gender norms, barriers faced by women and gender equality issues in agriculture. Section 3 presents the research methodology. Section 4 provides an overview of gender disparities in the Lithuanian agricultural sector along with the results of the qualitative study. Section 5 discusses the main outcomes and identifies key areas for policy improvement. Finally, Section 6 concludes with a summary of findings.

2. Literature review

This section overviews the main research directions and findings of studies addressing gender equality issues in the agricultural sector, as well as presenting the main outcomes of studies analyzing gender issues in Lithuanian agriculture.

2.1. Gender differences in agriculture

The scientific community shows growing interest in various issues related to women's participation in agricultural activities in both developing and developed countries. Key areas of focus include women's access to land (Horst and Marion, 2019; Agarwal and Mahesh, 2023; Khodary, 2022), barriers women face in agricultural activities such as finance and economic participation (Tsiaousi and Partalidou, 2021; Rahman et al., 2023; Fusco et al., 2023), gender gaps in labor markets (Makhdum and Kousar, 2021; Fisher et al., 2022), gendered access to information (Mudege et al., 2017; Medendorp et al., 2022), gender and climate change (Assan et al., 2018; Lawson et al., 2020; Nosheen et al., 2023), gender gaps in productivity (Palacios-Lopez and Lopez, 2015; Fowowe, 2023; Julien et al., 2023), and agricultural innovation processes (Badstue et al., 2018; Kawarazuka and Prain, 2019; Valverde et al., 2022). Table 1 provides a summary of studies on gender equality issues in the agricultural sector and indicates whether gender differences were identified in each field examined.

Despite the growing importance of the topic, the literature review confirms the findings of Ball (2020) and Fanelli (2022) indicating that limited research in the field of economics on agriculture is related to women in developed countries; in contrast, such studies are more common in developing countries. Most studies identified significant gender differences in various aspects of agriculture, including land ownership, productivity, barriers to finance, and participation in agricultural activities. This indicates a widespread presence of gender inequality in agricultural contexts across different regions and countries. While most studies highlighted significant gender differences, a few, such as those from India, Southeast Asian countries, and the Czech Republic, found no significant differences. This suggests that the impact of gender on agricultural practices can vary significantly depending on the regional and cultural context. Common barriers identified include limited access to land ownership, finance, agricultural information, and extension services, as well as the influence of gender norms and the double burden of reproductive and productive work. Studies focusing on the impact of climate change also reported significant gender differences, highlighting that women are more vulnerable and face unique challenges in adapting to climate variability and accessing resources for climate-related agricultural projects. The findings emphasize the necessity for gender-sensitive policies and interventions to address the diverse barriers faced by women in agriculture and to promote gender equality and innovation. Some studies did not analyze gender differences, which may result in overlooking critical insights into how gender dynamics influence agricultural practices, productivity, and innovation.

Table 1. Gender studies in agriculture: main research directions and findings.

Reference	Main contribution of the study	Scope of the study	Gender-wise differences
Land ownership and productivity			
Akter et al. (2017)	Relationship between land ownership and productivity from a gender perspective	Regional/Southeast Asian countries (Myanmar, Thailand, Vietnam and the Philippines)	No significant differences
Horst and Marion (2019)	Gender inequities in farmland ownership	National/US	Significant differences identified
Khodary (2022)	Societal changes in perceptions and practices related to women's ownership and inheritance of agricultural land	National/Egypt	Significant differences identified
Agarwal and Mahesh (2023)	Relationship between land ownership and productivity from a gender perspective	National/India	No significant differences
Barriers to finance and economic participation			
Sandhu et al. (2012)	Women's barriers to finance	National/India	Significant differences identified
Sofer and Saada (2017)	Women's barriers and drivers to enterprise development	National/Israel	NA
Varela-Candamio et al. (2018)	The competitive advantage of women's businesses	National/Spain	Significant differences identified

Reference	Main contribution of the study	Scope of the study	Gender-wise differences
Tsiaousi and Partalidou (2021)	Women's position in the agricultural sector	National/Greece	Significant differences identified
Barry and Gahman (2021)	Women's barriers to business growth and development	Regional/ Caribbean (Grenada, St. Lucia, St. Vincent, the Grenadines)	Significant differences identified
Osabohien et al. (2021)	Female participation in agriculture and economic development	Regional/33 African Countries	NA
Sallawu et al. (2022)	Drivers of and barriers to women's participation in agricultural activities	National/Nigeria	NA
Hernandez et al. (2023)	Women's participation in agriculture cultural and economic barriers	National/Guatemala	Significant differences identified
Fusco et al. (2023)	Gender differences in the performance of agricultural activity	National/Italy	Significant differences identified
Rahman et al. (2023)	Women's participation challenges in agricultural practices	National/Bangladesh	Significant differences identified
Labour markets			
Makhdum and Kousar (2021)	Determinants in the rural labour market	National/Pakistan	Significant differences identified
Fisher et al. (2022)	Gender wage inequality in agriculture	National/US	Significant differences identified
Access to information			
Mudege et al. (2017)	Gender inequalities in relation to access to agricultural information and knowledge	National/Malawi	Significant differences identified
Medendorp et al. (2022)	Gender differences in extension training	National/Bangladesh	Significant differences identified
Climate change			
Assan et al. (2018)	Gender perspective adapting to climate change	National/Ghana	Significant differences identified
Lawson et al. (2020)	Gender influence on perceptions of climate variability	National/Ghana	Significant differences identified
Lecoutere et al. (2023)	The impact of climate change on gender equality identifying and mapping climate–agriculture–gender inequality hotspots	International/Bangladesh, Mali, Pakistan, Zambia	Significant differences identified
Nosheen et al. (2023)	Gendered component of vulnerability to climate change	National/Pakistan	Significant differences identified
Koomson (2023)	Rural women's involvement and roles in climate change-related projects	National/Ghana	NA
Productivity			
Palacios-Lopez and Lopez (2015)	Gender gap in agricultural productivity	Regional/sub-Saharan Africa	Significant differences identified
Slavchevska (2015)	Gender gap in agricultural productivity	National/Tanzania	Significant differences identified
Pechrová and Simpach (2015)	Gender differences in agricultural efficiency	National/Czech Republic	No significant differences
Fowowe (2023)	Gender gaps in agricultural productivity	National/Mali	Significant differences identified
Tufa et al. (2022)	Gender differences in agricultural technology adoption and crop productivity	National/Malawi	Significant differences identified
Ojo and Baiyegunhi (2023)	Gender gaps in agricultural productivity	National/Nigeria	Significant differences identified
Julien et al. (2023)	Gender gaps in agricultural productivity	Regional/Malawi, Tanzania, Uganda	No significant differences in Malawi

Reference	Main contribution of the study	Scope of the study	Gender-wise differences
			Significant differences identified in Tanzania and Uganda
Agricultural innovations			
Badstue et al. (2018)	Drivers to innovate across gender	International/19 countries	Significant differences identified
Kawarazuka and Prain (2019)	Gendered processes of agricultural innovation	National/Vietnam	Significant differences identified
De Rosa et al. (2020)	Innovation adoption in women farmers	National/Italy	NA
Rietveld and van der Burg (2021)	Gendered innovation processes	National/Uganda	Significant differences identified
Valverde et al. (2022)	Innovations, drivers and barriers towards gender equality	National/Guatemala	Significant differences identified
Timsina et al. (2023)	Gender norms in the Eastern Gangetic Plains, adopting agricultural technology	Regional/Eastern Gangetic Plains of India, Nepal and Bangladesh	Significant differences identified

Source: designed by the authors.

Gramm et al. (2020) state the fact that women's work in agriculture is often not formally recognized nor economically compensated, and they are frequently economically dependent on the male farmer. This is evidenced by the lack of sufficient statistics on women's participation in agricultural and rural activities, their involvement in agricultural associations, and other farmer cooperation platforms. Moreover, traditional gender roles still strongly persist in Europe, where patrilineal farm succession remains the tradition, and male farmers continue to be the formal decision-makers and the representatives of the farm to the outside world. Consequently, women in farming families are disadvantaged in terms of access to agricultural resources and decision-making. Additionally, rural depopulation leads to a decrease in the availability of social services in these areas. The provision of childcare for women farmers enhances women's autonomy and positively impacts their skills and competences. The lack of local services in rural areas is identified by Ahl et al. (2023), who state that the most important factor for rural women entrepreneurs is the provision of good public services, including schools and social care, that make rural life viable. Findings such as the lack of economic autonomy for women farmers, social isolation of women farmers, and the necessity to include them in research to increase their recognition and visibility are presented in the study by Fernandez-Gimenez et al. (2021). The cases examined by Sarkki et al. (2021) show great promise that women-led social innovation can significantly change gender inequality conditions in rural areas towards "new normalities" entailing more gender equity and enabling rural women to contribute to rural development. Ahl et al. (2023) identify this as a crucial issue and propose redirecting some of the agricultural support towards the development and support of local social and physical infrastructure as a solution.

These studies show that female farmers often face unique challenges, including limited access to resources, financial constraints, and sociocultural barriers, which impede their ability to innovate and thrive in the sector compared to their male counterparts. Additionally, societal norms and the disproportionate burden of household responsibilities further restrict women's capacity to engage in agricultural innovation and decision-making processes.

2.2. Researching gender differences in the context of Lithuanian agriculture

As in the EU, the issue of gender equality is one of the top ideas on the international political agenda, but the attention paid in Lithuanian political documents is low. Nevertheless, according to the study by Blomberg et al. (2017), Lithuania can be characterized as having a relatively high level of gender equality. Issues of gender equality in Lithuanian agriculture do not receive significant attention in scientific literature. The scientific studies analyzing the context of women in Lithuanian agriculture can be divided into two categories: studies performed on a national scale and those performed in the context of the EU countries. The main research directions and results are summarized in Table 2.

Table 2. The main research directions and findings: the case of Lithuania.

Reference	The main contribution of the study	Scope of the study	Gender-wise differences
Balezentis et al. (2021)	Identification of gender equality patterns among future generations of farmers	National	No significant differences
Girdziute et al. (2022)	Determination of factors affecting youth's willingness to work in the agriculture sector	National	Significant differences identified
Raisiene et al. (2018)	Analysis of the feasibility of stakeholder participation in agricultural policy decision making	National	Significant differences identified
Vidickienė (2017)	Analysis of attractiveness of rural areas for young well-educated women	National	NA
Fanelli (2022)	Identification of differences between farms owned by women and men in the EU	Regional	Significant differences identified
Shortall and Marangudakis (2022)	Analysis of the mismatch between regional legislation on employment and women's employment position in EU agriculture	Regional	Significant differences identified
Matuszewska-Janica (2018)	The diversity of women employed in agriculture across the EU	Regional	Significant differences identified
Jackova et al. (2016)	Analysis of rural women's entrepreneurial activities in the agriculture sector across the EU member states	Regional	NA

Source: designed by the authors.

One of the recent national-scale studies, conducted by Balezentis et al. (2021), delves into an analysis of gender inequality within Lithuanian agriculture. The study specifically focuses on young farmers, aged up to 40, with the objective of uncovering patterns of gender equality among the farmers of future generations. By surveying 473 young farmers, the authors compared the demand for advisory services and participation in Common Agricultural Policy measures across genders. The findings indicate that there are no significant differences, suggesting that the Lithuanian agricultural sector benefits both men and women equally. However, it's important to note that women farm owners constituted only 19% of the analyzed sample. The analysis of the area of residence among genders revealed no significant differences, highlighting the suitability of Lithuanian rural infrastructure to meet the needs of women. In line with trends observed in various sectors, notable differences in education were identified among young women and men farmers. Specifically, 76% of women respondents held higher education degrees compared to 56% of men respondents. Given that young women farmers tend to be more educated and environmentally aware (Huyer and Partey, 2020), they are likely to play a crucial role in adopting innovative farming practices, engaging in climate-smart agriculture, and contributing to the realization of sustainable development goals. Additionally, the flexibility of women in adapting to changes in agricultural activities becomes particularly significant in the face of uncertainties arising from climate change and other global concerns.

Vidickienė's (2017) study examined the attractiveness of rural areas for educated young women in Lithuania. The author surveyed students specializing in fields such as food science, agriculture, bioenergy, and sustainable natural resource use. The findings revealed a substantial motivation among educated young women to reside in rural areas, with 67% expressing strong interest. Moreover, 39% demonstrated a willingness to live in isolated homesteads or small villages, driven by the perception of many opportunities for self-realization in rural areas. However, research by Girdziute et al. (2022) revealed that among the factors influencing the willingness of Lithuanian youth to pursue careers in agriculture are gender, residential location, and the belief that agricultural work lacks opportunities for self-realization. The study confirmed a diminished interest among young women in engaging in agricultural work. Additionally, a reduced willingness to work in agriculture was observed among individuals residing in urban areas, while higher interest was noted among youth whose parents were employed in the agricultural sector and who are sympathetic to nature and animals.

Numerous researchers agree that, due to the unique nature of the agriculture sector, involving stakeholders in decision-making processes is of high importance (Raisiene and Skulskis, 2018; Zagata et al., 2021; Clerino et al., 2023). However, the success of participation depends on various factors such as stakeholders' readiness to engage and collaborate. In their 2018 study, Raisiene et al. examined the potential involvement of stakeholders in decision-making processes within Lithuania. After analyzing data from 1,108 farmers, the authors discovered that only about half 53.8% of them expressed a willingness to contribute to agriculture policy decision-making and to represent the interests of farmers. The findings highlighted that women expressed a lower willingness to participate compared to men when it came to decision-making representing farmers' interests. Furthermore, the study revealed that only one out of every ten farmers (9.7%) was a member of an agriculture organization. The study contributed to the research field by offering important insights into the profile of a typical farmer interested in agriculture policy development and their willingness to engage in decision-making processes. Four key factors contribute to the description of a typical contributing farmer: age, gender, education, and farm size. Typically, this contributing farmer is a man belonging to the middle-aged group (35-65), possessing higher education, and owning a larger landholding (Raisiene et al., 2018). Despite women in Lithuania being characterized by higher education levels than men, their participation and willingness to engage in decision-making processes within the agriculture sector are notably lower than men.

The analysis and comparison of women in agriculture in the context of the EU countries allows us to compare the achievements of the country and possible directions for improvements based on experiences in the whole region. Fanelli (2022) conducted an analysis to explore disparities between farms owned by women and men in EU countries. Utilizing descriptive statistical analysis, principal component analysis, and multivariate regression models, the study aimed to ascertain the gender gap in the agricultural sector. The findings indicated that both genders play significant roles in agriculture; however, the agricultural activities of women tend to be less profitable than those of men. Notably, Lithuania, along with Latvia, stands out with the highest proportion of women-run farms, accounting for approximately 45%, against the EU average of 29% in 2016. This outcome is attributed to the high participation of Lithuanian women in the labor market. Matuszewska-Janica (2018) conducted an analysis of the diversity of women employed in agriculture across the EU. The study focused on women aged 20–64 and identified significant variations among countries in terms of the women's labor market in agriculture. Countries were categorized into ten groups based on their performance, with Lithuania falling into a category alongside Croatia, Finland, Latvia, and Portugal. In these countries, the average women employment rate in agriculture was approximately 4%, and they exhibited a high level of self-employed women, averaging 49%, with a relatively low share of self-employed women having employees (10% on average). The results further indicated that countries with higher levels of economic development tended to have a higher percentage of self-employed women with employees compared to countries with a less favorable economic situation.

Shortall and Marangudakis (2022) analyzed the mismatch between European legislation on employment and women's employment position in agriculture. According to the authors, farming attracts women less because agriculture is considered as a sector rather than an occupation in European legislation. Therefore, the issue of gender equality does not receive proper attention in agriculture. Jackova et al. (2016) investigated the entrepreneurial activities of rural women in the agriculture sector across the EU countries. Emphasizing the significance of supporting women's entrepreneurship and self-confidence, the authors highlighted the potential to expand climate-smart agriculture in Lithuania. Given the well-educated nature of women in Lithuania, the study suggested that with government support and the dissemination of targeted information, there exists an opportunity to enhance climate-smart agricultural practices.

Despite their substantial contributions to rural development and agriculture, the literature inadequately represents the role of women farmers. This gap is evident in studies where participants are categorized by gender, but the outcomes are not adequately reported. This gap suggests a lack of consideration for gender as a factor influencing agricultural innovation, with a greater focus on education and age groups. Simultaneously, research on innovation applications in agriculture fails to provide comprehensive insights into the role of women, their attributes, utilized technologies, and applications.

Consequently, this gap hinders researchers from gaining a nuanced understanding of gender-related issues in agriculture, impeding the advancement of gender-focused research in the country. The available information on women's innovations in agriculture is fragmented, offering only partial insights at the national level.

3. Methodology

To present the statistical picture of women's situation in the agricultural sector and rural areas in Lithuania several indicators have been selected which capture key aspects of gender inequality and provide insights into the challenges and opportunities faced by women and men in agriculture. An overview is useful to achieve a baseline understanding of the demographic composition of individuals engaged in farming activities, population and age structure indicators in rural areas and farms. Standard Output (SO) per farm is a vital indicator in the context of gender disparities in agriculture, which gives valuable insights into economic empowerment, resource allocation, market participation, and the overall sustainability of the sector.

To identify gender norms and barriers facing women innovators in Lithuanian agriculture, the three-stage qualitative research was performed, which analyses the problem from different perspectives and includes two focus groups of women agricultural innovators, two focus groups of men agricultural innovators and interviews of experts in agricultural innovations. The schematic logic of the research is provided in Figure 1.

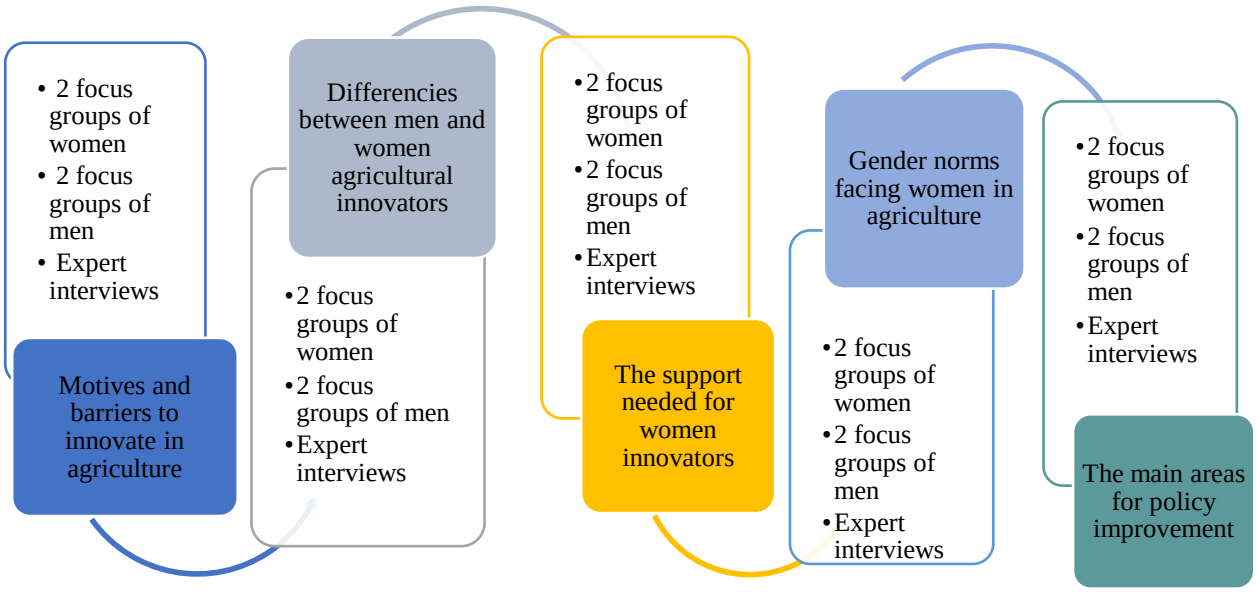


Figure 1. Logical framework of the research.

Source: designed by the authors.

The research design was based on a qualitative study consisting of four FGDs—two for men only and two for women only—and 14 interviews: a total of 34 participants from all over Lithuania. In qualitative research, small sample sizes are frequently cited as a limitation. However, this study employed the concept of "information power" as proposed by Malterud et al. (2016). Throughout the research process, theoretical saturation was attained, following the framework of Braun and Clarke (2021), indicating that no new information or themes emerged from the data. Several studies have used similar sample sizes for in-depth investigations. For example, Petesch et al. (2018) explored how gender norms influence agricultural innovation across 26 low- and middle-income countries, utilizing FGDs with 16–20 participants in total. Kraaijvanger et al. (2016) used FGDs with five farmers, while Bullock and Tegbaru (2019) conducted two FGDs with ten participants each. Similar to the Kraaijvanger et al. (2016) study, the FGD participants in the present research were selected based on their expertise, making

the group akin to an expert panel, as the selected participants had significant knowledge about the adoption of agricultural innovations on farms.

Participants in the FGDs were selected to reflect gender differences in involvement in innovation in rural areas or agricultural production, therefore a sample of ten women and ten men were invited to participate. The participants for focus groups from all over Lithuania were purposely selected following a public online call.

The questionnaires were composed of 27 open-ended questions for men FGDs, 24 questions for women FGDs and 15 questions for expert/stakeholder interviews. The questionnaire for the women's FGDs centred on their direct experiences and personal barriers to innovation. It began with an introduction where participants shared their backgrounds, personal and professional roles, and connections to agricultural innovation. The questions then focused on motivations, personal, professional, and sector-wide barriers, as well as drivers of innovation. Finally, participants were asked to share their future vision. In contrast, the men's discussion focused on their perceptions of women's roles, challenges, and the impact of gender norms on women's ability to innovate. It included questions related to men's views on women's roles, differences between men and women innovators, gender norms and stereotypes, professional and sector-wide barriers, and the support systems available to women.

Fourteen experts/stakeholders who are part of the Agricultural Knowledge and Innovation Systems and who support those who innovate in the rural/agricultural sector were invited to take part in the study, of which two stakeholders related to digitalization. The aim was to assess the environment of women innovators by gathering detailed insights from stakeholders' perspectives on rationales for supporting women innovators, experiences with women innovators, expectations and demands of women innovators, gender norms, expectations on what needs to be changed, and knowledge of the support currently available to women innovators.

The qualitative study was carried out between June and July 2023. The FGDs meeting took place on 12 June 2023. The expert/stakeholder interviews were conducted over the phone or on remote communication platforms like Microsoft Teams or Zoom. The FGDs meeting took about 2–3 h and the stakeholder interviews were between 45 min and 1.5 h.

The detailed methodology and questionnaires used in this study are based on the GRASS CEILING project framework. For comprehensive methodological details and access to the full questionnaires, please refer to the project website: https://www.grassceiling.eu. All materials and procedures performed were approved by the Ethics Committee at the Lithuanian Centre for Social Sciences and informed consent was obtained from all individual participants included in the research. The qualitative data from the FGDs and experts'/stakeholders' interviews were transcribed, coded and inductively analyzed through close reading of the data. Findings related to the research questions were thematically structured by combining common themes across the interviews.

The women innovators focus group participants ranged in age from 36 to 56 years. All women were engaged in farming activities, operating various enterprises, such as three carrying out milking and two of whom diversify activity by cheese making; two running berry farms; two running organic vegetable farms; mixed farms growing crop and engaged in aquaculture; apiculture farms; cereal farms, and pressing various oils from their own production.

The average number of years of women innovators in farming is 13, with a range between 1 and 30 years. Participants used a variety of sales channels, including direct, retail, and wholesale. The average age of male innovators was 37, ranging from 25 to 51 years. Seven participants were farmers and three were rural innovators.

4. Results

4.1. Stylized facts on disparities in the Lithuanian agricultural sector within the EU context

This subsection presents the statistical picture of women's situation in the agricultural sector and rural areas in Lithuania. In the last eight years, the population of predominantly rural areas in Lithuania decreased by 31,000, from 2014 to 2022, which corresponds to a decline of approximately 13%. This

decline was similar for both men and women, with the rural female population decreasing by 17,000 and the male population decreasing by 15,000 (Figure 2). Ubarevičienė and van Ham (2017) found that the most "successful" individuals, those with higher socio-economic status and better education, tend to migrate from declining regions to urban areas, intensifying rural depopulation. According to the authors, this selective migration leaves behind older residents and those with lower socio-economic status. Additionally, the lack of a clear strategy to address population decline and regional inequalities exacerbates the situation, perpetuating the downward spiral of rural depopulation.

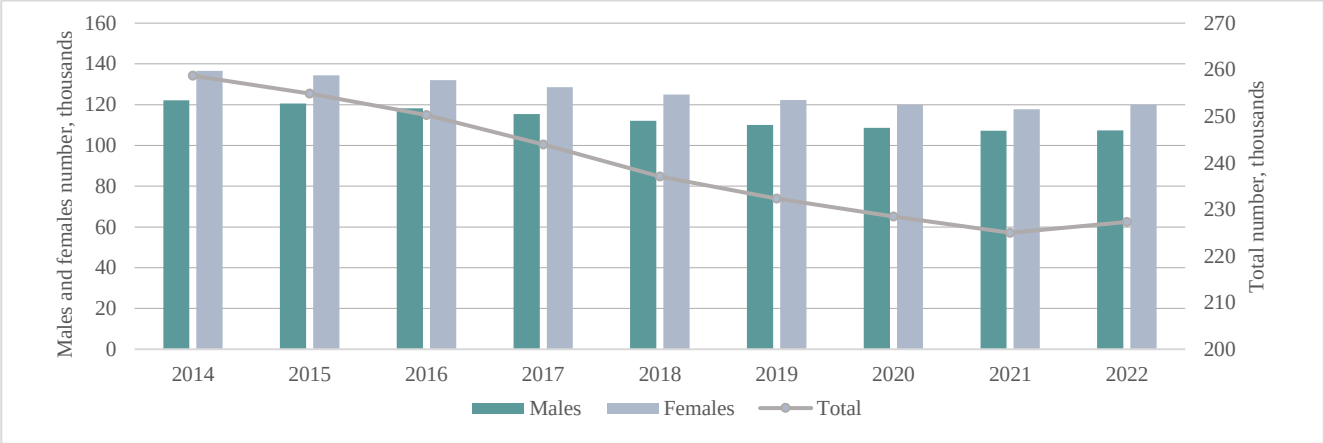


Figure 2. Population in predominantly rural areas in Lithuania (in thousands), 2014–2022.
Source: designed by the authors based on Eurostat Database (2023).

The data from the 2020 Agricultural Census provided by Eurostat show that the number of farms in Lithuania significantly decreased between 2005 and 2020. Specifically, a 42.6% decrease over 2005–2020 is noted. The decline for female-owned farms is higher and amounts to 44.7%. Over the aforementioned period, the share of female-owned farms fluctuated between 42.4% and 47.7% (Figure 3). In the EU-28, the number of female-owned farms in 2020 ranged from 5.6%, in the Netherlands, to 44.9 in Lithuania, thus leading in terms of this indicator.

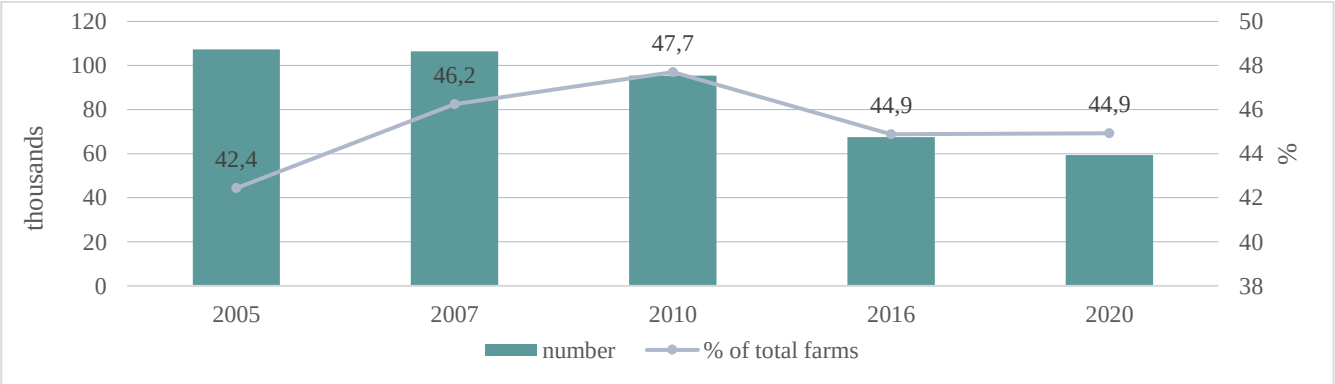


Figure 3. Number of female-owned farms and their share of total farms in Lithuania in 2005–2020.
Source: designed by the authors based on Eurostat Database (2023).

Figure 4 shows the age structure of farm managers by gender in EU countries in 2020. In Lithuania, the unfavorable age structure of female farmers is characterized by a predominance of males in the age groups up to 39 years and 40–64 years, while females outnumber males in the farming population aged 65 years and older. This exacerbates gender inequality in the sector. Notably, this unfavorable age distribution is consistent with the average trend observed in the EU-28. May et al. (2019) emphasize that the small proportion of young (female) farmers is particularly concerning, given the need to transition to a more sustainable food system and the crucial role that farmers play in this transition.

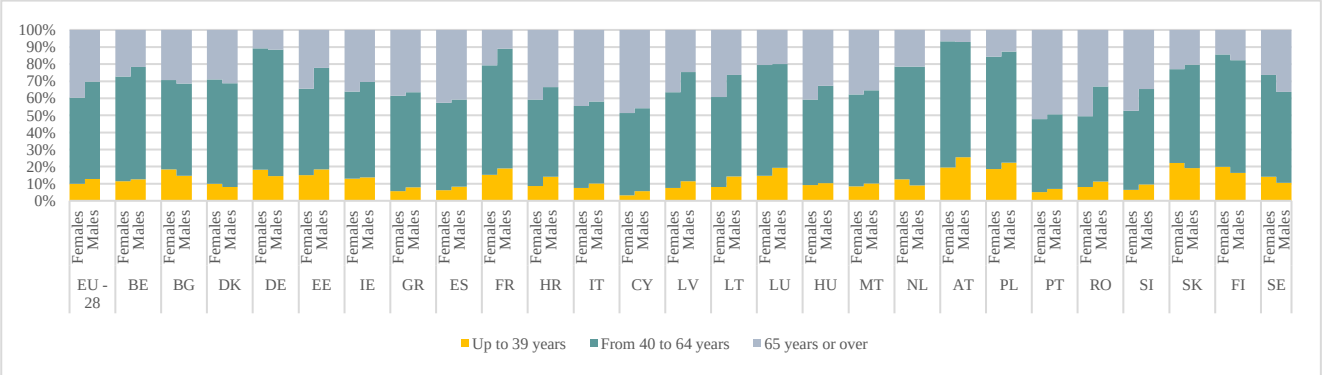


Figure 4. Age structure of farm managers by gender in EU countries in 2020.
Source: designed by the authors based on Eurostat Database (2023).

The unfavorable situation for female farmers is also highlighted by statistics related to the distribution of resources by gender. In 2020, on average in the EU-28, male farmers accounted for the largest share of utilized agricultural area (UAA) at 82.6%, while female farmers accounted for only 17.4% (Figure 5). Among EU countries, the lowest shares of UAA owned by female farmers were found in the Netherlands at 3% and Denmark at 6%, while the highest shares were in Austria at 31.3%, Poland at 27.5%, Latvia at 25.3%, Romania at 24.8%, and Lithuania at 24.1%.

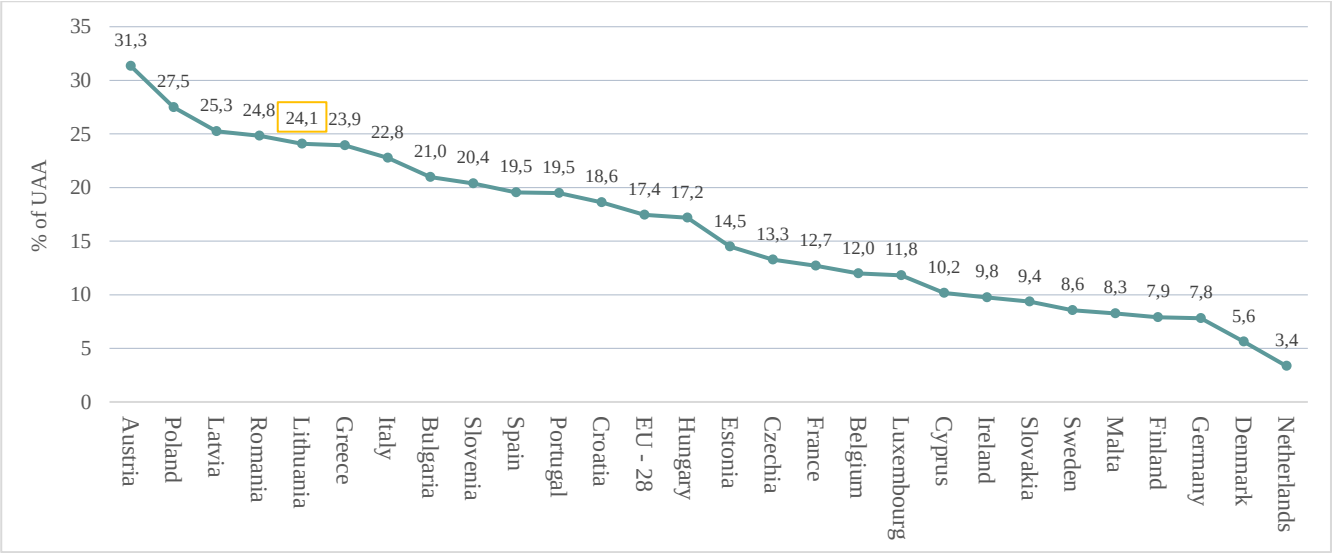


Figure 5. Share of utilized agricultural area managed by female farmers in the EU-28 countries in 2020.
Source: designed by the authors based on Eurostat Database (2023).

In 2020, a notable disparity was observed in the SO per farm based on the gender of the manager within the EU-28. On average, the SO of female-managed farms was 38% of that of male-managed farms. The most pronounced gender gaps in SO were recorded in Cyprus, Malta, and Lithuania, where women's SO represented only 23%, 26%, and 34% of men's SO, respectively. Conversely, the smallest gender differences in SO were observed in Czechia, Austria, and Finland (Figure 6). In Lithuania, the majority of female-managed farms are very small, with 46.5% of these farms having SO of less than EUR 2,000. SO per farm indicator is related to many aspects and indicates economic disparities and constraints among gender access to resources and opportunities, highlighting variations in resource allocation and efficiency between men and women farmers. SO is influenced by the availability and effective use of agricultural inputs such as land, seeds, fertilizers, and technology; evaluation of the SO per farm allows for an indirect assessment of whether women farmers have equal access to these inputs. The indicator can also be tied to decision-making authority within agricultural households and give insights on women's influence over decisions related to farm management and resource allocation. As

SO of women managed farms in Lithuania is very low, urgent actions are needed in order to reduce gender disparities in Lithuanian agriculture.

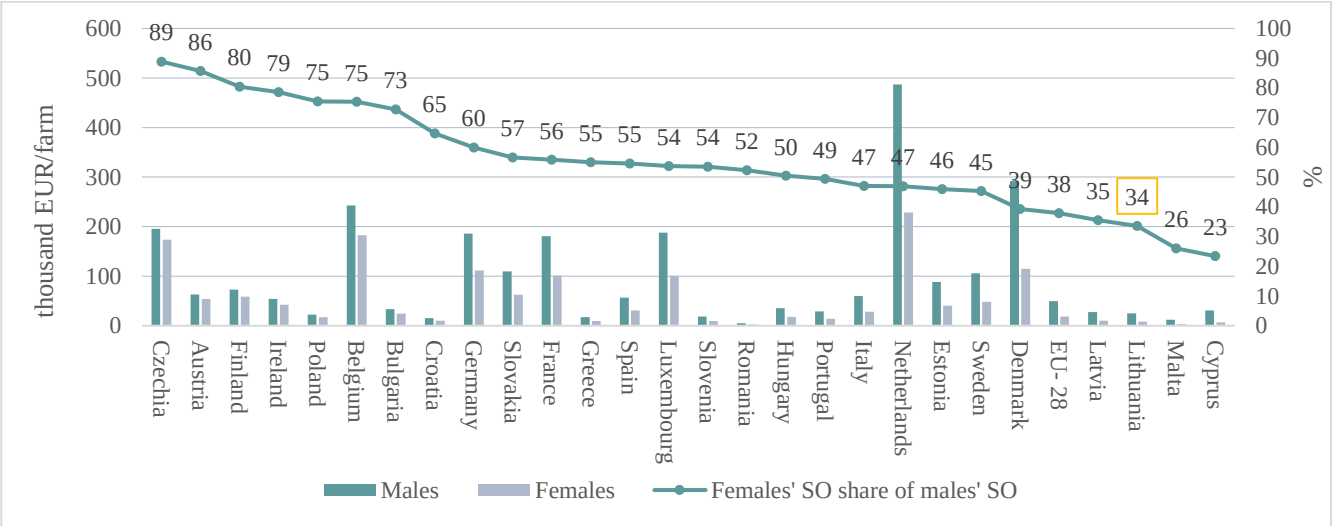


Figure 6. SO per farm by sex in the EU-28 countries in 2020.
Source: designed by the authors based on Eurostat Database (2023).

Figure 7 illustrates the distribution of farms by size (ha) across EU countries. The data indicate that small farms predominate in Europe, with farms under 19.9 h comprising 85% of all farms on average in the EU-28. In Lithuania, such farms represent 83% of the total. Conversely, farms larger than 100 ha account for an average of 3.6% of farms in the EU-28, whereas in Lithuania, they constitute 4.4%. Additionally, the figure reveals a significant gender disparity in the management of larger farms (over 100 ha), with only 12.8% of these farms being managed by women on average in the EU-28, and 18.3% in Lithuania.

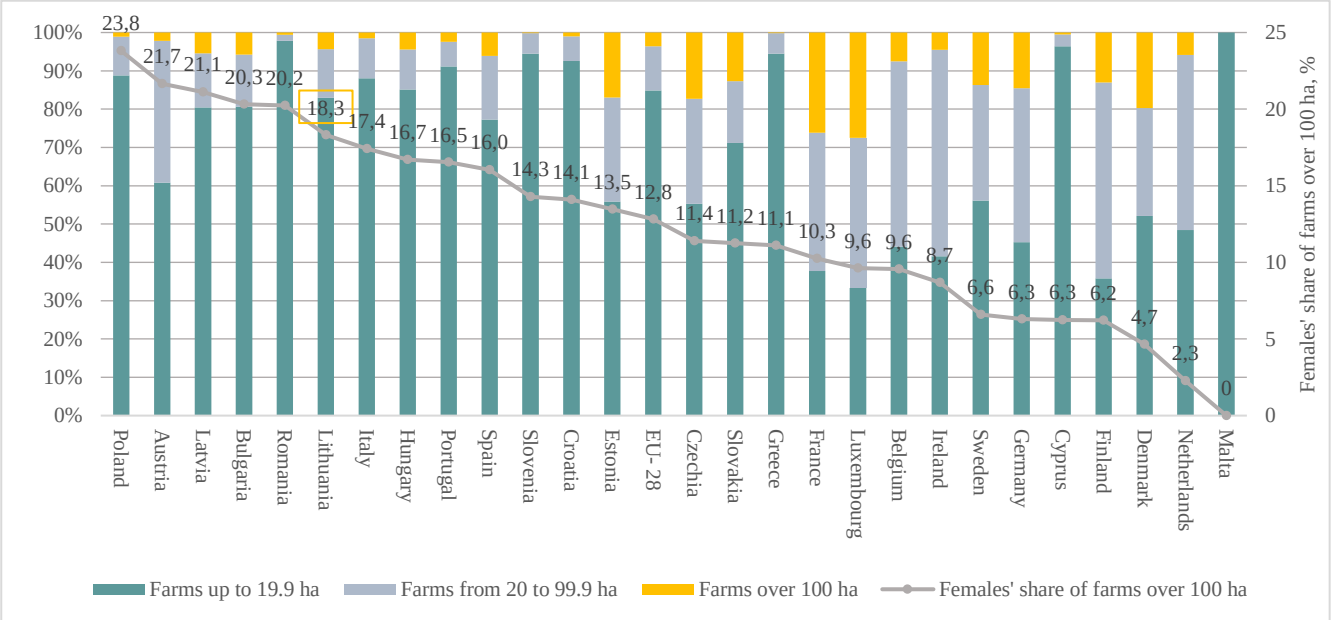


Figure 7. Structure of farm size (ha) and share of female-owned farms over 100 ha in the EU-28 countries in 2020.
Source: designed by the authors based on Eurostat Database (2023).

In Lithuania, consistent with the EU-28 average, there remains a substantial gap between men's and women's readiness for farming. A significantly lower proportion of female farm holders had basic

or full agricultural education in 2020 (Figure 8). This educational disparity highlights the challenges women face in entering and succeeding in the agricultural sector.

However, data from the Lithuanian State Data Agency (2023) indicate that rural women are more likely to engage in lifelong learning activities compared to their male counterparts. In 2022, within the last 12 months, 16.7% of women and 10.0% of men aged 25–64 participated in lifelong learning activities. This suggests that while women may have less formal agricultural education, they are more proactive in continuing their education and skill development through lifelong learning programs.

These findings underscore the importance of supporting educational initiatives and lifelong learning opportunities to bridge the gender gap in agricultural readiness and competency.

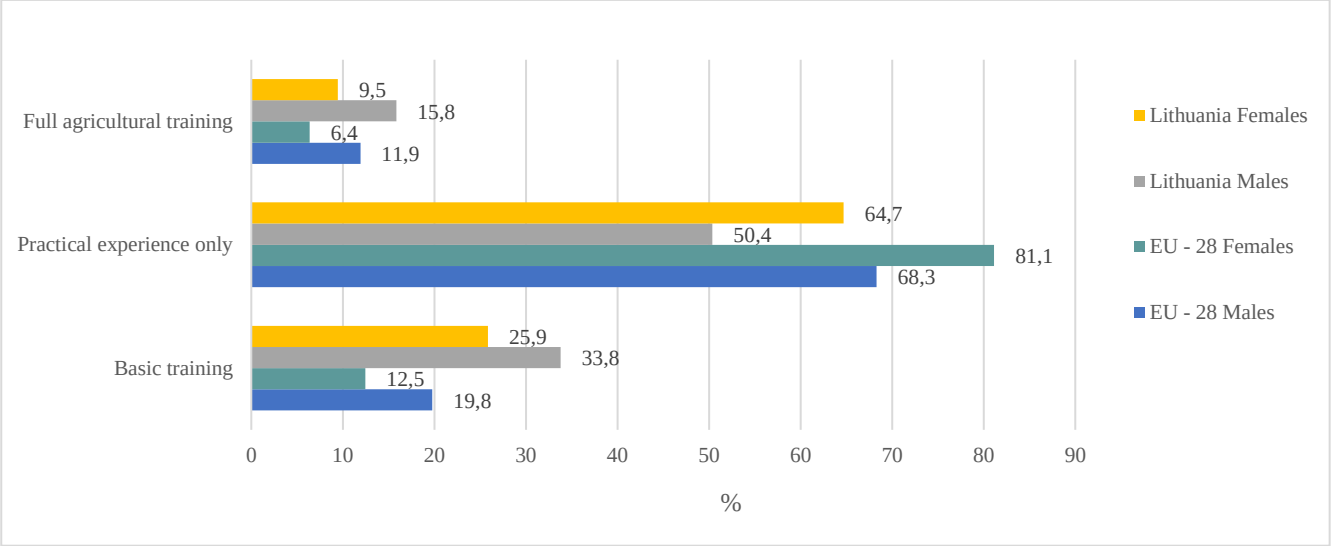


Figure 8. Farm managers by training and sex in Lithuania and the EU-28 in 2020, % of total holdings.
Source: designed by the authors based on Eurostat Database (2023).

Self-employment is a valuable indicator of a country's economic development. As noted by Matuszewska-Janica (2018), self-employment rates are higher in countries with higher levels of economic development compared to those with lower levels. According to Eurostat data, in 2022, the self-employment rate in Lithuania's agriculture, forestry, and fishing sectors was 10,400 women and 19,300 men. These results highlight the need for changes in Lithuania's agricultural sector, particularly in promoting female entrepreneurship in rural areas.

Figure 9 gives information on the median equivalised net income in rural areas of Lithuania by gender from 2005 to 2022. The average equivalent net income of men in Lithuania was on average 4.1% higher than that of women over the period 2005–2022.

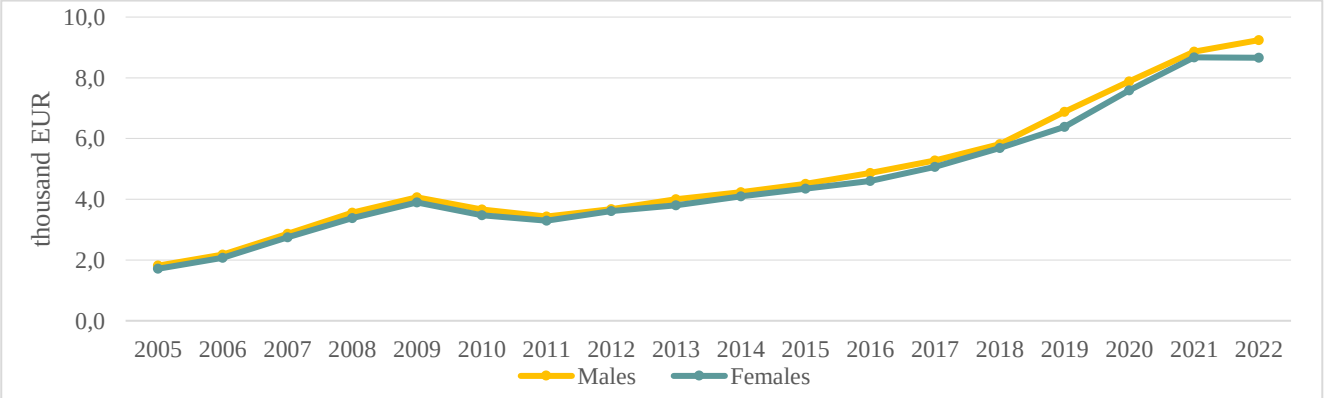


Figure 9. Median equivalised net income by sex in Lithuanian rural areas, 2005–2022, thou. EUR.
Source: designed by the authors based on Eurostat Database (2023).

The gender income gap in rural Lithuania in the context of EU countries exceeds the EU-27 average in 2022 (Figure 10). According to Lauzadyte-Tutliene and Mikuciauskaite (2022), this gap is partly attributed to occupational segregation, where women are concentrated in lower-paying jobs. Persisting gender income disparities contribute to broader social and economic inequalities. This includes less favorable financial situations for women, lower pensions in old age, and heightened vulnerability to poverty (Krinickiene, 2018).

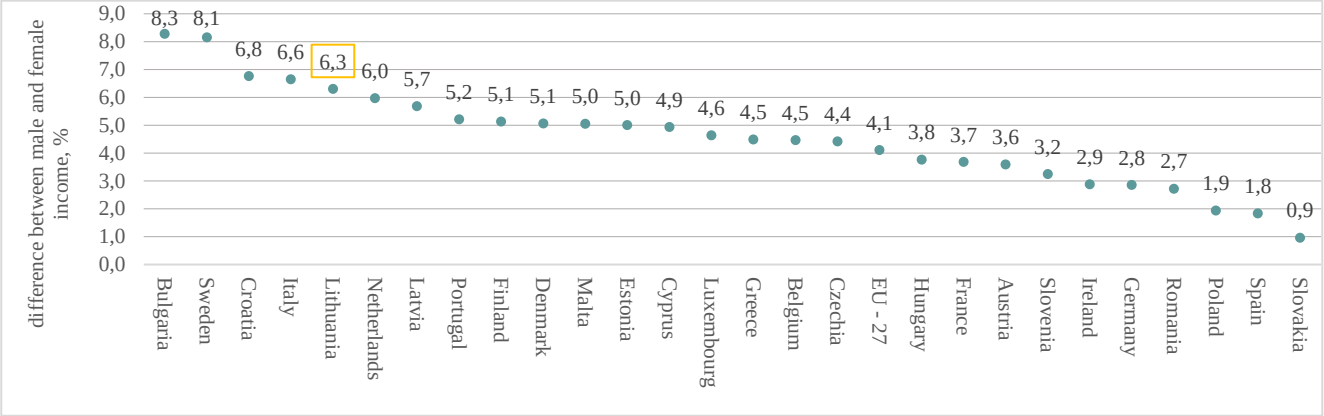


Figure 10. Gender gap for median equivalized net income in the EU-28 countries in 2022, %.
Source: designed by the authors based on Eurostat Database (2023).

This section presents motives and barriers to innovation in the Lithuanian agricultural sector, identifies differences between women and men innovators in agriculture, determines the nature of support needed for women innovators and presents a relationships diagram between the main aspects affecting women's engagement in agricultural innovations.

4.2. Motives and barriers to innovate in the Lithuanian agricultural sector

Three groups of stakeholders (women agricultural innovators, men agricultural innovators and experts from agricultural knowledge and innovation systems) were engaged to find out their experience regarding the most influential factors, which encourage and inhibit women's participation in the creation and implementation of agricultural innovations.

Motives to innovate. The responses to the open-ended question, asking to identify motives to innovate, were discussed during the FGDs with men and women innovators. The results are provided in Table 3.

Table 3. Motives to innovate in the Lithuanian agricultural sector.

Type of motivation	Women agricultural innovators	Men agricultural innovators
Personal	Considerations of the family's future; Willingness to ensure quality of lifestyle for the family; Desire to develop new products; Desire for further growth and development; Desire to make work easier;	Self-realization; Interest in technology;
Financial	Economic benefits; Costs reduction; New customers attraction;	Economic benefits; Creation of routine work system – work optimization; Increase in productivity; Cost reduction; Increase in technological competitiveness; Possibility to increase quality;
Societal	Possibility to create additional value for yourself and the consumers;	Value creation for self and consumers;

Type of motivation	Women agricultural innovators	Men agricultural innovators
		The lack of labour force forces to look for technological improvements
Sustainability concerns	Environmental interests; Health interests;	Environmental interests; Health interests.
Rural revitalization	Creation of additional value for the local rural community; Desire to preserve traditions.	

Source: designed by the authors.

The research findings indicate some notable distinctions in the motives that drive men and women to undertake new projects. For men, the primary motive is centered around maximizing financial gains, aligned with goals of higher productivity and efficiency. Their focus tends to be on tangible outcomes, where the success of a business venture is directly reflected in financial benefits. In contrast, women's motivation lies in a thirst for new knowledge and curiosity. Women often contribute to the social ecosystem, seeking added value for themselves or the existing community. As women display a tendency to engage in innovations that address broader societal issues beyond mere financial gain, the driving force for women goes beyond profit, extending towards creating solutions for larger societal challenges. Additionally, the research highlights that women place a higher value on recognition and aspire to enhance their visibility in society, demonstrating a keen interest in becoming better known for their contributions.

During the research, it was also found that the domains of involvement that women innovators choose, or are interested to address, are slightly different. For instance, technology acquisition projects are predominantly implemented by men *("Men's innovators are more focused on technical activities, more concerned with increasing productivity and efficiency"; "As a rule, technology acquisition projects are mostly written and implemented by men")*. However, women frequently take the lead in resolving issues related to the environment, social concerns, and animal husbandry *("if women are developing the business, it is more social businesses"; "The social innovation strand is more attributed to women, and the chairpersons of the local action groups are also more women"; "Women are more socially-minded").*

Regarding the contribution to the rural community, it was noted that women stand out as proactive organizers involved in the execution of diverse initiatives. They actively write, win, and implement various community projects *("Rural and community activities are flourishing with the activity and initiatives of women"; "Women actively participate in various rural community activities, such as nurturing cultural and culinary heritage"; "Women are more motivated to take up community projects due to their natural characteristics as women are more sensual, impulsive and communal").*

Barriers to innovation. The responses to the open-ended question identifying barriers to innovation for women in agriculture can be grouped into three categories based on their nature: common barriers for agricultural innovators, gender norms or stereotypes, and additional barriers specific to women agricultural innovators. Common barriers to innovation, regardless of gender, were further classified into two subcategories: professional and personal. The findings from the analysis of data collected during women's and men's FGDs are presented in Table 4.

Table 4. Professional and personal barriers for agricultural innovators.

Professional barriers	Personal barriers
Extremely frequently mentioned	
Lack of finance	Personal fear and uncertainty regarding potential losses Lack of time to explore innovations and consider them all in detail Preference for spending time on hobbies and family/lack of time
Very frequently mentioned	
Bureaucracy Lack of targeted support measures for implementing necessary innovations	Lack of desire to be interested in innovation

Too many regulatory requirements and rules Lack of funding Poor-quality innovation services and support, both during and after implementation High price of innovative products Lack of information on available support	
Moderately frequently mentioned	
Difficulty in assessing the profitability of innovations Differences in opinions and experiences among colleagues Realization of the production problems Country's tax system for food products	Lack of basic knowledge of organizational issues Low readiness to accept innovations among family members or colleagues

Source: designed by the authors.

The most common barriers to innovation for both genders are the lack of financial resources, the fear of losses and the lack of time to analyze in detail possible innovation alternatives. Also, the participants single out many professional barriers, among which are: bureaucracy, lack of support tools, excessive and difficult-to-understand requirements, gaps in the provision of information, etc. This clearly identifies what changes need to be made at the country's institutional level.

Gender norms and additional barriers for women. Gender norms or stereotypes and additional barriers for women agricultural innovators were identified during the experts' interviews and agricultural innovators' FGDs. The identified gender norms and barriers in each group of participants are presented according to the frequency of mention in that group of participants. The frequency was determined according to the popularity (%) of the identified barriers and gender norms among the study participants in each research group (Table 5). The results, i.e., the popularity in percentages of identified barriers and gender norms separately in three groups of research participants (14 experts, 10 women and, 10 men innovators in agriculture), are presented in Table 6.

Table 5. Description of frequency levels.

Frequency, %	90–100	80–89	60–79	50–59	40–49	20–39
Interpretation	Extremely frequently	Very frequently	Frequently	Moderately	Infrequently	Rarely

Source: Designed by the authors.

Table 6. Gender norms and additional barriers for women to innovate in the Lithuanian agricultural sector.

Norm or barrier	**Experts**	**Women**	**Men**
Gender norms			
Childcare responsibilities	Very frequently	Extremely frequently	Extremely frequently
Household chores	Very frequently	Extremely frequently	Extremely frequently
Personal fears because of the prevailing weaker role of women in society	Frequently	Moderately	Moderately
Social responsibilities	Frequently	Very frequently	Very frequently
Prevailing norm is that men are the ones working in agriculture	Infrequently	Moderately	Moderately
Prevailing norm is that men are more capable of doing things	Infrequently	NA	NA
Additional barriers			
Differences between the education of rural and urban women	Rarely	NA	NA
Infrastructure differences in urban and rural environments	Infrequently	NA	NA
A lot of physically demanding work in agriculture	Infrequently	Extremely frequently	Extremely frequently
Technical knowledge is often required on the farm, where women often have less technical knowledge and experience	Infrequently	Extremely frequently	Extremely frequently

Note: "NA" indicates that this data was not obtained because this respondent group did not discuss or identify this information during the interview.
Source: designed by the authors.

Almost all participants concur that the lower involvement of women in agricultural activities can be attributed to traditionally assigned roles of home, social, and childcare responsibilities for women. Women typically bear a greater burden of social and household duties compared to men, often shouldering responsibilities related to maintaining the home environment, childcare, food preparation, and other domestic tasks (*"When you drop out for a few years because you have children, it is a challenge to catch up, because the skills are lost, you have to update your knowledge"; "If kids are sick, it is impossible to work", "Preparing food takes a lot of time", "Housework makes it very difficult to set up a business and there is a lack of support from family and husband", "All the burden of the household falls on the woman, so there is no time to generate new ideas").* The persistent societal norm that positions men as the primary workforce in agriculture remains prevalent. In some cases, women innovators still encounter societal biases ingrained in antiquated notions that suggest women are incapable of being innovators or excelling in traditionally "male-driven" domains. This bias, rooted in long-established norms and stereotypes, has the potential to dissuade women from actively pursuing innovation and may raise doubts about their capabilities *("Women innovators have more barriers than men because they have to prove more that they know how to do things and that they can do them as well as men"; "Women encounter numerous challenges stemming from societal attitudes and biases").* The participants agreed that gender stereotypes exist in the agricultural sector, especially among older people, and there is a lack of favorable attitudes among older farmers towards women farmers *("When making technological decisions, it is worth going with a man, because a woman is sometimes not taken seriously").* However, it is agreed that this bias is antiquated and gradually declining among new generations.

From the perspective of numerous experts, urban women face fewer challenges when participating in new activities due to the established infrastructure in urban areas. Conversely, for rural women, every initiative demands increased effort and time. Although social capital supporting innovative initiatives exists in villages, it is particularly strong in communities surrounding major urban centers.

Furthermore, disparities in the educational experiences of rural and urban women are noticeable. As highlighted by the expert, *"If there is no water, sewerage, street lighting, paved roads or a school, kindergarten and other necessary infrastructure are tens of kilometres away, it will never be attractive"*. Hence, it is essential to establish more favorable conditions in rural regions, as currently, young families are relocating to urban areas or choosing to live abroad. The existing infrastructure in rural areas is also linked to various social issues, such as alcoholism (*"There is very high alcoholism in rural areas today and social policy today does not encourage people to find a job, the benefits received are often invested in alcohol"*).

4.3. Differences between women and men innovators in agriculture

Concerning the distinctions between male and female innovators, certain variations between the genders were identified. The main differences between women and men agricultural innovators can be pointed out:

- Women tend to display higher levels of motivation, persistence, and activity *("The first steps and initiatives usually come from the side of women"; "Women desire to implement the project to the end"; "Women are most motivated to get things done faster, to have more time for themselves and their families"; "Women more strive to get recognition"; "If women decide to do something, they practically always do it"; "Women tend to solve problems faster"; "Women are more focused"; "Men have a narrow focus and if it doesn't work they take a decision and go on to another decision"; "Women have a lot of desire"; "Women are more interested and more active")* ;
- Women tend to be more oriented to detail *("Women are more meticulous, while men see a situation as a whole, women think more in the details"; "Women notice the details more"; "Women are more thorough and go deeper into the problem and its essence"; "Women can perform tasks in a more diligent manner than men"; "Women are more detail-oriented")*;

- Women are more emotional and impulsive *("Women often receive information emotionally"; "men are more rational"; "Men react more calmly to problems as they arise")*;
- Women tend to be more compassionate and community-oriented *("Women, due to their inherent characteristics, are more motivated to engage in community projects as they are more compassionate, guided by emotions, and community-oriented"*; *"Women care about the social ecosystem"; "Women are more attentive to relational things"; "Women have a sense of what a person needs")*;
- Women are better able to collaborate *("Women are able to work in a team, while men usually prefer more individual work")*;
- Women are more capable of assimilating new information *("Women are more receptive to new knowledge and information")*;
- Women tend to be more cautious when it comes to taking risks *("Women often are consulted several times about the same issue, it can be influenced by the willingness to reduce risk"; "Women seek to reduce the risk"; "Women tend to be more thoughtful, contemplative, and evaluative"; "Men are more tend to take a risks, whereas women think ten steps ahead and then they are afraid to move and do"; "Women innovators sometimes tend to be more cautious when it comes to risk-taking" or "There may be slight differences in risk-taking tendencies, with female innovators appearing more cautious and calculated in assessing risks")*;
- Women may exhibit less boldness and show a lower level of concentration on the objective *("Women have a lack of concentration on one thing and have extra things to do in the same activity"; "Men are more focused, more concentrated in their activities")*;
- Additionally, women are attributed with such features as broad consideration and a desire for a harmonious work environment *("Men often have a direct target in mind, while women approach things with more thoughtfulness, weighing aspects, and paying attention to detail"; "Women take into account more how their business and product affect the environment, people and the impact they have"; "Women are more interested in their activities and the people they bring together to implement their activities"; "Men are more focused on the result"; "Women do things broadly"; "Men dive more headfirst into the activity, whereas women somehow calculate things more carefully*"). Accordingly, it can be stated that *"Women have more objectives in their projects, while men mostly concentrate on one objective"*.

During the research, attention was also paid to the need for physical strength in agricultural activities. As women often have different physical capabilities compared to men, it may be relevant in specific innovations that require physical strength. Also, there is still a lack of digitization and robotics in agriculture, so physical work is still necessary, and men have an advantage. However, in evaluating abilities beyond physical characteristics, it's necessary to highlight that capabilities can significantly differ among individuals, irrespective of their gender.

Despite recognizing differences among genders, participants agreed that both genders have high potential for innovation and success in various fields *("Mental/intellectual capabilities are based on personal characteristics, ambitions and personal experiences and do not have linkages with gender")*.

4.4. The nature of support needed for women innovators

The experts selected possess expertise in working with innovators of both genders. They consistently emphasized a lack of gender-based differentiation in their support provided for agricultural innovators, underscoring their focus on the individual characteristics and background of a person. For the experts, gender distinctions are not present in their work when providing support, and there is no specific emphasis on supporting women *("I have never heard of women being ignored on one or another issue"; "People are not discriminated against gender when giving support"; "There are no any specific or supporting conditions for women farmers in the preparation and evaluation of projects").* Therefore, it can be stated that: *"The involvement of a person and the final result of the project is dependent only on the activity and personal characteristics of the person himself"*.

Women and men innovators during the FGDs also agreed that the support needed for innovators is not dependent on gender and is primarily influenced by the individual background of a person rather

than gender itself. They emphasized that comprehensive support and consultation can effectively address all innovators' needs and the fulfilment of these needs depends on the effort of the support provider. Consequently, it is imperative to ensure that support services will be inclusive, accessible, and meet the individual needs of each innovator.

However, the gender norms, stereotypes, and additional barriers for women highlighted by the research participants undoubtedly influence women's active participation in agricultural activities. The performed research allowed us to identify and systemize the aspects affecting women's engagement in agricultural innovations (Figure 11).

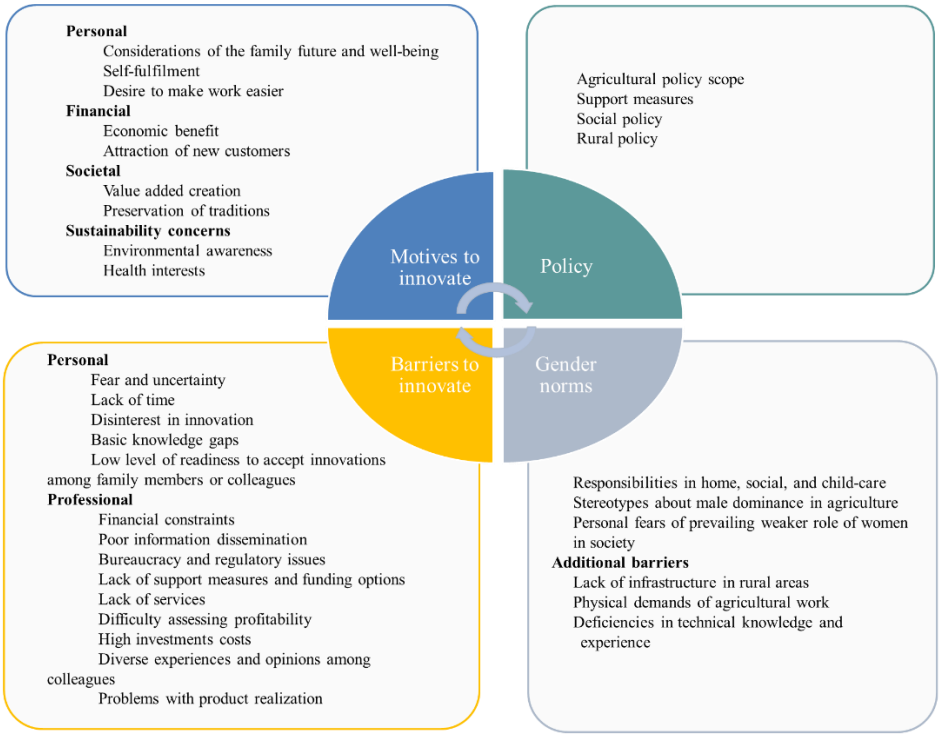


Figure 11. Women's engagement aspects in agriculture innovations and value creation.
Source: designed by the authors.

5. Discussion

Earlier literature argued that the increase of innovative output level is impacted by scientific excellence and international economic activities, an example being the outcomes of the study carried out by Andrijauskiene et al. (2021). As a result, having well-educated women, Lithuania has a great potential to empower women in business innovations. However, it requires active policy decisions and targeted budget allocation. Basically, the initiatives of women's entrepreneurship education, creation of innovations or other initiatives related to the improvement of the gender equality situation in the country have been supported or initiated based on the EU programs. It is also worth mentioning that the achievements of newly adopted laws depend on the strength of the legal and political environment. The results of the study carried out by Hozer-Kocmiel et al. (2017) showed that the socio-economic situation in Lithuania is not prepared properly to launch new businesses for women. National political documents, reports or development plans do not pay attention specifically to the encouragement of women's entrepreneurship and the creation of innovations. As an example, the Lithuanian innovation development program for 2014–2020 has no focus on the empowerment of women in the labour market or support for women's business innovation opportunities (The Government of the Republic of Lithuania, 2013). The Ministry of Economy and Innovation of the Republic of Lithuania (2023) only provides information on separate initiatives supported or carried out by the European Union programs. Therefore, it can be stated that the gender equality policy in Lithuania is mainly addressed to the development of the gender equality concept (Žvinklienė, 2016) than related to the institutional active actions in policy measures.

However, some actions are being taken to reduce gender inequality in the Lithuanian labor market. For example, changes in the parental leave policy adopted in 2021 aimed to reduce the gap between men and women in the labor market and provide women with the opportunity to remain competitive after childcare leave (Seimas of the Republic of Lithuania, 2022). These changes in the law aim to return women to the labor market temporarily during their leave, obliging men to take a portion of the childcare leave. The practical relevance of these amendments to the law and their impact on women's participation and leadership in the labor market will become known after a few years. However, a patriarchal attitude still prevails in Lithuania, especially when it is entrenched in rural areas (Balezentis et al., 2021).

However, despite the lack of initiatives and programs specifically aimed at increasing business innovation opportunities for women, considerable attention is paid to encouraging entrepreneurship and supporting the development of innovations in Lithuania. The three-stage research methodology allowed areas for improvements to be identified in order to reduce gender inequality issues in the Lithuanian agricultural sector:

- more attention to gender equality issues;
- clear, convenient and targeted dissemination of information;
- the development of rural infrastructure;
- lower bureaucracy and more flexibility;
- improvement in mentoring services.

Improvements in these areas would allow women innovators to participate more actively in innovative agricultural and rural development activities and would also contribute to the reduction of gender inequality, not only in the agricultural sector but in other sectors as examples of good practice.

One of the main areas for improvement is clearly related to the country's gender equality policy and the attention paid to this issue. This finding aligns well with Sivertsson and Tell (2015), who state that regulations and government policy barriers are very influential, especially for small farmers.

The research results revealed that more attention should be paid to gender equality issues in the policy and in society. Therefore, the gender equality issue should be included in the common agricultural strategy. This should also include special programs and projects designed specifically for the inclusion of women innovators. There should also be more funding opportunities dedicated to supporting women's ideas and innovations, thereby enabling women to become more actively involved in innovative agricultural activities.

Another extremely important area of improvement is the creation of a clear, user-friendly, and targeted information dissemination system. This is relevant not only for women but also for men, i.e., for all agricultural innovators and farmers seeking to participate in various support measures. For women innovators, clear and targeted dissemination of information would make it easier for them to get involved in future projects and implement their ideas. This finding is supported by Karamushka et al. (2018), who argue that it is necessary to create a convenient and targeted information dissemination system to ensure that the information search process is not a deterrent but rather a means of encouraging the implementation of innovation.

The development of rural infrastructure is a critical area for improvement identified in the research. Addressing this issue requires a comprehensive approach, as it encompasses various sectors. The study's findings indicate that more suitable living conditions and necessary infrastructure in rural areas must be developed. Currently, in many rural regions of Lithuania, living conditions for young families are inadequate. Only regions near major cities have convenient infrastructure, including schools, kindergartens, accessible medical services, and well-developed transport systems. Additionally, rural areas face numerous social problems, such as alcoholism, poverty, and unemployment. These issues significantly impact the willingness of active, creative, and young individuals to live in rural areas, engage in agricultural activities, and contribute to the community's overall value. These findings align with Ahl et al. (2023), who emphasize the importance of supporting women in agriculture through the development of social and physical infrastructure. They suggest redirecting some agricultural support towards the development and enhancement of local social and physical infrastructure to overcome existing barriers.

Both female and male innovators, as well as experts interviewed, emphasized the significant bureaucratic barriers to the development of innovations in agriculture. According to all research participants, bureaucracy should be minimized, and greater flexibility should be introduced into all processes to facilitate breakthroughs in the sector. For instance, current policies do not provide funding for the commercialization of products, which is crucial for market introduction. Therefore, it is imperative that the commercialization of new innovative products be funded, similar to other significant stages of innovative product development. Campuzano et al. (2023) corroborate this finding by identifying "lack of policies for innovation promotion" and "unfavorable regulation" as key inhibitors to the adoption of new practices in the agricultural field.

Improving mentoring services is crucial to ensuring the vitality of innovations. Currently, there is a lack of mentoring services available during the project writing phase, implementation, and post-project periods. These services are necessary for innovators regardless of gender. However, it is observed that community and social projects are more often implemented by women. When projects extend beyond the activities of a single farm and involve the community, more challenges are frequently encountered. In such cases, mentoring services, especially after the project's implementation, are particularly important. This conclusion is also supported by Fatty et al. (2023), who emphasize the importance of mentoring services for agricultural small and medium enterprises.

The research results imply that Lithuanian women farmers are interested in developing agribusiness towards innovative activities. The major obstacles include difficulties in ensuring work and life balance, limited financial resources, and lack of expertise. The public support could be diverted towards corresponding mechanisms addressing those issues. Male and female farmers identified similar barriers for women innovators in agriculture. Therefore, it can be said that these barriers are widely acknowledged.

The findings reported in this study correspond with those obtained by Ahl et al. (2023) for the Swedish case, in that rural women appeared as those inclined to take part in the activities of local communities. The contributions of women innovators are important in supporting such activities and further contribution can be ensured by organizing, e.g., business training and counselling. These are important factors reported for both Lithuania and Sweden. Also, the need for financial assistance is obvious given the financial constraints reported in our study and that by Ahl et al. (2023).

The work–family divide became evident in the study of Ahl et al. (2023) in the context of women businesses in rural areas. The same finding was echoed in our study where women emphasized the need for further actions in promoting services for families that would allow dispensing time for social and business activities, especially for women. In the Lithuanian context, the declining population density in rural areas calls for further studies that would identify the novel business models for such services that would be viable in the case of low population density. On the other hand, increasing availability of services may affect population density.

The study by Wiścicka-Fernando (2022) focused on women entrepreneurs in Estonia, Poland, and Sweden, yet rural areas were not included in the sample. The results still suggest that financial obstacles were topical for women entrepreneurs in Estonia, Poland, and Sweden, especially at the outset of their business activities. Financial resources also appeared as a barrier to innovation activities. Indeed, similar patterns were reported by Lithuanian women farmers. These findings imply that barriers and motives for embarking on business activities and innovations may overlap across sectors. Accordingly, the provision of financial or educational resources may also be organized not only with a narrow focus on the agricultural sector and rural areas but also involving other strata of society.

6. Conclusions

6.1. Theoretical and practical implications

Although gender's role in agriculture is increasingly recognized, research on this topic remains limited in developed countries, with more studies in developing regions. Most research highlights substantial gender disparities in areas like land ownership, productivity, access to finance, and

agricultural participation, pointing to widespread gender inequality globally. However, a few studies report no significant gender differences, suggesting that regional and cultural contexts may influence these disparities. Common barriers for women include limited access to land, finance, agricultural information, extension services, and the dual demands of reproductive and productive work.

Gender equality issues in Lithuanian agriculture receive limited attention in the scientific literature. The available information on women's innovations in agriculture is fragmented and provides only partial insights at the national level, revealing a lack of recognition of both the challenges and potential in analyzing this topic.

A comprehensive picture of gender disparities in the Lithuanian agricultural sector emerges from the combined quantitative assessment of statistical data and the qualitative exploration of research findings. The statistics highlight significant gaps in farm ownership and management, with women managing smaller farms and achieving only 34% of the Standard Output (SO) of their male counterparts. This is linked to structural barriers such as limited access to resources, technology, and support systems, which hinder women's ability to manage larger, more economically viable farms. Women's focus on social and community projects, rather than purely economic ventures, further reflects these disparities in farm size and economic performance.

The age structure of farm managers reveals a predominance of older women in agriculture, with a lower proportion of young female farmers compared to men. Additionally, fewer women have formal agricultural education, though they engage more in lifelong learning activities. The research emphasizes the need for targeted educational and support systems to empower younger women in agriculture and bridge the educational gap through lifelong learning and skill development.

Statistical data also shows a persistent income gap, with rural women earning 4.1% less on average than their male counterparts from 2005 to 2022. This aligns with the research findings that women face systemic economic barriers, such as lack of access to finance, resources, and support for innovation, which directly contribute to their lower economic output.

Four FGDs allowed motives to current innovations led by women and men in agriculture to be identified. According to the results, the main motives to engage in innovations for both women and men are such aspects as: economic benefit, the creation of adding value for their farm and consumers, and environmental awareness. Some notable distinctions in the motives were also found. As for men, the primary motive is centered around maximizing financial gains, aligned with goals of higher productivity and efficiency. For women, motivation lies more in a desire to create added value for themselves and family or the existing community. Both genders agreed that women innovators have different attitudes towards activities they engage in, the way they perform their work, and the outcomes they achieve.

The FGDs and experts' interview results showed that men innovators make decisions faster, they are goal-oriented, more adventurous and less afraid to take risks. While women innovators are less aware to take risks, they are more creative, have a high-level motivation to implement the ideas generated, they are more detail-oriented, more emotional and impulsive, have better skills of collaboration, are less goal-oriented, and tend to consider issues broader, and have the desire to work in a harmonious environment.

Interviews with the agricultural innovation experts showed that in the experts' work, there is no focus on genders when giving support for agricultural innovators. When working with innovators, the experts focus on the individual characteristics of a person, not on gender. However, gender norms are making some differences in men's and women's innovating behaviour. For example, projects solving issues related to environmental, social, and community aspects are popular among women, while projects related to technological development are more often implemented by men.

The results of this study indicate that the primary areas for improvement in addressing gender equality in agriculture include placing greater emphasis on gender equality in policy documents, raising societal awareness, providing clear and targeted dissemination of information, enhancing rural infrastructure, and reducing bureaucratic barriers while improving mentoring services. These measures are crucial for fostering an inclusive and equitable agricultural sector.

More specifically, the study provides evidence for the need to develop targeted support programs that address the specific barriers faced by women in agriculture, such as limited access to resources, technology, and training. Policies could focus on financial support for women-led farms, facilitating

access to technology, and offering tailored training programs that build both technical and managerial skills. Additionally, policies could include incentives to increase women's participation in decision-making roles within agricultural organizations.

The findings also highlight the necessity of inclusive educational policies that go beyond formal agricultural education. Such policies should promote lifelong learning opportunities tailored to women, including digital literacy and access to modern agricultural technologies, enabling them to engage more effectively in innovative practices. To foster a positive, gender-equitable environment that supports agricultural innovation, the improvement of rural infrastructure is essential, such as childcare facilities, transportation, and access to education, strengthening parental leave policies to encourage equal sharing of childcare responsibilities between men and women, and incentivizing paternity leave through policy reforms and awareness campaigns to promote its uptake. These improvements would help alleviate some of the domestic and social responsibilities that disproportionately hinder women's participation in agricultural innovation, ultimately contributing to a more equitable and innovative agricultural sector.

Support for small farms under the CAP is key to promoting gender equality and inclusion in agriculture. These farms, which often face unique challenges, such as limited access to finance, technology, and markets, would greatly benefit from tailor-made advisory support packages. Such packages could provide comprehensive advisory services specifically designed for women-owned and small farms, helping them navigate administrative processes, access resources, and maximize their participation in investment projects.

6.2. Limitations and future research areas

Future research could focus on investigating the effectiveness of existing policies and support systems aimed at encouraging women's participation in agricultural innovation. This would involve comparing the outcomes of different policy frameworks within the EU and beyond to better understand which policies are most effective. Such insights could guide future policy development and help tailor support systems to better meet the needs of women innovators.

Additionally, analyzing successful case studies of innovative business models led by women in rural areas would allow for the identification of best practices and scalable solutions that can be applied in similar contexts.

Another important area of future research is examining how access to digital tools, technology, and Artificial Intelligence influences the ability of women to innovate in agriculture. While technology can be a powerful enabler for innovation, women often face additional barriers in accessing and utilizing these tools. Understanding these challenges is crucial for designing effective interventions.

In the context of Lithuania, future research could be facilitated by utilizing FADN (Farm Accountancy Data Network) data disaggregated by gender. Lithuania possesses robust data collection systems for agricultural and socio-economic statistics, enabling detailed analysis of gender disparities and progress over time. Integrating qualitative and quantitative data would provide a comprehensive understanding of current conditions, trends, and determining factors, thereby enabling the formulation of targeted support measures to promote the implementation of innovations in agriculture.

The limitations of this research primarily stem from its focus on Lithuania as a single case study. While this analysis provides valuable insights into the role of women farmers as innovators and the barriers to innovation they face, these findings should be contextualized within Lithuania's unique historical path, including its transition from a Soviet command economy to a market economy and, since 2004, its EU membership. The GRASS CEILING project will enable comparisons across nine European countries, though the study could be expanded to cover all EU countries, revealing both the differences and commonalities that could inform relevant decisions in shaping the EU CAP.

The study addresses gender differences, but it does not incorporate other social or economic factors, therefore in future research the additional layers of inequality could provide a more nuanced perspective. Additionally, this research provides a snapshot of the situation at a specific point in time. To ensure comparability and to identify trends, longitudinal studies in future should be conducted to capture changes over time.

Ethics

All materials and procedures used in this study were approved by the Ethics Committee of the Lithuanian Centre for Social Sciences under decision number 1G-85. Audio recordings and transcriptions of focus groups and interviews are stored safely and organized in accordance with data safety requirements.

CRediT authorship contribution statement

Vida Dabkiene: Writing – original draft, Investigation, Formal analysis, Conceptualization. **Indre Siksnelyte-Butkiene**: Investigation, Formal analysis, Conceptualization. **Dalia Streimikiene**: Writing – re- view & editing, Methodology, Conceptualization. **Vaida Sapolaite**: Visualization, Investigation, Data curation. **Tomas Balezentis**: Writing – review & editing, Methodology, Investigation, Funding acquisition.

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Data availability

Data will be made available on request.

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Indre Siksnelyte-Butkiene is a Senior Researcher at Lithuanian Centre for Social Sciences. She has published in such journals as Sustainable Cities and Society, Energy, Journal of Cleaner Production, and Sustainable Energy Technologies and Assessments, among others. Her main research interests include sustainable energy, integrated assessment, and systematic literature reviews.

Vida Dabkiene is a research fellow at Lithuanian Centre for Social Sciences. Her research focuses on agricultural sustainability, composite indicators, and agricultural economics. She has published in Journal of Cleaner Production, Sustainable Production and Consumption, and Journal of Business Research.

Dalia Streimikiene is research professor at Lithuanian Centre for Social Sciences and a professor at Vilnius University (Lithuania). Her main research areas are linked to assessment of public acceptance of energy technologies, sustainability assessment of energy technologies by applying MCDM.

Vaida Sapolaite is a research fellow at Lithuanian Centre for Social Sciences and holds a PhD degree in economics. Her expertise includes agricultural economics, agricultural accounts, and productivity analysis. She has participated in national and international research projects and published in international journals.

Tomas Balezentis is a research professor at Lithuanian Centre for Social Sciences and a professor at Vilnius University (Lithuania). He holds PhD degrees from Vilnius University and University of Copenhagen. The research activities of Dr. Balezentis span over multi-criteria decision making, agricultural economics, energy economics, and managerial economics. He has published in European Journal of Operational Research, Decision Sciences, Technological Forecasting and Social Change, Energy Economics, Energy Policy, and Resource and Environmental Economics.