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GENDER, WOMEN'S BARRIERS AND INNOVATION IN AGRICULTURE: A SYSTEMIC LITERATURE REVIEW



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Abstract: Agricultural innovations, coupled with the pivotal role of women in their implementation, are increasingly recognized as essential for advancing sustainable agricultural practices and contributing to the achievement of the Sustainable Development Goals. The article provides a systematic literature review (SLR) on gender women's barriers and innovation in agriculture. To achieve this, scientific publications based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method was conducted. This paper reviews 539 articles in the ISI Web of Science. The SLR analysis allowed the identification of several key literature nodes such as the most cited articles, the most productive countries, and the most popular keywords. The analysis of the five most-cited articles authored by researchers affiliated with European institutions, along with a review of relevant research from European countries, reveals limited attention to the research field within the European context. Research points to persistent barriers for women in agriculture, including social norms, gender stereotypes, and structural inequalities, which hinder access to resources and leadership. These challenges are evident in both developing and developed countries, reflecting slow progress in addressing gender disparities globally.

Keywords: gender norms, women's empowerment, innovations in agriculture, PRISMA

Highlights

- A rise in articles on gender norms, barriers, and women-led innovation in agriculture policies
- UN Sustainable Development Goals, particularly Goal 5
- The impact of climate change on women in agricultural settings
- Social norms, gender stereotypes, and inequalities in both developed and developing countries
- Articles affiliated with European institutions lead global research on gender and agriculture

1. Introduction

The agricultural sector plays a crucial role in the world despite it accounts for around 4% of global Gross Domestic Product (GDP). In some of the least developed countries, it can account for more than 25% of their GDP. Above this, agricultural activities also provide for home subsistence and informal markets. Agricultural innovation is recognized as a valuable tool for alleviating poverty for the 75% of the world's poor who live in rural areas and work mainly in agriculture. The growth of the agricultural sector is considered two to four times more effective in raising the incomes of the poorest compared to other sectors (Worldbank, 2024). However, climate change, various disease outbreaks (such as COVID-19), and conflicts (such as Russia's war in Ukraine) threaten food supply and security. Therefore, sustainable agricultural development, led by sustainable agricultural innovation, is recognized as a way to address the challenges facing agriculture and to achieve the Sustainable Development Goals (Rosário et al., 2020; Campuzano et al., 2023).

Some researchers have sought to clarify the concepts and methods used in practice to model innovation in agriculture (Montes de Oca Munguia et al., 2021) or shedding light on the importance and relevance of certain innovations (Piliai, 2022; Niedbała and Kujawa, 2023; da Silva et al., 2024). Meanwhile, others aim to identify barriers and factors to innovation in the agricultural sector (Long et al., 2016; Campuzano et al., 2023; Silva et al., 2023; Dunchev and Beluhova-Uzunova, 2023). One of the factors influencing the innovations adoption on farms is gender (Alarcón and Bodouroglou, 2014; Brown et al., 2019; Danso-Abbeam et al., 2019; Badstue et al., 2020; Aznar-Sánchez et al., 2020; Kaliba et al., 2020; Rizzo et al., 2023). Despite women's active role in agriculture and their perception of themselves as farm managers and decision-makers, social stereotypes still prevail, depicting men as the owners and managers of the farm, though women farmers' experiences are not the same in different contexts (Tsiaousi and Partalidou,

2021). As Badstue et al. (2020) argued, addressing gender norms is crucial to creating an enabling environment for agricultural innovation. Their research, part of the GENNOVATE (Enabling Gender Equality in Agricultural and Environmental Innovation) initiative, emphasizes that while agricultural interventions often seek to close gender gaps, they frequently overlook the deep-rooted social norms that perpetuate inequality. Challenging these norms is essential for fostering gender-equitable development in agriculture. Alarcón and Bodouroglou (2014) emphasized the importance of developing gender-sensitive policies that are adjusted to the specific socio-economic and cultural contexts in which women operate. Their study suggests that policy interventions should account for regional differences in access to resources, technology, and decision-making power to enhance women's contributions to agricultural innovation and food security. Though, to create lasting gender-transformative changes, innovation programs must critically examine and challenge gender norms. More research is needed on various gender approaches and indicators to measure progress toward gender equality, focusing on a broader social, historical, and political context (Sachs et al., 2020). Bock and Shortall (2017) demonstrated that while rural development programs often aim to address gender equality, they frequently fail to challenge entrenched cultural norms, leaving women marginalized in both policy and practice, particularly in agriculture. Shortall and Marangudakis (2023) provide critical insights into why agricultural policies at the European Union (EU) level fail to effectively promote gender equality. According to their findings, two main factors contribute to this issue. First, the influence of powerful agricultural lobbying groups shapes EU agricultural policy in ways that prioritize other interests over gender equality. Second, weak and ineffective lobbying for gender equality, combined with a lack of binding requirements and political will, hinders the successful implementation of gender equality principles in this domain. This imbalance underscores the structural barriers that prevent gender issues, such as the challenges faced by women farmers, from receiving adequate attention within agricultural policy frameworks. Farnworth et al. (2018) further emphasize that agricultural innovations and policies must be strongly context-specific and gender-sensitive, as the diverse realities faced by women highlight the importance of tailoring interventions to local socio-cultural conditions. The findings of Devkota et al. (2022) support these insights showing that even when gender mainstreaming is prioritized at the national level, as seen in Nepal, it often fails to create meaningful change at the local scale.

The scientific literature presents divergent opinions and conclusions regarding agriculture and innovation. For instance, Doss (2018) addresses the question: can investments in agricultural technology be utilized to address gender disparities and alleviate poverty? Could an agricultural investment strategy tailored towards women yield a dual benefit of enhancing gender equality while simultaneously boosting overall productivity? Conversely, Curry et al. (2021) highlighted that innovations have the potential to disrupt key aspects of social structure, such as gender and intergenerational relations, which may lead to societal challenges through destabilizing the existing moral and hierarchical order that governs relationships among individuals and groups. As Quisumbing et al. (2014) emphasized, closing the gender gap in agriculture would not only improve productivity but also bring social benefits by providing women with equal access to resources and decision-making power in the agricultural sector.

Do European women face gender inequality when implementing innovations in agriculture? Following the 5 main indicator groups of the Women's Empowerment in Agriculture Index (IPFRI, 2024), we look into production, resources, income, leadership, and time to assess women's inclusion in the agricultural sector. EU statistics reveal that gender equality in European agriculture is not ensured. In 2020, production, measured by standard output per farm, constituted 37.8% of women's contributions compared to men's in the EU-28. Assessing one of the most crucial resources in agriculture, land, on average, only 17.4% of utilized agricultural area was managed by women in the EU-28. Women's labour, measured by annual work units, accounted for an average of 24.9% of total agricultural work. Leadership, evaluated by the number of farms managed by women, reveals that 31.6% of farms were managed by women in the EU-28 in 2020. In rural areas, women's income, assessed by mean equivalized net income in rural areas in 2022 in the EU-27 countries, were on average 3.9% lower than men's. It is also worth mentioning that when observing each indicator separately for individual EU countries, the situation varies, which implies an even greater need for research. Therefore, researchers are exploring the barriers faced by women agricultural innovators in various contexts.

This article employs a systematic literature review (SLR) of indexed literature from the Web of Science (WoS) to explore potential trends and analyse the most frequently cited studies. This approach aims to support the further development of research in the field. Additionally, this study focuses on identifying and analysing the barriers to the adoption of innovations led by women in agriculture. By highlighting these barriers, as argued by Tsiaousi and Partalidou (2021), it becomes possible to break the glass ceiling and achieve meaningful social change, challenging the patriarchal structures that continue to dominate the agricultural sector.

The remainder of this paper is structured as follows: Section 2 describes the materials and method used to collect and proceed the data. Section 3 presents the results and discussion. Lastly, the conclusion, limitations and suggestions for future research are presented in Section 4.

2. Materials and method

The systematic literature review (SLR) was carried out using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method, as outlined by Koutsos et al. (2019), Cavazza et al. (2023), Silva et al. (2023), and Rizzo et al. (2023). The research question focused on four main keywords: gender, agriculture/farming, innovation in agriculture, and barriers. These search terms were selected based on a thorough literature review, drawing from the works of Farooq et al. (2020), Zougmoré and Partey (2022), Rizzo et al. (2023), and Brannan et al. (2023) (Table 1). Data were retrieved on October 6, 2024. The search parameters included the title keyword Gender and the topics Agriculture/Farming, Innovation in Agriculture, and Barriers, with the document type restricted to Articles. Review articles were excluded, and a geographic filter was applied to focus on studies conducted in European countries.

The PRISMA analysis followed the stages recommended by Koutsos et al. (2019) and adopted for this research, including identification, screening, eligibility, and reporting (Figure 1). It is important to note that, as in the study by Koutsos et al. (2019), this SLR also included introductory/pilot work. A search was conducted for previous systematic reviews on the same or similar issues. However, none of the previous systematic reviews specifically addressed the topic investigated in this paper. Nevertheless, in related studies, the use of search keywords and the construction of search strings have been addressed. Additionally, a suitable database for searching relevant publications was identified. Based on previous studies (Koutsos et al., 2019), publications were retrieved for analysis from the ISI Web of Science (WoS). However, this approach has certain limitations. The exclusive focus on WoS may result in incomplete coverage of relevant materials, such as scientific articles published in peer-reviewed volumes, handbooks, PhD theses, and journals not indexed in WoS. Additionally, the use of the PRISMA approach for publication filtering may have led to the omission of some relevant research. For presenting the results, the Visualisation of Similarities (VOS) viewer (van Eck and Waltman, 2010) was chosen. The VOSviewer platform offers optimal possibilities for displaying bibliometric maps in an easy-to-understand way for any audience (Bhagat et al., 2022).

The Web of Science (WoS) identified 1,836 articles based on the search string spanning the period from 1990 to 2024. In the second stage, the articles retrieved from WoS were screened through WoS categories, including Economics, Development Studies, Environmental Sciences, Environmental Studies, Agricultural Multidisciplinary, Green Sustainable Science Technology, Sociology, Women's Studies, Agricultural Economics & Policy, Social Science Interdisciplinary, Agronomy, Multidisciplinary Sciences, Agricultural Engineering, and Business Finance (N=878).

Tab 1. Search keywords used for literature identification in WoS. Source: own research

	Context	Searching string keys
1 Title	Gender	"gender*" OR "women*" OR "female*" OR "femin*"
2 Topic	Agriculture/ farming	"farm*" OR "agri*" OR "agro*" OR "primary producer*" OR "agri-food farm*" OR "organic agriculture" OR "biological agriculture*" OR "home garden*" OR "processing" OR "livestock" OR "ruminant" OR "crop-livestock" OR "animal husbandry" OR "animal production" OR "animal raising" OR "animal rearing" OR "pasture" OR "silvopast*" OR "pastoral system" OR "aquac*" OR "fish farm*" OR "fish production" OR "integrated aquaculture*" OR "aquaforest" OR "fish pond" OR "fish tank" OR "horticultur*" OR "cereal*" OR "dairying*" OR "pig farm*" OR "poultry farm*"
3 Topic	Innovation in agriculture	"innovat*" OR "precision agri*" OR "precision farm*" OR "no-till farming" OR "conservation tillage" OR "crop rotation innovations" OR "soil health innovat*" OR "sustainable agri*" OR "sustainability of agri*" OR "sustainable prod*" OR "digitalization" OR "agricultural technolog*" OR "agricultural transform*" OR "agricultural transition" OR "conservat* agri*" OR "vertical farm*" OR "climate smart" OR "climate adapt*" OR "farm* smart" OR "smart farm*" OR "climate-resilient crop*" OR "smart irrigation" OR "artificial intelligence" OR "cameras" OR "sensors" OR "GPS" OR "internet of things" OR "robotics" OR "drones" OR "mobile apps" OR "AgTech solution*"
4 Topic	Barriers	"barrier*" OR "obstacle*" OR "constraint*" OR "hind*" OR "challenge*" OR "lever*" OR "driver*" OR "enabl*" OR "opportunit*" OR "lock-in*" OR "impediment*" "restriction*" OR "bottleneck*" OR "limitation*" OR "shortcoming*" OR "trigger*"
5 Document type		Article
6 Topic		"literature review" OR "systematic review" OR "review article" OR "state of the art" OR "theoretical review" OR "scoping review" OR "narrative review" OR "overview of research" OR "synthesis of research" OR "survey of research" OR "evidence synthesis" OR "knowledge synthesis" OR "bibliometric review" OR "surveys the literature" OR "literature survey"
Research filter to examine studied European countries		
7 Topic	Countries	"nordic countr*" OR "baltic state*" OR "balkan" OR "europ*" OR "european union*" OR "EU" OR "non-eu europ*" OR "eurozon*" OR "non-euro EU countr*" OR "Alban*" OR "Andorr*" OR "Austri*" OR "Belgium" OR "Belgian" OR "Bosni*" OR "Bulgar*" OR "Croat*" OR "Cyprus" OR "Cypriot" OR "Czech*" OR "Denmark" OR 'Danish" OR "Eston*" OR "Finland" OR "Finnish" OR "France" OR "French" OR "German*" OR "Deutsch" OR "Greece" OR "Greek" OR "Hungar*" OR "Iceland*" OR "Ireland" OR "Northern Ireland" OR "Irish" OR "Ital*" OR "Kosov*" OR "Latv*" OR "Liechtenstein*" OR "Lithuan*" OR "Luxembourg*" OR "Malt*" OR "Monac*" OR "Monegasque" OR "Montenegr*" OR "Netherland" OR "Dutch" OR "North Macedon*" OR "Norway*" OR "Norwegian" OR "Poland" OR "Polish" OR "Portug*" OR "Roman*" OR "San Marin*" OR "Sammarinese" OR "Serb*" OR "Slovak*" OR „Sloven*" OR "Spain" OR "Spanish" OR "Sweden" OR "Swedish" OR "Switzerland" OR "Swiss" OR "Turkey" OR "Turkish" OR "Ukrain*" OR "United Kingdom*" OR "UK" OR "Britain" OR "British" OR "Scotland" OR "Scottish" OR "Wales" OR "Welsh"

Note: in WoS, the use of the asterisk * allows for a broad search covering multiple variations of a root word. For example, searching for agri* retrieve results for "agriculture", "agricultural", "agribusiness", etc., because the search term matches any word starting with a root "agri". The quotation marks " " are used to search for an exact phrase, preserving the word order and structure within the quotes.

Additionally, articles were filtered at the WoS meso level citations topics, choosing Agricultural Policy, Gender & Sexuality Studies, Climate Change, Nutrition & Dietetics, Forestry, Management, Economics, Sustainability Science, and Crop Science (N=658). In the subsequent stage, the titles and abstracts of each article were reviewed to identify and exclude those not relevant to the research area and the duplicated records. After reviewing the abstracts, 539 articles were selected for detailed analysis. To select studies focused on European countries, an additional search string was used, consisting of the official names of individual European countries, as well as broader terms reflecting regional, political or economic groupings of countries (Figure 1).



Fig 1. PRISMA stages. Source: own research

3. Results and discussion

3.1 Research distribution across years, geographies and publishers

Figure 2 shows the entire distribution of publications on gender, barriers, and innovation in agricultural research from 1994–2024. As publication trend indicates contemporary interest in the issue emerged in 1994 with publishing four articles.

The empirical evidence shows a clear pattern: up until 2014, the number of scholarly articles on this subject remained consistently low, averaging four articles per year. However, after 2014, there has been a notable increase, with an average of forty-two articles per year. A similar result was observed by Kovaleva et al. (2021) for gender issues in climate change which became broadly acknowledged in the field of agricultural research, particularly from 2015 onward. Since then, the adoption of the United Nations Sustainable Development Goals (SDGs), especially Goal 5 (UN, 2015), which aims to achieve gender equality and empower all women and girls, appears to have played a significant role in driving scientific research on gender equality. This global framework has provided a clear mandate for both policymakers and researchers to focus on gender issues, fostering increased attention to gender disparities across various sectors, including agriculture.

This publication trend lends itself to a bifurcation into two distinct stages: an initial stage characterized by a sluggish output (in total 77 articles), succeeded by a stage of growth (in total 462 articles). Such

a trajectory underscores the burgeoning scholarly attention and intensified interest among researchers towards this thematic domain.

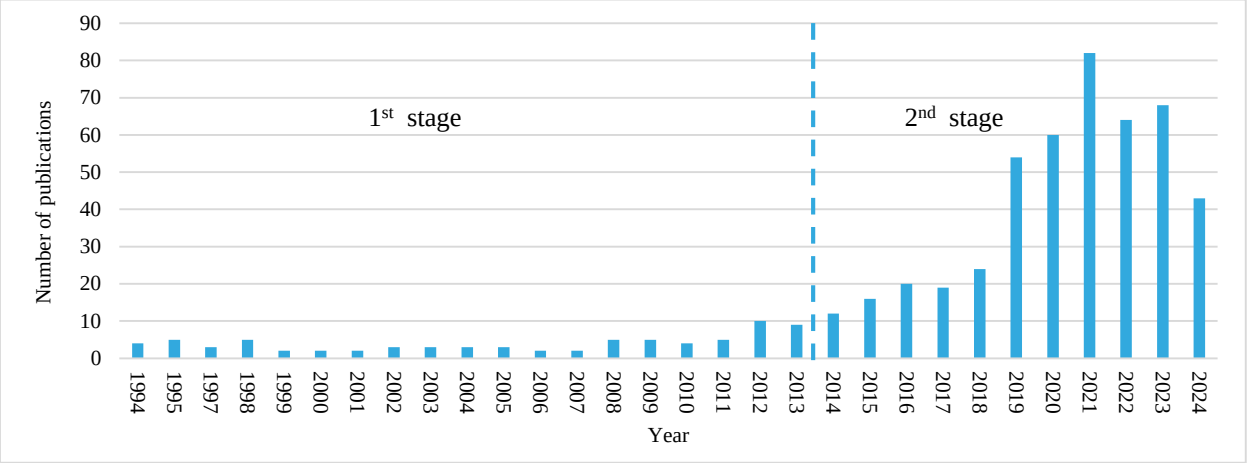


Fig 2. Trend analysis of articles on gender barriers, and innovation in agriculture from 1994 to October 6, 2024. Source: own research

The five most cited articles from each period were analysed in detail, highlighting the barriers faced by women identified in these studies. The articles from the more recent period (2014–2024) generally have higher citation counts compared to the earlier period (1994–2013). For instance, Jost et al. (2016) has 215 citations, while the highest citation from the earlier period is Djoudi and Brockhaus (2011) with 132. This suggests that gender-related research in agriculture and innovation adoption has gained more attention and influence in recent years. Studies focusing on the intersection of gender, agriculture, and climate change, such as Jost et al. (2016) and Eastin (2018), are particularly highly cited, reflecting growing academic and policy interest in how climate change disproportionately affects women in agricultural settings.

The studies from the 2014–2024 period focus on gender-specific barriers, such as inequity in access to resources, decision-making power, and involvement in agricultural organizations, representing a shift from earlier studies, which primarily concentrated on access to land and labour issues. The earlier period (1994–2013) includes studies from both developed countries (Northern Ireland and the USA) and developing countries (Mali, Ghana, Uganda), while the later period (2014–2024) focuses exclusively on developing countries, such as Uganda, Ghana, Bangladesh, Kenya, Myanmar, Indonesia, and the Philippines, highlighting that attention to the issue remains particularly focused on in developing regions.

Research conducted during the later period (2014–2024) identifies a broad and diverse set of barriers faced by women in agriculture and innovation adoption. The social norms, gender stereotypes, and structural inequalities continue to limit women's access to resources, decision-making power, and leadership roles. Studies show that these challenges are not confined to developing countries but are also present in developed countries, indicating that the pace of change in dismantling gender barriers is slow across different contexts (Table 2).

Tab 2. Barriers faced by women regarding innovations in agriculture: most cited studies from 1993–2013 and 2014–2024. Source: own research

1993–2013				2014–2024			
Authors	Citations in WoS	Gender issues	Key barriers identified	Authors	Citations in WoS	Gender issues	Key barriers identified
Djoudi and Brockhaus (2011)	132	Climate change adoption by women farmers in Mali	Increased workload without increased income; Defeminization of agricultural activities; Loss of access to land; Insecure land tenure; Social restrictions on access to markets; Increased workload due to male migration; Lack of automatic acquisition of rights; Under recognition of women's contributions; Societal and cultural barriers; Limited access to markets and value chains.	Jost et al. (2016)	215	Gender analysis of climate-smart agriculture and climate adaptation strategies in the context of smallholder farmers in Uganda, Ghana and Bangladesh.	Uganda: Limited access to resources; Higher labour demands; Mobility constraints. Ghana: Land ownership issues; Labor-intensive tasks; Mobility limitations. Bangladesh: Marginalization in extension services; Limited property rights; Social mobility restrictions.
Carr (2008)	116	Gender patterns of cropping in Ghana	Gendered production roles; Limited access to resources; Vulnerability to environmental shocks; Land tenure issues.	Ndiritu et al. (2014)	181	Gender differences in the adoption of sustainable intensification practices in agriculture in Kenya	Access to resources; Labor and time constraints; Decision-making power.
Shortall (2002)	104	Women's off-farm work and their participation in rural development policy and practice in Northen Ireland	Off-farm work undervalued; Cultural and gender norms; Gendered control of resources; Gender ideology in agriculture; Exclusion from rural development; Superficial inclusion; Time lag in changes.	Akter et al. (2017)	157	Gender inequity and women's empowerment in agriculture in Myanmar, Thailand, Indonesia, and the Philippines	Indonesia: Limited decision-making power; Limited access to resources; Low representation in agricultural organizations; Lack of access to extension services. Myanmar: Exclusion from formal agricultural groups; Limited access to land ownership; Minimal involvement in decision-making processes;

							Lack of organized opportunities for women in agriculture. Philippines: High levels of time-related drudgery; Overburdened with both farming and household responsibilities; Health issues due to workload; Active decision-making but insufficient off-farm income opportunities. Thailand: Limited leadership roles in agricultural organizations; Time management challenges during peak farming seasons; relatively better decision-making power but still room for improvement in community-level participation.
Jarosz (2011)	103	Motivations of women farmers in community-supported agriculture in USA	Economic viability; Balancing work and family; Limited support from partners; Gender stereotypes; Social and cultural expectations; Labor intensive work.	Perez et al. (2015)	154	Gender disparities in access to resources and services in East and West African countries	Limited access to land and other resources; Limited external support, dependence on informal social networks; Inadequate training and extension services.
Canagarajah et al (2001)	98	Non-farm income, gender, and inequality in rural Ghana and Uganda	Limited non-farm opportunities; Self-employment challenges; Gendered nature of work; Education and capital barriers.	Eastin (2018)	131	Impact of climate change on gender equality and women's rights in developing countries	Limited access to land and other resources; Increased workload due to male migration; Power imbalances in the household due to women’s low capacity to generate independent income.

Observing the countries dedicated to producing research on gender equality in the context of innovation implementation in agriculture, it was identified which continents and countries at both the global and European scales were identified. According to continent-based data from the WoS database, authors affiliated with European institutions lead the research field, contributing 252 articles, which represent 47% of the total. Authors affiliated with African institutions hold the second position with 247 articles (46%), followed by North America in third place with 181 articles (34%). Asia ranks fourth with 176 articles (33%), while Oceania and South America lag behind with 48 articles (9%) and 18 articles (3%), respectively. It should be noted, however, that a single article may have authors affiliated with institutions in multiple countries.

Analyzing the articles across countries based on author affiliations, authors affiliated with institutions in the USA contributed the highest number of articles, with 144 publications (27%) and 2,899 citations. Regarding research conducted by authors affiliated with European institutions, those in Germany, England, the Netherlands, Italy, Sweden, and France lead in studies on gender norms, barriers, and women-led innovation in agriculture, with a total of 165 publications. Authors affiliated with institutions in Germany stand out as the most productive, accounting for 9% of the total 539 articles, with 566 citations (Figure 3).

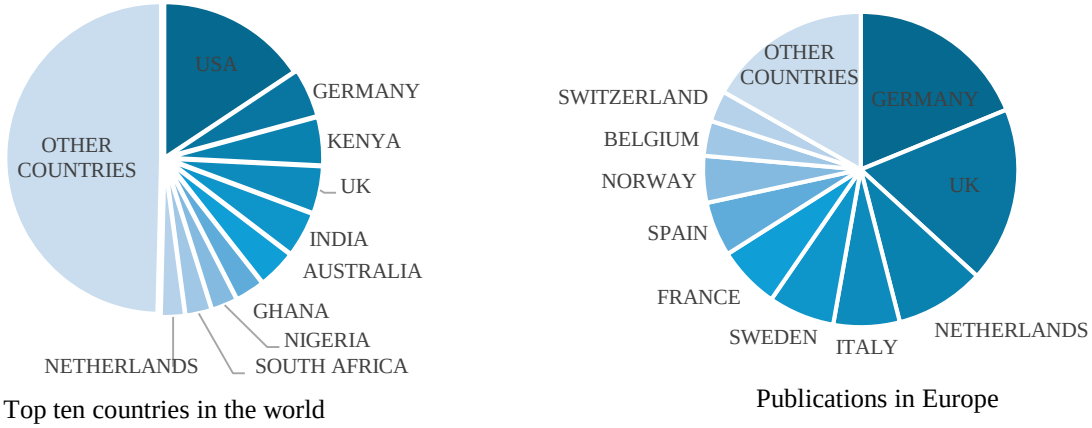


Fig 3. Distribution of the articles based on geographies. Source: own research

3.2 The main publishers and primary authors of the articles selected for the SLR

Based on data from the WoS, Figure 4 illustrates the primary international journals that published research on gender norms, barriers, and women-led innovation between 1994 and 2024.

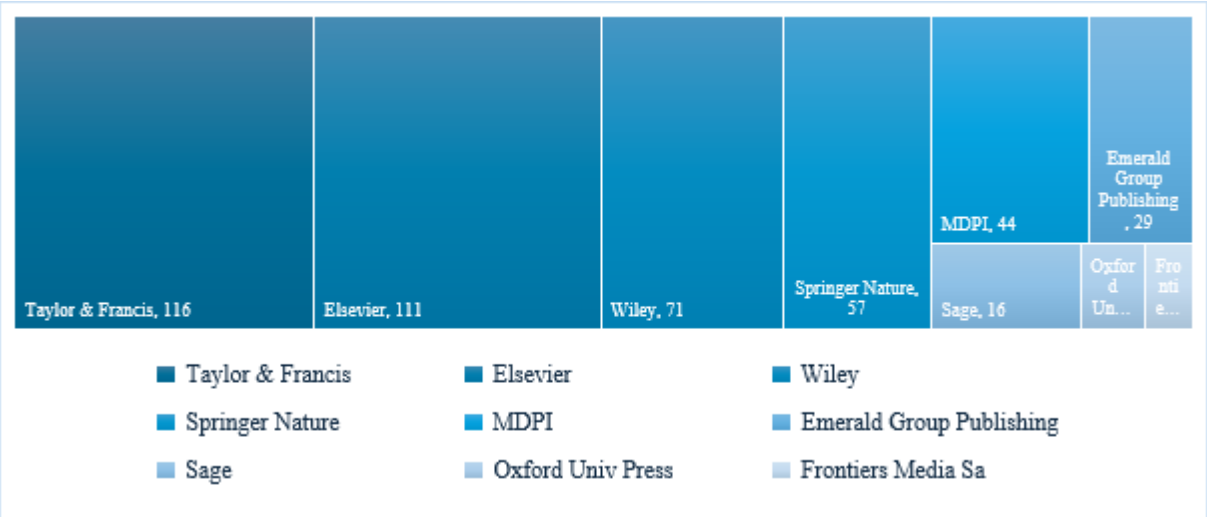


Fig 4. Number of articles on gender norms, barriers, and women-led innovation in agriculture by the main publishers (1993–2024). Source: own research

The top ten publishers shown in the figure collectively account for 444 articles on the topic, representing 82% of the total publications. Taylor & Francis, with 116 articles, and Elsevier, with 111 articles, are the leading publishers in this field.

3.3 Overview of the five most-cited articles by authors affiliated with European institutions

The primary organization, accounting for about 40% of the articles selected for analysis, and to which the articles related to gender equality and barriers to innovation adoption in agriculture are affiliated, is the CGIAR (Consultative Group on International Agricultural Research) research centres. At the European level, Wageningen University & Research leads with 16 articles.

Five top-cited articles from authors affiliated with European institutions, according to WoS, on gender norms, barriers, and women-led innovation in agriculture, are presented in Table 3. The most globally cited article, authored by Jost et al. (2016), explores the impact of gender norms on the adoption of climate-smart agricultural practices in smallholder farming communities across Uganda, Ghana, and Bangladesh. This article is one of the most cited on this topic, regardless of the authors' institutional affiliation (see Table 2). The study employed participatory rural appraisal methods, including gender-separated focus groups, Venn diagrams, and key informant interviews, to collect qualitative data on gender roles and climate adaptation strategies. The research revealed that women face significant barriers in accessing labour and cash necessary to implement new agricultural practices in Uganda. Adaptation strategies like soil and water conservation often require additional labour, which disproportionately affects women. Moreover, social norms restrict women's mobility, making it difficult for them to engage in farmer-to-farmer learning or attend extension programs. In Ghana, the inability of women to own land was found to diminish their incentive to adopt new agricultural practices, as practices like composting increase their labour burden. Additionally, women's limited access to funds and transportation further hinders their ability to travel and learn from other farmers or adopt new technologies. The case of Bangladesh disclosed women's very limited property rights and national policies that define farmers as landowners exclude them from receiving agricultural extension services. Furthermore, their mobility is constrained by social norms, which limits their ability to gather agricultural information and participate in farmer-to-farmer learning.

The second most-cited research, conducted by Perez et al. (2015) discusses the resilience of farming households and communities to climate change in nine African countries, with a focus on gender differences in vulnerability and adaptation. The methodology used in the article is a combination of quantitative household surveys and qualitative village focus group studies, conducted across eleven sites in nine countries in East and West Africa (countries include Ethiopia, Kenya, Tanzania, Uganda, Burkina Faso, Ghana, Mali, Niger, and Senegal). It was found that women in agriculture have limited access to land and agricultural resources, making it difficult for them to improve productivity. Women have less access to agricultural technology, credit, and training, which are crucial for adapting to climate change and other challenges. The research identified that women are generally excluded from decision-making processes, particularly in the management of natural resources. Female-headed households often experience higher levels of food insecurity compared to male-headed households. Cultural norms and gender roles often limit women's participation in formal institutions that could support their agricultural efforts.

The study conducted by Shortall (2002) is a case study of Northern Ireland, focusing on how Common Agricultural Policy (CAP) reforms have impacted women's roles in agriculture and rural development. The study employs focus group interviews with men and women on farms, as well as rural development stakeholders, to gather qualitative data on gender relations in farming and rural development. The findings are based on discussions with 107 participants from various backgrounds across Northern Ireland. It was identified that part-time farming and off-farm work, often undertaken by women, do not lead to greater equality within the household. Despite women contributing financially through off-farm employment, farming remains viewed as a male-dominated occupation, and women's contributions are largely framed as supporting the primary farming activity rather than shifting gender roles. In rural development, even though efforts are made to involve women, the male-dominated structures of rural development policies and programs mean that gender inequalities persist, and women's participation does not lead to significant shifts in gender power dynamics.

The study by Mutenje et al. (2019), which ranks as the fourth most cited, evaluated the economic viability of climate-smart agriculture (CSA) technologies in Malawi, Mozambique, and Zambia, with a focus on gender-differentiated barriers to adoption. The researchers employed a cost-benefit analysis (CBA),

stochastic dominance analysis, and a dynamic mixed multinomial logit model to assess the economic benefits of various CSA technologies. Data was collected from households and complemented by focus group discussions in each country to better understand community-level trends and barriers to CSA adoption. The findings indicate that in Malawi, women face significant challenges in adopting CSA practices due to limited access to resources such as agricultural inputs, labour, and decision-making power, especially in low-potential areas. In Mozambique, female-headed households in both high- and low-potential areas struggle with adopting labour-intensive technologies due to a lack of access to extension services and labour. In Zambia, women encounter limited access to high-investment CSA technologies due to socio-economic constraints, including restricted control over household resources. The authors emphasized that promoting women's active participation in household decision-making is critical to enhancing the capacity of smallholder farmers to select and adopt suitable CSA options.

The article by Galiè et al. (2019) introduces the Women's Empowerment in Livestock Index (WELI), a tool developed to measure women's empowerment in the livestock sector. The study is based on pilot data collected from four districts in Tanzania, where livestock plays a crucial role in rural livelihoods. The research employs a mixed-methods approach, utilizing focus group discussions, in-depth interviews, and quantitative surveys involving 373 women from livestock-dependent households. The WELI measures six dimensions of empowerment, including control over resources, decision-making, and workload, providing both qualitative and quantitative insights into women's empowerment in livestock production. The findings highlight significant gendered divisions in livestock management, with women primarily responsible for smaller livestock, such as poultry, while men dominate the management and decision-making around larger livestock, such as cattle. Additionally, women have limited access to credit and extension services, which hampers their ability to expand or commercialize their livestock production. The lack of control over income from livestock sales further diminishes women's financial independence and constrains their economic empowerment.

The analysis of the five most-cited articles from authors affiliated with European institutions reveals a consistent theme: the significant impact of gender norms and barriers faced by women in the agricultural sector globally. These barriers include limited access to resources, restricted land ownership, and cultural constraints, which impede women's ability to fully participate in and benefit from agricultural innovation and climate-smart practices.

Furthermore, the research highlights the global relevance of including gendered impacts, showing that gender challenges are not region-specific but occur across diverse contexts, from smallholder farming in Africa and Asia to rural development in Europe (Northern Ireland). However, it is worth noting that four out of the five analysed articles focus on Africa and Asia, rather than Europe.

Tab 3. Top five articles from authors affiliated with European institutions according to citations. Source: own research

No.	Title	Citations in WoS	Journal name	Publisher name	Impact factor	Ref.
1.	Understanding gender dimensions of agriculture and climate change in smallholder farming communities	215	Climate and development	Taylor & Francis Ltd	4.3	Jost et al. (2016)
2.	How resilient are farming households and communities to a changing climate in Africa? A gender-based perspective.	154	Global environmental change-human and policy dimensions	Elsevier SCI Ltd	10.5	Perez et al. (2015)
3.	Gendered agricultural and rural restructuring: a case study of Northern Ireland	104	Sociologia Ruralis	WILEY	3.8	Shortall (2002)
4.	A cost-benefit analysis of climate-smart agriculture options in Southern Africa: Balancing gender and technology	95	Ecological economics	Elsevier	6.9	Mutenje et al. (2019)
5.	The Women's Empowerment in Livestock Index	83	Social indicators research	Springer	3.2	Galiè et al. (2019)

3.4 Overview of articles based on research conducted in European countries

A total of 39 articles were selected that analyse gender norms, barriers, and women-led innovation in European agriculture. From 1994 to 2024, an average of two articles were published per year, with the highest number in 2020 and 2024, at four articles each. In terms of country-specific research, Spain and Turkey received the most attention, with five articles each, followed by France and Norway, with four articles each. Figure 5 provides co-authorship (not-connected) network visualization of 79 authors, which conducted research in European countries. The connected clusters indicate groups of authors who have collaborated on research together.

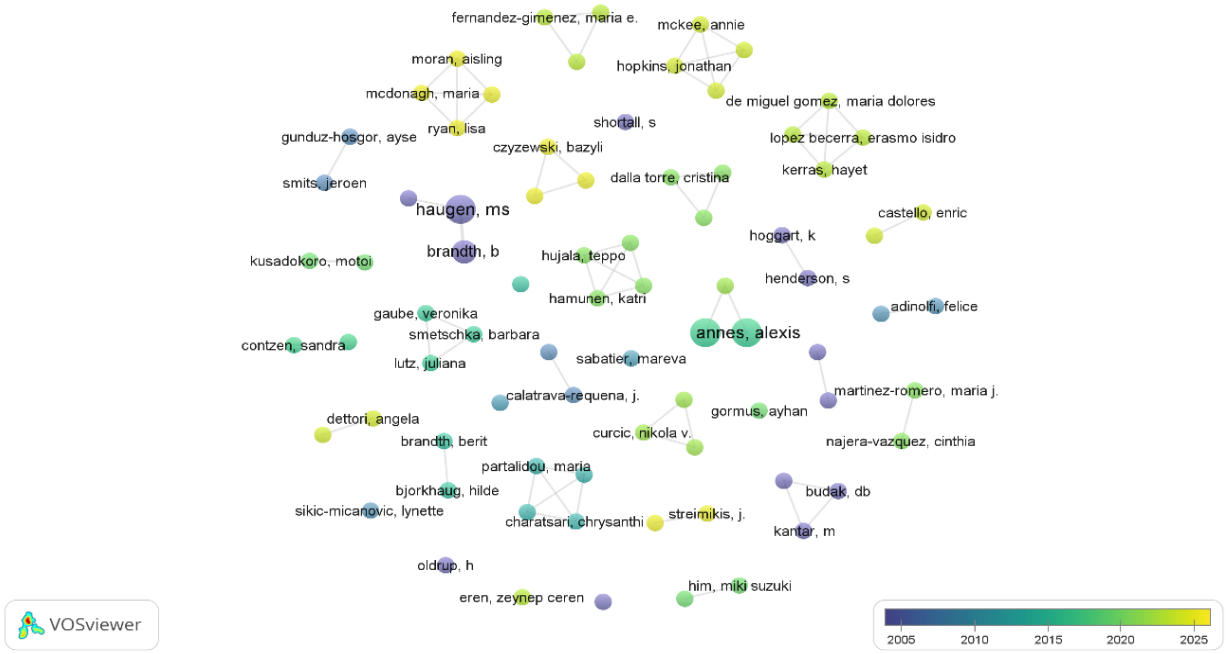


Fig 5. Co-authorship (not-connected) network visualization. Source: own research

Of these 39 studies, 36 focus on specific countries, while three provide comparative analyses across several countries (McDonagh et al., 2024; Czyżewski et al., 2024; Streimikis and Kyriakopoulos, 2024). It is worth noting that the comparative studies were conducted in 2024, highlighting both the growing interest in this topic and the clear importance of presenting cross-country comparisons. Such analyses are often conducted when examining studies on developing countries (Perez et al., 2015; Jost et al., 2016; Mutenje et al., 2019).

The study by McDonagh et al. (2024) investigated the perceived barriers faced by female agri-food entrepreneurs in rural areas of Europe, specifically in Ireland, Belgium, Poland, and Italy. The study employed a qualitative approach, using seven focus groups with a total of 25 participants, and a thematic analysis to identify key themes related to barriers and enablers for business development. The findings revealed three major themes: business initiation and development, perceived barriers, and mentorship programs. Within the business initiation and development theme, participants highlighted the importance of market research and relationship-building with local customers. However, many lacked confidence in their digital skills, which was seen as a limitation in expanding their businesses. The perceived barriers theme focused on several significant challenges. Financial support was the most prominent barrier, with participants expressing frustration over the complexity of funding applications and a lack of awareness of available financial assistance. Sociocultural support was also lacking, with some entrepreneurs describing a sense of isolation and the “gatekeeping” of information by more established businesses. Bureaucracy and administration were seen as additional obstacles, as the legal and administrative processes required to run a business were perceived as overwhelming and time-consuming. Furthermore, while participants did not report overt gender discrimination, many felt that they were not taken as seriously as their male counterparts, reflecting the male-dominated nature of the agri-food sector. Finally, participants

recognized the importance of digital transformation for business growth but lacked confidence in their ability to utilize digital tools effectively. The third theme, mentorship programs, revealed a general lack of awareness and understanding of such programs among participants. However, many were open to the idea of mentorship and believed it could significantly benefit their business development by providing both technical and emotional support. The study concluded that addressing these barriers – particularly by improving access to financial support, enhancing digital literacy, and offering mentorship opportunities – could significantly enhance the entrepreneurial success of female agri-food entrepreneurs in Europe. It emphasized the need for policymakers to develop tailored support systems that address the specific needs of these entrepreneurs, especially those in rural areas, to foster sustainable growth and promote gender equality in the agri-food sector.

The study by Czyżewski et al. (2024) explores the impact of women's empowerment on the eco-efficiency of small farms in Central and Eastern European countries (CEEC), specifically focusing on Poland, Romania, Serbia, and Moldova. It examines how varying levels of gender empowerment, alongside socio-economic factors such as succession, age, education, and specialization, influence eco-efficiency in agricultural practices. Using a two-stage double-bootstrapped Data Envelopment Analysis (DEA) approach, the study assesses eco-efficiency by considering desirable outputs like plant diversity and environmental pressures, including soil biodiversity loss. The sample consists of 1,630 small crop farms, and gender empowerment is classified into four levels based on social participation and decision-making power. The findings reveal that lower levels of women's empowerment negatively impact eco-efficiency on small farms, whereas farms managed by women who are highly socially engaged demonstrate the highest eco-efficiency. In Romania and Poland, women's empowerment was strongly correlated with higher eco-efficiency, while in Serbia and Moldova, farms managed by men – whether socially engaged or not – were found to be more eco-efficient.

The study also highlights that socio-economic factors such as succession planning, age, and specialization in crops or horticulture significantly influence eco-efficiency, while education and subsidies had a less significant impact. The study reveals that barriers vary across the countries analysed. In Serbia and Moldova, traditional patriarchal values and social norms remain dominant. Women often face discrimination and inequality in economic relationships and are not taken as seriously as business partners. This limits their participation in decision-making, reduces access to resources, and ultimately diminishes their efficiency in agriculture. There are also cultural barriers related to expectations that women conform to traditional gender roles, limiting their involvement in agricultural management and decision-making.

In Romania and Poland, the barriers are linked to lower social participation and a lack of decision-making power. Although both countries have had more time to assimilate gender equality values through their EU membership, women's social involvement – such as participation in training, professional associations, and cultural events – remains limited. Women who are less socially involved tend to demonstrate lower eco-efficiency. Additionally, even when women are socially engaged, many still lack the necessary decision-making power, which serves as a key barrier to improving their agricultural efficiency.

The authors concluded that policy interventions, particularly in the CAP in the EU, need to place more emphasis on gender empowerment alongside challenges like farm succession and the ageing farming population. This aligns with the findings of McDonagh et al. (2024), and the focus on gender equality in policy formation is further reflected in the study by Streimikis and Kyriakopoulos (2024).

The study by Streimikis and Kyriakopoulos (2024) investigated the integration of gender dimensions within the CAP of selected EU member states, focusing on how gender equality is addressed in the CAP Strategic Implementation Plans for the 2023–2027 period from seven EU member states: Croatia, Ireland, Italy, Lithuania, the Netherlands, Spain, and Sweden. The findings reveal significant differences in how gender considerations are integrated into the CAP documents across the selected countries. In countries like Ireland, Italy, Spain, and the Netherlands, there are several measures and objectives aimed at addressing gender equality. In contrast, the CAP Strategic Plans of Croatia, Lithuania, and Sweden are almost entirely gender-blind, with little to no mention of measures specifically aimed at improving gender equality.

The most recent studies revealed that European women in agriculture face barriers such as limited access to land and financial resources, entrenched patriarchal norms, insufficient social support, and bureaucratic hurdles, which hinder their ability to participate fully and efficiently in the sector. Addressing these challenges requires targeted policies that improve resource access, dismantle societal biases, and provide comprehensive support systems.

3.5 Keyword co-occurrence analysis: main themes

Keywords of the publications briefly reflect the main theme, subject, content, and methods used. In this research, VOSViewer was employed to display a bibliometric keyword network of selected publications. Out of the 539 articles retrieved in this research, 1,405 authors' keywords were identified. A total of 73 keywords appearing more than five times were selected, while repeated keywords and country names were excluded. The visualization map of the co-word network related to the nexus of gender norms, barriers, and women-led innovation in agriculture was classified into 3 clusters (Figure 6), disclosing the main research themes in scientific literature:

Cluster 1 (10 items), gender and climate change: "adaptation", "agricultural extension", "climate change", "climate-smart agriculture", "corporate social responsibility", "gender", "gender equality", "intersectionality", "smallholder farmers", "vulnerability".

Cluster 2 (10 items), women-led farms productivity: "decision-making", "feminist political ecology", "irrigation", "drought", "land", "livestock", "migration", "participation", "productivity", "sustainability", „women".

Cluster 3 (9 items), women's empowerment in agriculture: "agriculture", "development", "entrepreneurship", "food security", "gender equity", "nutrition", "resilience", "women farmers", "women's empowerment".

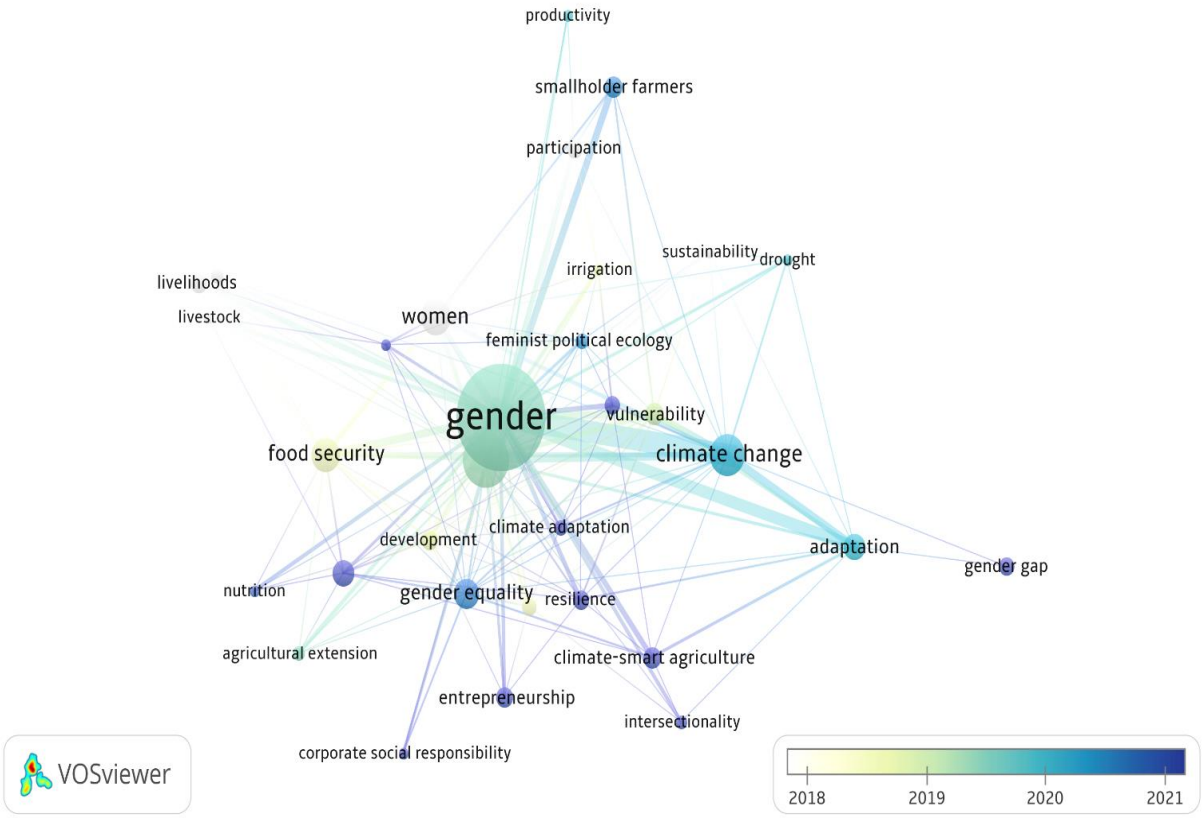


Fig 6. Co-occurrence of authors' keywords on gender norms, barriers, and women-led innovation in agriculture. Source: own research

Note: The sizes of the term and circles are proportional to the frequency of keyword occurrence.

3.6 Discussion on barriers for adoption of innovations on women-led farms

In this subsection, the main barriers faced by women in implementing agricultural innovations across different countries, identified through a keywords cluster analysis, will be briefly discussed.

Low women's empowerment in agriculture is closely related to the access and control of various resources related to farm such as land and capital, as well as agricultural inputs and technologies including enhanced crop varieties, extension training, information and marketing services is evidenced by many conducted studies in various countries (Akter et al., 2017). Khodary (2022) investigated societal changes in perceptions and practices related to women's ownership and inheritance of agricultural land in Egypt. The author draws attention to statistics from Egypt and Africa showing that socio-cultural barriers hamper women's access to agricultural land. In Egypt, only 5% of agricultural land is owned by women, while in Kenya, where 70% of agricultural work is done by women, less than 1% of agricultural land is owned by women. The study found that social perceptions and practices improved for the better situation for women, which in turn led to better results for rural development through improved socio-economic well-being and the overall well-being and quality of life of rural residents.

Bergman Lodin et al. (2019) found that women's mobility in rural Kenya and Nigeria is often restricted by social norms, which not only limit their capacity to participate in innovation but also affect their access to key agricultural resources and information. By understanding the relationship between gender norms and spatial mobility, their study highlights the need for gender-sensitive approaches that address both the physical and social constraints women face in agricultural communities.

Nosheen et al. (2023) also comments on land stewardship, examining the gendered component of vulnerability to climate change in Pakistan. The authors pointed out that only 2% of land is owned by women, these farms are often smaller and have lower-yielding, and less valuable crops. According to Hernandez et al. (2023), in case of Guatemala, the lack of resources is a major obstacle to women's ability to expand their small-scale activities and commercialize their products. Nevertheless, individual and group loans are viewed negatively, albeit as possible solutions. Lawson et al. (2020) also found that a key barrier to adaptation to climate change adaptation among women farmers in Ghana was land access and ownership and concluded that in a region where agriculture is the main source of food and income, land ownership is critical to social wellbeing.

In the case of Zambia where farming is the main source of livelihood for the majority of the population, 68% of women in Luapula Province do not own land. Notwithstanding that under statutory law, women in Zambia have equal rights to acquire land and inherit land upon widowhood, the customary law coexists alongside and often takes precedence over statutory provisions, especially in rural areas (Lecoutere et al., 2023).

Barry and Gahman (2021) present evidence on the food system challenges and structural barriers faced by women farmers and food producers in the Organisation of Eastern Caribbean States. The study found that the main barriers faced by women in agriculture are lack of access to land and capital; limited attention to gender equality by extension services; and absence of a national and sectoral gender policy. The authors pointed out that the food security of a region depends directly on grassroots women food producers, family farmers and small entrepreneurs, whose concerns, realities, ideas and solutions are usually dismissed or seen as peripheral. According to the authors, it is also an injustice that rural women experience greater time poverty, work more hours per day, have lower incomes, own less land and expend more energy than their counterparts in the fields of agricultural production, economic development and the food system in general.

The USA study (Horst and Marion, 2019) showed persistent gender inequalities in terms of managing land: about 63% of non-operating landowners, 86% of farm owners and 87% of tenant farmers were men, and women farmers also tended to have lower incomes than men.

The case in India (Sandhu et al., 2012) disclosed the barriers relate to finance, which reveals that the relationship of women owners/managers with banks is influenced by gender biases inherent in the male-dominated Indian banking sector. Women owners/managers had significantly higher loan rejection rates than their male counterparts. Bank managers were significantly more likely to require

collateral and/or letters of recommendation from female owners/managers than from male equivalent applicants.

Access to agricultural advisory services is seen as an essential tool for achieving agricultural development, poverty reduction in rural areas and food security. In countries where the gross domestic product is heavily dependent on agriculture, knowledge and training are both highly needed (Mudege et al., 2017). The case in Bangladesh (Medendorp et al., 2022) showed that socio-cultural and structural barriers make it more difficult for women in developing countries to access formal and non-formal education, as well as consultancy services. As noted by Rahman et al. (2023), in Bangladesh, the majority of people who service technological equipment are men. As a result, it has been observed that a significant number of women do not have the necessary skills and training to handle different types of equipment. Most Caribbean women identified the lack of national and sectoral gender policies, gender-sensitive training and women's associations as major obstacles. This shows that women as a group are often systematically disadvantaged and institutionally marginalized (Barry and Gahman, 2021).

A study in Pakistan (Makhdum and Kousar, 2021) found that the education of the head of the household has a positive impact on agricultural output, confirming the widely recognised role of human capital in improving farmer productivity.

Osabohien et al. (2021) found that a 1% increase in female education would lead to about 0.34% (Central Africa), 0.47% (East Africa), 8.6% (North Africa), 0.20% (Southern Africa and 0.48% (West Africa) in the economic development. On the other hand, the increase in the female population and participation in agriculture without the required education can have a negative impact on economic development in Africa. A study in Nigeria (Sallawu et al., 2022) found that financial constraints and limited access to extension services were among the key constraints to women's participation in agriculture.

Yumusak et al. (2013) points out that, although the positive contribution of women's education to the economy and society has long been recognized, women's educational attainment is insufficient in many countries, and, as demonstrated by the example of Turkey, where half of the female workforce is employed in the agricultural sector, only 3.9% of women have a university degree.

According to a study carried out in Israel (Sofer and Saada, 2017), the main accelerators of economic development are the search for alternatives to declining farm incomes, self-realization and professional development, while the main constraints are the limited availability of capital, as well as lack of self confidence in oneself and in the ability to manage a business. The results of the Timsina et al. (2023) study revealed that there is a vicious circle, since women are uneducated, this should be a justification for not receiving training or participating in information exchange, thus continuing this repetitive cycle, and eliminating a possible way out for women from this vicious circle.

Despite women's limited access to essential resources like land and credit, their workload in agricultural activities is high, and their wages remain low. De Pablo Valenciano et al. (2021) states that gender equality promotes sustainable local development in all sectors of society, and public policies should therefore encourage the creation of mechanisms to improve women's work-life balance. As Budge and Shortall (2023) noted, equality cannot be achieved until men and women share household and care responsibilities.

The results in Bangladesh (Rahman et al., 2023) showed that the role of women in the agricultural sector is changing from traditional unpaid family work to positions of power as farm managers, though this change is not sufficient. Lecoutere et al. (2023) findings indicated that in Bangladesh, just like in Mali, patriarchal gender norms limit women's access to resources and decision-making. In this country, women spend 86% of their working time in unpaid domestic activities, compared to only 25% for men. In addition, women's roles and contributions are not always recognised by their male colleagues.

The gender pay gap limits women's participation in agriculture, notes Rahman et al. (2023), and as the study reveals, there is discrimination between men and women's wages. Due to existing patriarchal social structures, women are considered weaker than men. The results of a study in Macedonia (Petreski et al., 2014) showed that gender pay discrimination in the country ranges from 5.4% to 9.8%, and that women's education is very important in addressing pay discrimination, as the study shows that wage

inequality does not exist among women with a university degree. The case in Pakistan (Lecoutere et al., 2023) shows that women's work contributes substantially to harvesting, and that women's additional work at home (housework and care work) adds up to between 12 and 15 hours of women's working day. Makhdum and Kousar (2021) investigated the labour supply of men and women in rural households in relation to activities on their own farm, in agricultural wage farming and in the non-agricultural sector in Pakistan. Researchers found that family class plays a crucial role in reducing women's freedom. It is also found that women's labour supply in non-agriculture and agriculture decreases as they move up the class category. There are cultural and social barriers that hinder women's entry and survival in the labour market. They are not allowed to go out into the field to work and are confined to household chores, which they consider as honourable.

A study in the US (Fisher et al., 2022) shows that women earn 5–6% less per hour than men and are less likely to receive a bonus or have their health insurance paid for by their employer. These gender inequalities can be partly explained by differences between women and men in terms of farming experience, number of hours worked, farm work and crops grown.

In the case of Guatemala, Hernandez et al. (2023) stated that cultural barriers make it difficult for women to envision futures outside of household roles and verbalize their personal ambitions and aspirations.

It is widely recognized that reducing gender inequalities contributes to agricultural growth and food and nutrition security, and many international development programmes consider women's empowerment to be a key factor in reducing the gender gap in agricultural productivity (Diiro et al., 2018). The gender differentials on productivity were examined by Ojo and Baiyegunhi (2023) in Nigeria. The research results showed that there is gender inequality between men and women, resulting in a productivity gap of around one third in favour of men. This gap was mainly influenced by marital status, education, farm size and access to market information. The empirical results in Mali (Fowowe, 2022) showed that gender differences in agricultural productivity exist, and the gender gap can equal to 70%. In Malawi, farms managed by women were 14.6% to 23.1% less productive than those managed by men (Tufa et al., 2022). The evident in sub-Saharan Africa showed that labour productivity is on average 44% lower on plots owned by female-headed household (Palacios-López and López, 2015). The research conducted in Italy (Fusco et al., 2023) also confirms the pattern, that male-run farms generally seem to perform better than female-run farms, whereas despite the fact that there are reasons why farms managed by women may be less efficient, such as the fact that women may use traditional technologies, either because of a lack of knowledge, or because they do not have access to modern means of production associated with new technologies, or because of the higher costs of introducing new technologies. However, in Tanzania and Uganda, men's average total factor productivity is significantly higher than women's, implying that the productivity gap persists. According to the authors, the differences in technical efficiency, adoption of the best technologies and total factor productivity may be related to women's lower access to good fertilizer, better seeds, credit markets and agricultural extension services. Another study conducted in Tanzania (Slavchevska, 2015) found that the gender gap in agricultural productivity is about 21%, though women can obtain higher yields than men when they farm smaller plots with fewer men and more women, thus reducing the gender productivity gap at the aggregate level, but there are still many factors that are significant in contributing to the widening gap.

Despite the fact that several studies have shown that female farmers tend to have lower yields than male farmers, gender differences in productivity are unclear and sometimes, contradictory. The research in India (Agarwal and Mahesh, 2023) found that gender is not a statistically significant factor in explaining differences in farm productivity. No differences in efficiency have been found in the Czech Republic (Pechrová and Šimpach, 2015). The study of Julien et al. (2023) provides statistical evidence that there is no difference in the average total factor productivity of male and female farmers in Malawi. A study in Spain (Varela-Candamio et al., 2018) showed that rural women are better placed than others to create businesses based on niche functional foods. Despite contradicting results from studies, Doss (2018) questions whether women's productivity, as defined by the definition of a farmer, can be measured at all, and whether socio-cultural differences mask women's contribution to farm productivity.

The participation of different target populations (women) in agricultural innovation interventions can stimulate and ensure the development of local innovation (Quisumbing et al., 2023; Badstue et al., 2018). The innovations can also be a targeted pathway to greater gender equality (Rietveld and van der Burg, 2021). The research conducted by Badstue et al. (2018) revealed that men are often better placed than women to take advantage of innovation opportunities, and women innovators are more likely than men to face criticism for contradicting local gender norms, especially if they are married. Spousal support is therefore particularly important for (married) female innovators. Quisumbing et al. (2023) concluded that the gender norms will not be transformed by working only with women. To change gender equality, measures must also involve men and change institutional structures. In Guatemala, Valverde et al. (2022) study showed that with higher tolerance the greater the opportunity for women to develop and activate their innovative capacity. The results show that agro-ecological innovations strengthen the role of women farmers in the family farm and contribute to distributive justice, albeit insufficiently. The women and girls consider agro-ecological innovations and market opportunities tailored to the needs of women farmers as factors contributing to gender equality and equitable transition. Women farmers are seen as needing more skills to better understand their rights and to be able to participate as equal stakeholders in family farming, as well as in decision-making in their organisations and public life.

The study of Kawarazuka and Prain (2019) shows that women's innovation in Vietnam are closely linked to their position as wives and daughters. Their innovations tend to be gradual, small-scale and less technological. The case in Uganda (Rietveld and van der Burg, 2021) shows that the innovation application does not have a gender divide, however, women's ability to innovate is limited compared to men's, as gender norms restrict women's opportunities, including in terms of mobility and financial independence.

Gender mainstreaming in climate change adaptation interventions is critical because both women and men possess valuable knowledge that can enhance the design of strategies aimed at addressing climate change impacts on food security and household well-being (Assan et al., 2018). This issue is highlighted by the most-cited articles on gender and agriculture focus on the intersection of gender and climate change (Table 2, Djoudi and Brockhaus, 2011; Jost et al., 2016; Eastin, 2018). Djoudi and Brockhaus (2011), in Mali found that although climate change affects both men and women, it disproportionately impacts women because of their reliance on natural resources and their exclusion from decision-making processes. This exclusion weakens women's capacity to adapt, underscoring the need for gender-sensitive climate adaptation policies that integrate women's knowledge and address these inequalities. Similarly, Jost et al. (2016) examined climate-smart agriculture (CSA) in Ghana, Uganda, and Bangladesh, concluding that while women engage in agricultural practices to cope with climate change, their involvement remains confined within existing gender roles. Women are often excluded from labour-intensive CSA technologies due to a lack of access to labour and financial resources, which highlights the importance of developing gender-responsive adaptation strategies that account for the unique challenges women face. Eastin (2018) states that in societies where women's access to land, labour, and political participation is limited, climate change amplifies these inequalities, making women more vulnerable.

Nyongesa et al. (2017) research on climate-smart agricultural technologies in Kenya demonstrates that women face barriers such as limited access to assets and decision-making power. Authors state that without gender-sensitive interventions, women's contributions to and benefits from CSA remain constrained. Tsige et al. (2020) quantified gendered constraints in adopting climate-smart practices in Ethiopia, finding that despite the potential economic benefits of CSA, women face persistent barriers such as restricted access to technology, training, and resources. Mutenje et al. (2019) found in their study of Malawi, Mozambique, and Zambia, that women's bargaining power and access to climate-smart technologies were key determinants of their ability to adopt such practices. The research demonstrated that improving women's access to information and resources was crucial for successful climate adaptation. Moreover, CSA practices have proven to be economically viable for risk-averse farmers, helping them adapt to extreme weather while improving soil and water conservation. CSA not only boosts productivity but also enables better risk management and economic viability for smallholders.

Huyer and Partey (2019) argue, CSA can provide significant benefits to women in terms of resilience and productivity, but only if these interventions are gender responsive. Their study highlights that without

addressing systemic barriers – such as the gender division of labour and unequal access to resources – CSA technologies can reinforce rather than alleviate existing inequalities. This reinforces the importance of context-specific adaptation practices that consider gendered differences in access to resources, workloads, and decision-making power.

Koomson (2023) emphasizes the socio-cultural barriers to women's participation in climate change projects in Ghana, where patriarchal decision-making structures and the devaluation of women's voices limit their involvement in climate adaptation initiatives. These findings underscore the need to tackle not just the technological and resource-based barriers but also the cultural and social norms that impede women's full participation in climate adaptation efforts.

A review of the research shows that the issues being addressed vary considerably depending on the country, its traditions, and norms. Despite ongoing efforts and policies, recognition of women's roles and gender-transformative changes have been slow in both low-income and wealthier countries. Nevertheless, gender-sensitive policies and interventions are necessary to address structural inequalities and support women's participation in agricultural innovation and climate change adaptation.

4. Conclusions

The trend of articles on gender norms, barriers, and women-led innovation in agriculture from 1994 to 2024 shows a clear shift: scholarly articles on the topic remained consistently low until 2014, after which there was a notable increase. This rise can be attributed to heightened policy attention, particularly the UN's Sustainable Development Goals, especially Goal 5, which emphasizes gender equality and has driven scientific research on gender issues, including in agriculture.

The analysis of the most cited articles highlights a growing focus on the intersection of gender, agriculture, and climate change, with highly cited studies like Jost et al. (2016) and Eastin (2018) underscoring the disproportionate impact of climate change on women in agricultural settings.

Research from 2014–2024 reveals persistent barriers for women in agriculture, including social norms, gender stereotypes, and structural inequalities, which hinder access to resources and leadership. These challenges are evident in both developing and developed countries, reflecting slow progress in addressing gender disparities globally.

Based on continent-based data from the WoS database, according to author affiliations, European institutions lead the research field with 47% of the total articles, followed by African institutions (46%) and North American institutions (34%). At the country level, U.S. institutions contributed the highest number of articles (27%). Within Europe, institutions in Germany, England, the Netherlands, Italy, Sweden, and France lead research on gender norms, barriers, and women-led innovation in agriculture, totalling 165 publications. Taylor & Francis (116 articles) and Elsevier (111 articles) are the leading publishers in this field.

The analysis of five top-cited articles by European-affiliated authors underscores the global relevance of gendered impacts across diverse contexts, from smallholder farming in Africa and Asia to rural development in Europe. However, four of the five articles focus on Africa and Asia, with limited analysis of the European context. Based on the findings, it is important to support research opportunities in regions beyond Europe and to balance the current focus on Western continents, such as Europe and North America, with greater attention to research in Asia and Africa. Additionally, research on Central and South American countries requires further exploration and encouragement to be more prominently included in WoS-indexed literature. This may be particularly relevant as much of this research is likely published in Spanish and therefore underrepresented in indexed journals.

A review of research articles from European countries revealed that Spain and Turkey were the most studied, with five articles each, followed by France and Norway with four each. Recent articles provide valuable insights through cross-country comparisons within Europe, highlighting the diverse research contexts and outcomes in these countries. The analyzed studies show that women in agriculture across Europe face common barriers, such as limited access to land, financial resources, and support, as well as

bureaucratic and societal obstacles. Overcoming these challenges requires targeted policies to improve resource access, dismantle biases, and provide comprehensive support systems.

Keyword cluster analysis identified the main themes of articles which relate to climate change and gender, women-led farms productivity and women's empowerment in agriculture.

Especially for new fields as Gender in Agriculture it seems to be important to acknowledge that this SLR research has some limitations. Firstly, it only analyses the indexed literature in the ISI WoS, which unfortunately is an incomplete coverage of all relevant scientific literature. Secondly, during the PRISMA approach used, some relevant research may have been omitted due to publication filtering.

Future research could primarily focus on an extended systematic literature review that encompasses a broader range of databases and includes other scientific publications beyond WoS indexed articles. In the context of innovation implementation in European countries, studies disaggregated by gender are particularly relevant. Such research should provide cross-country comparisons, analyse specific innovations in greater detail, and consider additional farm characteristics, such as farm size, type of farming, and other relevant factors. Future research could explore the differences in the barriers women face in the adoption of innovations on farms depending on their role within a household and family farm. For example, when a woman is the farmer within a family farm, when a single woman is a farmer, or when a widow has taken over the management of the farm.

Academic references

[1] Agarwal, B. & Mahesh, M. (2023). Does the Landowner's Gender Affect Self-Cultivation and Farm Productivity? An Analysis for India. *The Journal of Development Studies*, *59*(5), 758–777. DOI: 10.1080/00220388.2022.2162883.

[2] Akter, S., Rutsaert, P., Luis, J., Htwe, N. M., San, S. S., Raharjo, B. & Pustika, A. (2017). Women's empowerment and gender equity in agriculture: A different perspective from Southeast Asia. *Food policy*, *69*, 270–279. DOI: 10.1016/j.foodpol.2017.05.003.

[3] Alarcón, D. & Bodouroglou, C. (2014). Agricultural innovation for food security and environmental sustainability in the context of the recent economic crisis: Why a gender perspective? In Antonopoulos, R., ed., *Gender Perspectives and Gender Impacts of the Global Economic Crisis* (pp. 255–277). London: Routledge.

[4] Assan, E., Suvedi, M., Schmitt Olabisi, L. & Allen, A. (2018). Coping with and adapting to climate change: A gender perspective from smallholder farming in Ghana. *Environments*, 5(8), 86. DOI: 10.3390/environments5080086.

[5] Aznar-Sánchez, J. A., Velasco-Muñoz, J. F., López-Felices, B. & del Moral-Torres, F. (2020). Barriers and facilitators for adopting sustainable soil management practices in Mediterranean olive groves. *Agronomy*, *10*(4), 506. DOI: 10.3390/agronomy10040506.

[6] Badstue, L., Lopez, D. E., Umansteva, A., Williams, G., Elias, M., Farnworth, C. R., Rietvald, A., Njuguna-Mungai, E., Luis, J., Najjar, D. & Kandiwa, V. (2018). What drives capacity to innovate? Insights from women and men small-scale farmers in Africa, Asia, and Latin America. *Journal of Gender, Agriculture and Food Security*, 3(1), 54–81.

[7] Barry, T. & Gahman, L. (2021). Food system and social reproduction realities for women in agriculture across the Caribbean: Evidence from Grenada, St. Lucia, and St. Vincent and the Grenadines. *Journal of Agrarian Change*, *21*(4), 815–833. DOI: 10.1111/joac.12426.

[8] Bhagat, P. R., Naz, F. & Magda, R. (2022). Artificial intelligence solutions enabling sustainable agriculture: A bibliometric analysis. *PloS one*, *17*(6), e0268989. DOI: 10.1371/journal.pone.0268989.

[9] Bock, B. B. & Shortall, S., eds. (2017). *Gender and rural globalization: International perspectives on gender and rural development*. Wallingford: CABI.

[10] Brannan, T., Bickler, C., Hansson, H., Karley, A., Weih, M. & Manevska-Tasevska, G. (2023). Overcoming barriers to crop diversification uptake in Europe: A mini review. *Frontiers in Sustainable Food Systems*, *7*, 1107700. DOI: 10.3389/fsufs.2023.1107700.

[11] Brown, P., Daigneault, A. & Dawson, J. (2019). Age, values, farming objectives, past management decisions, and future intentions in New Zealand agriculture. *Journal of Environmental Management*, *231*, 110–120. DOI: 10.1016/j.jenvman.2018.10.018.

[12] Budge, H. & Shortall, S. (2023). Agriculture, COVID-19 and mental health: Does gender matter? *Sociologia Ruralis*, *63*, 82–94. DOI: 10.1111/soru.12408.

[13] Campuzano, L. R., Hincapié Llanos, G. A., Zartha Sossa, J. W., Orozco Mendoza, G. L., Palacio, J. C. & Herrera, M. (2023). Barriers to the adoption of innovations for sustainable development in the agricultural sector – systematic literature review (SLR). *Sustainability*, *15*(5), 4374. DOI: 10.3390/su15054374.

[14] Canagarajah, S., Newman, C. & Bhattamishra, R. (2001). Non-farm income, gender, and inequality: evidence from rural Ghana and Uganda. *Food policy*, *26*(4), 405–420. DOI: 10.1016/S0306-9192(01)00011-2.

[15] Cavazza, A., Dal Mas, F., Paoloni, P. & Manzo, M. (2023). Artificial intelligence and new business models in agriculture: a structured literature review and future research agenda. *British Food Journal*, *125*(13), 436–461. DOI: 10.1108/BFJ-02-2023-0132.

[16] Curry, G. N., Nake, S., Koczberski, G., Oswald, M., Rafflegeau, S., Lummani, J., Peter, E. & Nailina, R. (2021). Disruptive innovation in agriculture: Socio-cultural factors in technology adoption in the developing world. *Journal of Rural Studies*, *88*, 422–431. DOI: 10.1016/j.jrurstud.2021.07.022.

[17] Czyżewski, B., Prędki, A. & Brelik, A. (2024). Importance of women empowerment for eco-efficiency of small farms in the context of other social factors: Building sustainable agriculture in Central and Eastern European countries. *Sustainable Development* 32(5), 5550–5566. DOI: 10.1002/sd.2989.

[18] da Silva, A. L. F., Plaza-Úbeda, J. A. & Souza Piao, R. (2024). Social innovation as a game changer in agriculture: A literature review. *Sustainable Development* 32(4), 4160–4171. DOI: 10.1002/sd.2898.

[19] Danso-Abbeam, G., Dagunga, G. & Ehiakpor, D. S. (2019). Adoption of Zai technology for soil fertility management: evidence from Upper East region, Ghana. *Journal of Economic Structures*, 8(1), 32. DOI: 10.1186/s40008-019-0163-1.

[20] De Pablo Valenciano, J., Milán-García, J., Uribe-Toril, J. & Guerrero-Villalba, M. A. (2021). Rural development from a gender perspective: The case of women farmers in southern Spain. *Land*, *10*(1), 75. DOI: 10.3390/land10010075.

[21] Devkota, R., Pant, L. P., Hambly Odame, H., Rai Paudyal, B. & Bronson, K. (2022). Rethinking gender mainstreaming in agricultural innovation policy in Nepal: a critical gender analysis. *Agriculture and Human Values*, *39*(4), 1373–1390. DOI: 10.1007/s10460-022-10326-1.

[22] Doss, C. R. (2018). Women and agricultural productivity: Reframing the Issues. *Development policy review, 36(1),* 35–50. DOI: 10.1111/dpr.12243.

[23] Dunchev, D. & Beluhova-Uzunova, R. (2023). Conceptual models, barriers and opportunities for adoption and diffusion of agricultural innovations. *Scientific Papers Series Management, Economic Engineering in Agriculture & Rural Development*, *23*(2). 229–236.

[24] Farnworth, C. R., López, D. E., Badstue, L., Hailemariam, M. & Abeyo, B. G. (2018). Gender and agricultural innovation in Oromia region, Ethiopia: from innovator to tempered radical. *Gender, Technology and Development*, *22*(3), 222–245. DOI: 10.1080/09718524.2018.1557315.

[25] Farooq, M. S., Riaz, S., Abid, A., Umer, T. & Zikria, Y. B. (2020). Role of IoT technology in agriculture: A systematic literature review. *Electronics*, *9*(2), 319. DOI: 10.3390/electronics9020319.

[26] Fisher, M., Lewin, P. A. & Pilgeram, R. (2022). Farmworkers and the gender wage gap: An empirical analysis of wage inequality in US agriculture. *Applied Economic Perspectives and Policy*, *44*(4), 2145–2163. DOI: 10.1002/aepp.13202.

[27] Fowowe, B. (2023). Financial inclusion, gender gaps and agricultural productivity in Mali. *Review of Development Economics* 29(1), 3–42. DOI: 10.1111/rode.13034.

[28] Fusco, G., Toma, P. & Vecchio, Y. (2023). Efficiency, gender diversity and public aid: evidence from Italian agrifood sector. *Applied Economics, 55(36),* 4177–4193. DOI: 10.1080/00036846.2022.2128175.

[29] Galiè, A., Teufel, N., Korir, L., Baltenweck, I., Webb Girard, A., Dominguez-Salas, P. & Yount, K. M. (2019). The women's empowerment in livestock index. *Social Indicators Research*, *142*(2), 799–825. DOI: 10.1007/s11205-018-1934-z.

[30] Hernandez, M. A., Alarcon, C., Berrospi, M. L., Lopera, D., Quintero, D., Reyes, B. & Olivet, F. (2023). Cultural and economic barriers and opportunities for the participation of women in agricultural production systems: A case study in Guatemala. *Frontiers in Sustainable Food Systems, 7,* 1185756. DOI: 10.3389/fsufs.2023.1185756.

[31] Horst, M. & Marion, A. (2019). Racial, ethnic and gender inequities in farmland ownership and farming in the US. *Agriculture and Human Values*, 36, 1–16. DOI: 10.1007/s10460-018-9883-3.

[32] Jost, C., Kyazze, F., Naab, J., Neelormi, S., Kinyangi, J., Zougmore, R., Aggarwall, P., Bhatta, G., Choudhury, M., Tapio-Bishone, M-L., Nelson, S. & Kristjanson, P. (2016). Understanding gender dimensions of agriculture and climate change in smallholder farming communities. *Climate and Development*, *8*(2), 133–144. DOI: 10.1080/17565529.2015.1050978.

[33] Julien, J. C., Bravo-Ureta, B. E. & Rada, N. E. (2023). Gender and agricultural Productivity: Econometric evidence from Malawi, Tanzania, and Uganda. *World Development, 171, 106365.* DOI: 10.1016/j.worlddev.2023.106365.

[34] Kaliba, A. R., Mushi, R. J., Gongwe, A. G. & Mazvimavi, K. (2020). A typology of adopters and nonadopters of improved sorghum seeds in Tanzania: A deep learning neural network approach. *World Development*, *127*, 104839. DOI: 10.1016/j.worlddev.2019.104839.

[35] Kawarazuka, N. & Prain, G. (2019). Gendered processes of agricultural innovation in the Northern uplands of Vietnam. *International Journal of Gender and Entrepreneurship,* 11(3), 210–226. DOI: 10.1108/IJGE-04-2019-0087.

[36] Khodary, Y. (2022). Women, land and rural development in Egypt: a socio-cultural perspective. *Journal of Chinese Economic and Foreign Trade Studies*, *15*(3), 261–278. DOI: 10.1108/JCEFTS-10-2021-0061.

[37] Koomson, P. (2023). Participating under constraints: roles and limitations of rural women's involvement in climate change adaptation planning and implementation in Ghana. *Ciência Rural*, 53(9), not paged. DOI: 10.1590/0103-8478cr20220345.

[38] Koutsos, T. M., Menexes, G. C. & Dordas, C. A. (2019). An efficient framework for conducting systematic literature reviews in agricultural sciences. *Science of The Total Environment*, *682*, 106–117. DOI: 10.1016/j.scitotenv.2019.04.354.

[39] Kovaleva, M., Filho, W. L. & Borgemeister, C. (2022). Gender issues within climate change research: a bibliometric analysis. *Climate and Development*, *14*(8), 725–740. DOI: 10.1080/17565529.2021.1980365.

[40] Kristjanson, P., Bryan, E., Bernier, Q., Twyman, J., Meinzen-Dick, R., Kieran, C., Ringler, C., Jost, C. & Doss, C. (2017). Addressing gender in agricultural research for development in the face of a changing climate: where are we and where should we be going? *International Journal of Agricultural Sustainability*, 15(5), 482–500. DOI: 10.1080/14735903.2017.1336411.

[41] Lawson, E. T., Alare, R. S., Salifu, A. R. Z. & Thompson-Hall, M. (2020). Dealing with climate change in semi-arid Ghana: understanding intersectional perceptions and adaptation strategies of women farmers. *GeoJournal,* 85, 439–452. DOI: 10.1007/s10708-019-09974-4.

[42] Lecoutere, E., Mishra, A., Singaraju, N., Koo, J., Azzarri, C., Chanana, N., Nico, G. & Puskur, R. (2023). Where women in agri-food systems are at highest climate risk: a methodology for mapping climate–agriculture–gender inequality hotspots. *Frontiers in Sustainable Food Systems, 7*, not paged. DOI: 10.3389/fsufs.2023.1197809.

[43] Long, T. B., Blok, V. & Coninx, I. (2016). Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy. *Journal of cleaner production*, *112*, 9–21. DOI: 10.1016/j.jclepro.2015.06.044.

[44] Makhdum, M. S. A. & Kousar, R. (2021). Gender in agriculture: Determinants of female labor supply decisions among rural households in the context of market imperfections in Pakistan. *Agricultural Economics*, *52*(2), 235–248. DOI: 10.1111/agec.12616.

[45] McDonagh, M., Ryan, T., Moran, A. & Ryan, L. (2024). A qualitative investigation into perceived barriers experienced by European female agri-food entrepreneurs. *Journal of Global Entrepreneurship Research*, 14(1), 7. DOI: 10.1007/s40497-024-00377-5.

[46] Medendorp, J. W., Reeves, N. P., Celi, V. G. S. Y. R., Harun-Ar-Rashid, M., Krupnik, T. J., Lutomia, A. N., Pittendrigh, B. & Bello-Bravo, J. (2022). Large-scale rollout of extension training in Bangladesh: Challenges and opportunities for gender-inclusive participation. *Plos one*, 17(7), e0270662. DOI: 10.1371/journal.pone.0270662.

[47] Montes de Oca Munguia, O., Pannell, D. J. & Llewellyn, R. (2021). Understanding the adoption of innovations in agriculture: A review of selected conceptual models. *Agronomy*, *11*(1), 139. DOI: 10.3390/agronomy11010139.

[48] Mudege, N. N., Mdege, N., Abidin, P. E. & Bhatasara, S. (2017). The role of gender norms in access to agricultural training in Chikwawa and Phalombe, Malawi. *Gender, Place & Culture*, *24*(12), 1689–1710. DOI: 10.1080/0966369X.2017.1383363.

[49] Mutenje, M. J., Farnworth, C. R., Stirling, C., Thierfelder, C., Mupangwa, W. & Nyagumbo, I. (2019). A cost-benefit analysis of climate-smart agriculture options in Southern Africa: Balancing gender and technology. *Ecological Economics*, *163*, 126–137. DOI: 10.1016/j.ecolecon.2019.05.013.

[50] Niedbała, G. & Kujawa, S. (2023). Digital Innovations in Agriculture. *Agriculture*, *13*(9), 1686. DOI: 10.3390/agriculture13091686.

[51] Nosheen, M., Iqbal, J. & Ahmad, S. (2023). Economic empowerment of women through climate change mitigation. *Journal of Cleaner Production*, 421, 138480. DOI: 10.1016/j.jclepro.2023.138480.

[52] Ojo, T. O. & Baiyegunhi, L. J. (2023). Gender differentials on productivity of rice farmers in south western Nigeria: An Oaxaca-Blinder decomposition approach. *Heliyon,* 9(12), e22724. DOI: 10.1016/j.heliyon.2023.e22724.

[53] Osabohien, R., Olurinola, I., Matthew, O., Azuh, D. & Aderounmu, B. (2021). Female participation in agriculture and economic development in 33 African Countries. *African Journal of Reproductive Health*, 25(5s), 107–115. DOI: 10.29063/ajrh2021/v25i5s.10.

[54] Palacios-López, A. & López, R. (2015). The gender gap in agricultural productivity: the role of market imperfections. *The Journal of Development Studies*, *51*(9), 1175–1192. DOI: 10.1080/00220388.2015.1028539.

[55] Pechrová, M. & Šimpach, O. (2015). Are there any differences in efficiency between Czech agricultural holdings managed by male or female farmers? Proceedings of the Agrarian Perspectives 24, 340–346.

[56] Perez, C., Jones, E. M., Kristjanson, P., Cramer, L., Thornton, P. K., Förch, W. & Barahona, C. A. (2015). How resilient are farming households and communities to a changing climate in Africa? A gender-

based perspective. *Global Environmental Change*, *34*, 95–107. DOI: 10.1016/j.gloenvcha.2015.06.003.

[57] Petreski, M., Blazevski, N. M. & Petreski, B. (2014). Gender wage gap when women are highly inactive: Evidence from repeated imputations with Macedonian data. *Journal of Labor Research*, *35*, 393–411. DOI: 10.1007/s12122-014-9189-1.

[58] Piliai, S. (2022). Precision Agriculture Innovation in Agriculture. *Cardiometry*, (25), 678–684. DOI: 10.18137/cardiometry.2022.25.678684.

[59] Quisumbing, A., Cole, S., Elias, M., Faas, S., Galiè, A., Malapit, H., Meinzen-Dick, R., Myers, E., Seymour, G. & Twyman, J. (2023). Measuring women's empowerment in agriculture: Innovations and evidence. *Global Food Security*, 38, 100707. DOI: 10.1016/j.gfs.2023.100707.

[60] Quisumbing, A., Meinzen-Dick, R., Raney, T. L., Croppenstedt, A., Behrman, J. A. & Peterman, A., eds. (2014). *Gender in agriculture. Closing the knowledge gap*. Dordrecht: FAO and Springer. DOI: 10.1007/978-94-017-8616-4_1.

[61] Rahman, M. M., Huq, H. & Hossen, M. A. (2023). Patriarchal Challenges for Women Empowerment in Neoliberal Agricultural Development: A Study in Northwestern Bangladesh. *Social Sciences*, 12(9), 482. DOI: 10.3390/socsci12090482.

[62] Rietveld, A. M. & van der Burg, M. (2021). Separate and joint interests: Understanding gendered innovation processes in Ugandan farm systems. *Frontiers in Sustainable Food Systems*, 5, 666051. DOI: 10.3389/fsufs.2021.666051.

[63] Rizzo, G., Migliore, G., Schifani, G. & Vecchio, R. (2023). Key factors influencing farmers' adoption of sustainable innovations: a systematic literature review and research agenda. *Organic Agriculture*, 14, 57–84. DOI: 10.1007/s13165-023-00440-7.

[64] Rosário, J., Madureira, L., Marques, C. & Silva, R. (2022). Understanding farmers' adoption of sustainable agriculture innovations: A systematic literature review. *Agronomy*, *12*(11), 2879. DOI: 10.3390/agronomy12112879.

[65] Sachs, C. E., Jensen, L., Castellanos, P. & Sexsmith, K., eds. (2020). Routledge handbook of gender and agriculture. London: Routledge. DOI: 10.4324/9780429427381.

[66] Sallawu, H., Olabiyi, F. A., Alabi, D., Patrick, J., Martins, J. F. & Nmadu, J. (2022). Drivers and barriers of women participation in agricultural activities in Nigeria. *Pesquisa Agropecuária Gaúcha*, 28(1), 156–173. DOI: 10.36812/pag.2022281156-173.

[67] Sandhu, N., Hussain, J. & Matlay, H. (2012). Barriers to finance experienced by female owner/managers of marginal farms in India. *Journal of Small Business and Enterprise Development*, *19*(4), 640–655. DOI: 10.1108/14626001211277442.

[68] Shortall, S. (2002). Gendered agricultural and rural restructuring: a case study of Northern Ireland. *Sociologia Ruralis*, *42*(2), 160–175. DOI: 10.1111/1467-9523.00208.

[69] Shortall, S. & Marangudakis, V. (2024). Power and culture: Understanding EU policies on agriculture and gender equality. *Sociologia Ruralis*, *64*(2), 307–324. DOI: 10.1111/soru.12475.

[70] Shortall, S., McKee, A. & Sutherland, L. A. (2020). The performance of occupational closure: The case of agriculture and gender. *Sociologia Ruralis*, *60*(1), 40–57. DOI: 10.1111/soru.12279.

[71] Silva, F. T. D., Baierle, I. C., Correa, R. G. D. F., Sellitto, M. A., Peres, F. A. P. & Kipper, L. M. (2023). Open Innovation in Agribusiness: Barriers and Challenges in the Transition to Agriculture 4.0. *Sustainability*, *15*(11), 8562. DOI: 10.3390/su15118562.

[72] Slavchevska, V. (2015). Gender differences in agricultural productivity: The case of Tanzania. Agricultural Economics, 46(3), 335–355. DOI: 10.1111/agec.12168.

[73] Sofer, M. & Saada, M. T. (2017). Entrepreneurship of women in the rural space in Israel: Catalysts and obstacles to enterprise development. *Sociologia Ruralis*, 57, 769–790. DOI: 10.1111/soru.12125.

[74] Streimikis, J. & Kyriakopoulos, G. L. (2024). Gender dimension in EU agricultural policy. *Polish Journal of Management Studies*, *29*(1), 335. DOI: 10.17512/pjms.2024.29.1.20.

[75] Timsina, P., Chaudhary, A., Sharma, A., Karki, E., Suri, B. & Brown, B. (2023). Necessity as a driver in bending agricultural gender norms in the Eastern Gangetic Plains of South Asia. *International Journal of Agricultural Sustainability*, *21*(1), 2247766. DOI: 10.1080/14735903.2023.2247766.

[76] Tsiaousi, A. & Partalidou, M. (2021). Female farmers in Greece: Looking beyond the statistics and into cultural–social characteristics. *Outlook on Agriculture*, *50*(1), 55–63. DOI: 10.1177/0030727020928256.

[77] Tsige, M., Synnevåg, G. & Aune, J. B. (2020). Gendered constraints for adopting climate-smart agriculture amongst smallholder Ethiopian women farmers. *Scientific African*, 7, e00250. DOI: 10.1016/j.sciaf.2019.e00250.

[78] Tufa, A. H., Alene, A. D., Cole, S. M., Manda, J., Feleke, S., Abdoulaye, T., Chikoye, D. & Manyong, V. (2022). Gender differences in technology adoption and agricultural productivity: Evidence from Malawi. *World Development, 159,* 106027. DOI: 10.1016/j.worlddev.2022.106027.

[79] Valverde, R. O., Mesías, P. A. & Peris-Blanes, J. (2022). Just transitions through agroecological innovations in family farming in Guatemala: Enablers and barriers towards gender equality. Environmental Innovation and Societal Transitions, 45, 228–245. DOI: 10.1016/j.eist.2022.11.002.

[80] van Eck, N. J., Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* 84, 523–538. DOI: 10.1007/s11192-009-0146-3.

[81] Varela-Candamio, L., Calvo, N. & Novo-Corti, I. (2018). The role of public subsidies for efficiency and environmental adaptation of farming: A multi-layered business model based on functional foods and rural women. *Journal of Cleaner Production*, 183, 555–565. DOI: 10.1016/j.jclepro.2018.02.109.

[82] Villamor, G. B., van Noordwijk, M., Djanibekov, U., Chiong-Javier, M. E. & Catacutan, D. (2014). Gender differences in land-use decisions: shaping multifunctional landscapes? *Current Opinion in Environmental Sustainability*, 6, 128–133. DOI: 10.1016/j.cosust.2013.11.015.

[83] Yumusak, I. G., Bilen, M. & Ates, H. (2013). The Impacts of gender inequality in education on economic growth in Turkey. *Procedia-Social and Behavioral Sciences*, *103*, 1093–1103. DOI: 10.1016/j.sbspro.2013.10.437.

[84] Zougmoré, R. B. & Partey, S. T. (2022). Gender Perspectives of ICT Utilization in Agriculture and Climate Response in West Africa: A Review. *Sustainability*, *14*(19), 12240. DOI: 10.3390/su141912240.

Other sources

[85] International Food Policy Research Institute (IFPRI, 2024). Women's Empowerment in Agriculture Index (WEAI). https://www.ifpri.org/project/weai.

[86] United Nations (2015). The 17 goals. Available at: https://sdgs.un.org/goals.

[87] Worldbank (2024). Agriculture Overview: Development news, research, data | World Bank. https://www.worldbank.org/en/topic/agriculture/overview.

[88] CGIAR Gender research, see CGIAR Gender Impact Platform: https://gender.cgiar.org/.