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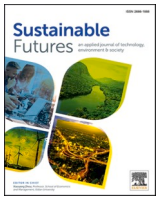

Challenges and potential solutions to employment issues in the agri-food sector of developed countries - A systematic literature review

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ABSTRACT

The agri-food sector in developed countries faces critical challenges, including climate change, demographic shifts, technological advancements and evolving consumption patterns. Recent global disruptions, such as the COVID-19 pandemic and the Ukrainian-Russian conflict, have further intensified uncertainties, significantly impacting agri-food supply chains and employment. Although previous reviews have explored sustainability, circular economy and labor conditions within specific niches such as organic farming, comprehensive analyses of employment dynamics across the broader agri-food sector in developed economies remain limited. This systematic literature review addresses this research gap by synthesizing employment-related challenges across six key themes: (1) family farming dynamics, (2) unique employment characteristics, (3) gender inequalities, (4) wage disparities, (5) education and training needs, and (6) productivity challenges. After the two-stage process, an initial database search identified 19,918 articles, with 128 Stud. included after rigorous screening. The findings highlight the continued importance of family farms despite industrial-scale agriculture pressures, the significant reliance on migrant and seasonal labor facing precarious conditions, and the crucial role of education and training in addressing technological changes and labor shortages. This review not only fills a critical gap in the literature but also provides an actionable roadmap: prioritize fair wages and legal protections for migrant and seasonal workers, invest in next generation of agricultural education, and design policies that keep family farms economically viable while embracing innovation. Implementing these measures is essential to future-proof the agri-food workforce, safeguard rural livelihoods and secure resilient, sustainable food systems across the developed world.

1. Introduction

The agri-food sector is exposed to many factors, most notably climate change, overpopulation, and changing food consumption patterns [3,78,107]. The coronavirus epidemic and the current Ukrainian-Russian conflict caused many problems, such as high food prices through increased uncertainties and high input prices or the intensified disruptions in global food systems, affecting employment and production in agriculture. The agri-food supply chain is susceptible to these factors; however, food security is not a problem in most developed countries, so they can generally focus on food safety issues [133].

Employment structures within the agri-food sector differ considerably from other economic sectors due to the unique nature of agricultural production, characterized by seasonal fluctuations, dependence on environmental factors, and the need for a diversified workforce, including family farmers, permanent workers, and seasonal or migrant labor. Traditionally, agriculture in developed countries relied heavily on family-operated farms that provided stability in employment within rural communities [111,125]. However, with increasing mechanization, technological advancement, and farm consolidation, the sector has experienced significant structural changes. Mechanization reduces manual labor demands, which increases productivity but can also decrease rural employment opportunities, potentially leading to depopulation and economic challenges in rural areas [120]. Additionally, while larger, industrial-scale farms may offer efficiency advantages, their emergence can displace smaller family farms, transforming

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employment structures and affecting rural livelihoods. Furthermore, employment practices in agriculture often involve substantial reliance on seasonal and migrant workers, who typically face wage disparities, precarious working conditions, and limited legal protections [11,45]. These labor dynamics are influenced by global economic pressures, policy frameworks, and regulatory standards that differ significantly between regions, thus requiring tailored responses to address local employment challenges effectively. Keeping young people in agriculture is also a significant and urgent challenge for developed countries [76, 127]. The more educated parents are, the more likely they are to educate their child, who is less likely to stay in agriculture. At the same time, taking over a prosperous agricultural enterprise can be attractive to the next generation. However, as in other sectors, there is a need for quality secondary and higher education in agriculture that is actively involved in various R&D activities and combines theoretical and practical knowledge to a sufficient extent [18,24].

Several systematic reviews have explored various dimensions of sustainability, circular economy, and labor issues in agri-food systems. For instance, Cahyadi et al. [17] and De Bernardi et al. [28] have provided extensive analyses of circular economy principles and transitions to sustainable food systems, yet their primary focus has not included detailed consideration of employment and labor-specific issues. Similarly, Magnano et al. [74] addressed labor conditions within the niche context of EU organic agriculture, highlighting social sustainability, particularly among migrant and seasonal workers. However, broader employment dynamics across the entire agri-food sector in developed countries remain underexplored. Other Stud., such as Duarte et al. [37] and Vesperi and Coppolino [134], emphasized territorial embeddedness and inter-organizational relationships, respectively, without systematically synthesizing employment-specific challenges. This review addresses this critical gap by comprehensively analyzing employment-related issues across the agri-food sector in developed countries, systematically evaluating critical themes in agricultural employment. Consequently, this study uniquely contributes to the existing literature by providing detailed policy and managerial recommendations specifically tailored to improve employment conditions in developed economies.

The rationale for focusing exclusively on developed countries is multilayered. First, these nations face unique demographic and socio-economic challenges, such as aging farmer populations and significant rural-to-urban migration, which directly impact labor availability and agricultural sustainability. Second, developed countries often have advanced technological infrastructures and higher levels of productivity, influencing employment patterns and educational needs differently compared to the rest of the world. Finally, understanding employment dynamics specifically in developed economies can offer valuable insights and lessons to policymakers and practitioners in similar high-income contexts, where attracting and retaining skilled labor is also a persistent challenge. The existing literature has provided a foundational framework for identifying the key themes that affect employment within the agri-food sector in developed countries, including family farms, migratory patterns, gender inequalities, wages, educational attainment, and productivity. Each of these topics plays a crucial role in shaping the dynamics and trends of agri-food employment, and they provide the basis for this analysis.

Thus, the aim of this paper, with the application of the systematic literature review (SLR) method, is to investigate and evaluate the challenges of employment in the agri-food sector of developed countries and to provide policy- and decision-makers with relevant employment policy and managerial recommendations on how to address these challenges, including strategies and measures to support family farms, improve labor conditions, and attract young talents into agriculture, through education and training. Yet, as mentioned earlier, the economic literature has not investigated and addressed these issues together in the agri-food industry of developed countries. Thus, this study contributes to the existing literature by systematically analyzing employment challenges in the agri-food sector of developed countries, focusing on six themes [(1) family farms, (2) unique characteristics of employment, (3) gender, (4) wages, (5) education, and (6) productivity)] related to employment challenges and seeks to provide relevant employment policy recommendations based on its findings. Furthermore, the article identifies knowledge gaps and provides a basis for future research. Thus, the following section outlines the methodology, including the selection process of articles. The third section details the analysis results divided into the six identified themes. The final section summarizes the results and provides policy and managerial recommendations, as well as limitations, possible future research areas and conclusions (Table 1).

2. Materials and methods

This study follows the methodological approach of a structured systematic literature review (SLR) based on established protocols outlined by PRISMA [87] and SPAR-4-SLR [100]. This method was found appropriate for critically analyzing, summarizing, and synthesizing the existing literature in this field [99,126], and is increasingly adopted in economics and related social sciences due to its ability to handle diverse methodological approaches and large volumes of literature [77,83,124]. These frameworks were selected to ensure methodological transparency, reproducibility, and academic rigor in synthesizing existing research on employment challenges within the agri-food sector of developed countries.

The selection of articles was a two-stage process [86,97]. The initial search was conducted in January 2023, using the Scopus database. The review includes articles published between 2000 and 2022, limited to empirical, peer-reviewed journal articles in English. Review articles, conceptual papers, dissertations, and grey literature were excluded to ensure that the focus remained on original empirical evidence. As ‘employment’ is a very diverse topic and many articles deal with it, sub-topics were identified. First, three general keywords were used for the selection of articles, providing the opportunity to identify the most important themes and research areas within this important topic. Table 2 provides details of the initial search.

Fig. 1 provides an overview of the first stage. First, 17,737 articles were identified in the Scopus database from 2000 to 2022. Scopus was used because it is one of the most widely used databases [79], and this database provided a sufficiently broad range of publications. The search was limited to the title and to peer-reviewed journal articles in English, as mentioned above. Of the 10,652 articles selected, 253 were eligible for full-text assessment. 91 articles were excluded, mainly because they did not have an English version or full text available. Covidence and Endnote software were used during the selection process. Consultation was conducted when disagreements arose between the authors (e.g., regarding the inclusion or exclusion of a publication from the analysis.

After that, studying the remaining 129 articles, a dual-level categorization process was followed: (1) first-level categories identified macro themes, such as employment dynamics or labor structure; (2) Second-level subcategories captured specific issues. The six identified themes are the following: (1) family farms, (2) unique characteristics of employment (off-farm, seasonal labor, migration/mobility), (3) gender, (4) wages, (5) education, and (6) productivity. Table 3 contains a brief overview of the six identified topics.

The six final analytical themes were thus grounded in a rigorous interpretive process. This thematic framework guided the synthesis of findings and supported the generation of policy recommendations. Thus, the following search string was added in parentheses with an AND operator to the initial string (Table 2) for the second stage of the analysis (Table 4).

Fig. 2 gives an overview of the final article selection process stages. The second search was conducted in January 2024, limited to peer-reviewed journal articles in English. The time horizon of the analysis was between 2000 and 2023. Based on the extended research string, 19.918 articles were identified (because of the extended time horizon),

Table 1
Roadmap of the article.

Introduction	Materials & Methods	Results	Discussion	Conclusions & Recommendations
Sector context, research gap, objectives, developed-country rationale	Systematic search strategy, inclusion/ exclusion criteria, synthesis approach	Key findings across six employment themes (family farms, employment characteristics, gender, wages, education, productivity)	Integrated interpretation of findings, theoretical and practical implications	Policy and managerial recommendations, Future research directions

Table 2
The Boolean operators of the initial search.

agriculture	AND	employment	OR	labor
OR food industry				OR labour

of which 942 were assessed for eligibility, and 190 were in-depth analyzed. Of the full-text Stud., 62 were excluded due to lack of focus on employment, for example, agricultural production, history, or management practices. Finally, articles that only analyze developing countries were removed. They cannot be removed earlier, as some of the identified and assessed articles dealt with developed countries in parallel with developing countries, and it was not always possible to separate them by title and abstract. This study aimed to analyze all articles dealing with the six identified subtopics. It meant a total of 128 articles.

To construct the analytical framework, a qualitative content analysis was employed, following the methodology described by [82]. This inductive and iterative process enabled the development of analytical categories directly from the reviewed literature, rather than applying a pre-defined coding frame. The themes emerged during multiple readings of the full texts and were discussed among the authors to reach consensus. The SLR does not include meta-analysis due to the heterogeneity of study designs and outcome variables. Instead, the results were synthesized through narrative integration, preserving the contextual richness of each individual study and allowing for cross-comparison among countries and policy environments. This approach enabled the identification of both consensus trends and regional divergences, forming the basis for evidence-informed policy proposals regarding agri-food sector employment in developed economies.

The annual distribution of analyzed articles was uneven; 2023, 2022 and 2021 were the most active years with 16, 14 and 14 articles. In the other years, 11 or fewer articles were published.

The journal distribution of the analyzed articles was even more diverse; only 7 journals provided 3 or more articles (Fig. 4). The three primary literary sources were the J. Rural Stud. (5 articles), Scientific Papers-Series Management, Economic Engineering in Agriculture and Rural Development (4 articles), and Sustainability (4 articles). The other 74 articles were published in 66 different journals.

3. Results

The six subtopics identified during the selection stage provide the basis of the analysis. This chapter summarizes the most important findings in each area. It presents the main trends and challenges, as well as some good solutions and best practices, identified within each area that developed countries face.

3.1. Family farming

When production factors, labor, land, capital and management are properly functioning, family farms are more efficient than other farming

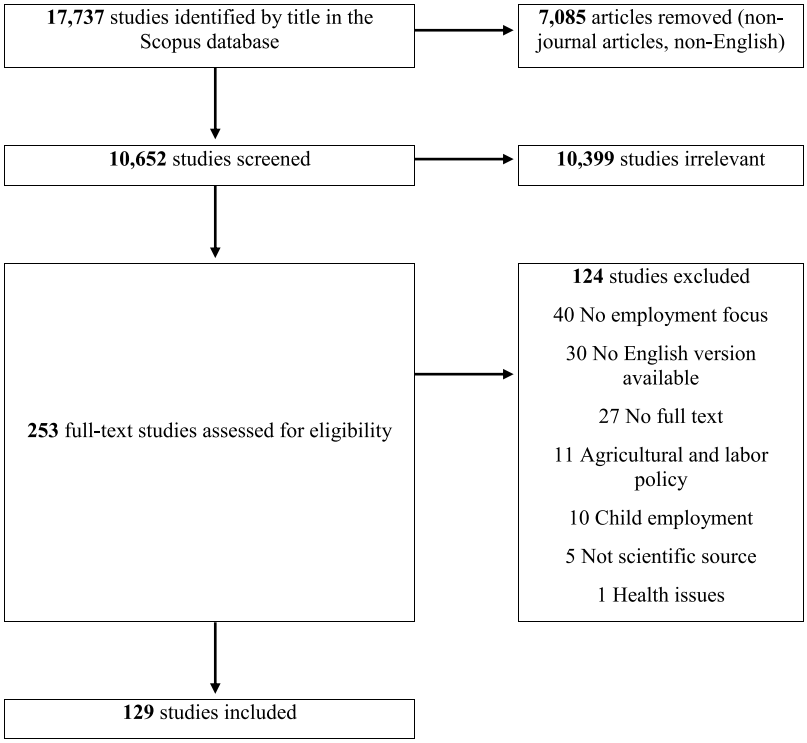

Fig. 1. First stage – Identification of the sub-topics.

Table 3
Brief description of the six identified topics.

Family farms	Family farms, typically managed by a single family, have historically been an integral part of agriculture in developed countries. They are vital for rural development and agricultural employment, significantly contributing to agricultural production and local economies.
Unique characteristics of employment	Agricultural migration and mobility refer to employment-related movement within or beyond the agricultural sector. It often includes seasonal migration between countries or rural areas, influencing labor dynamics and economic stability. It can also involve shifts from agriculture to other industries (e.g., industry or services).
Gender	Historically, agriculture has been a male-dominated sector, especially in management. Although women's participation has grown recently, they continue to face significant barriers. Promoting gender equality and increasing women's participation in agriculture are crucial.
Wage	Agricultural wages in developed countries are generally lower than wages in other sectors due to the seasonal and physical nature of work, and the high percentage of migrant labor, which tends to be paid less than domestic workers.
Education	Agricultural education and training are essential to advance the agricultural sector. Rapidly changing technology and constantly changing circumstances require a different type of education and training.
Productivity	Agricultural productivity in developed countries is generally high driven by efficient farming practices. However, productivity growth has slowed in some areas due to labor shortages or aging issues, and there are differences in productivity between sectors and countries.

enterprises [49]. Even today, family farms play an essential role in the agriculture of many developed countries. Family farming is still the predominant type in the EU, although its number is decreasing [60]. This decrease can be mainly explained by the increasing average size of farms, as there is an ever-larger efficiency pressure on modern farms. This trend is powerful in the more developed countries of Europe in terms of agriculture, countries such as France, the Netherland, and Poland [13,22,26,36,46,50,56,57,66,136]. Rye et al. [115] show that family labor is being replaced by wage labor in Norway, while migrant workers are replacing domestic workers. Stępień et al. [128] emphasize that market integration is a key part of becoming more efficient for family farms.

In less developed European countries, family farming is also dominant, and family farms are run by an aging farmer with below-middle education and family members. These family workers have a lower likelihood of flowing into the non-agricultural sector due to being less mobile and having psychological characteristics, such as pride and valuing autonomy [81,129]. Family farms in East European countries played a key role in absorbing labor after the collapse of the Soviet Union, which also contributes to their current importance [81].

There are also socio-economic trends driving the decline of family farming in the developed world: the size of families gets smaller, children who get higher education leave the agriculture sector, and the average age of farmers is increasing. These changes drive the consolidation of agribusinesses during which larger farms absorb many small family farms and the remaining ones switching to non-family labor [2,3,8,18,35,36,41,46,50,64–66,94,127]. Despite this trend, Schewe [119] found that organic farms began to return to employing family members instead of wage labor in New Zealand. Wu et al. [138] showed that natural disaster payments increased the available family farm member labor supply for family farms in Taiwan. It may be due to the payments increasing the farmers' motivation to continue working on the farm despite the natural disaster.

Bertoni and Cavicchioli [10] show that higher population density and local employment rates increase the likelihood of succession in family farming activities, particularly horticulture. It implies that urban and wealthier areas favor the continuation of high value-added farming practices [55]. The success of family farms is also important since Smędzik-Ambroży et al. [125] found that the age of the farmer is inversely correlated with the sustainability of the family farm. If family farms are to survive, they must increase their efficiency, especially with respect to labor cost. It can be aided by introducing new tools and technologies and training the workforce to use them efficiently [5]. Another route is that family members take on jobs outside the farm, increasing the available working capital, allowing the family farm to contract additional labor or implement new technology [24,43]. Other reasons family farmers take on off-farm work in North America is to manage the risks associated with running the family farm [53] and secure health insurance [12]. However, in general, family farms use labor very efficiently [49]; family labor provides greater economic flexibility and resilience [133]; family farms still represent the backbone of agriculture [23].

3.2. *Unique characteristics of employment*

Agriculture operating in the global capitalist economic system can only increase its profit rates by reducing the cost of labor due to the peak in production; thus, it is increasingly dependent on profiting from the skimming of the economic value produced by migrant workers. This practice not only forces migrant workers into often inhumane and illegal working conditions but also threatens the stability of the labor supply of the entire global agricultural system due to epidemiological restrictions on international mobility (see e.g., [108]). Informal employment may worsen this situation [30,71]. In several Stud., the literature details the dependence of the agricultural sectors of developed countries on off-farm labor [15,16,18,26,35,40,46,51,98,105,113,115,132,140].

Based on this, for example, most of the seasonal workers in the US come from Mexico. The reason for this is Mexico's low economic growth compared to the US, as well as the labor-absorbing power of the rapidly developing sectors in the US, which are replaced by migrant workers [40]. Coincidentally, large US-based farms, significantly dependent on immigrant labor, are fierce advocates for the easier admission of seasonal workers [18]. Furthermore, nearly half of the migrant workers employed by US crop farms do so without a permit [140]. In many cases, most of the farms employ refugees due to their lower wages or flexible work schedules [20]. According to Avola [4], on the contrary, migrant workers have better employment opportunities in Mediterranean agriculture; however, it means low-skilled and low-paid jobs along with high

Table 4
The Boolean operators of the final search.

family farm	OR	off-farm labor OR off-farm labour OR seasonal labor OR seasonal labour	OR	migration OR mobility	OR	gender	OR	wage	OR	education	OR	productivity

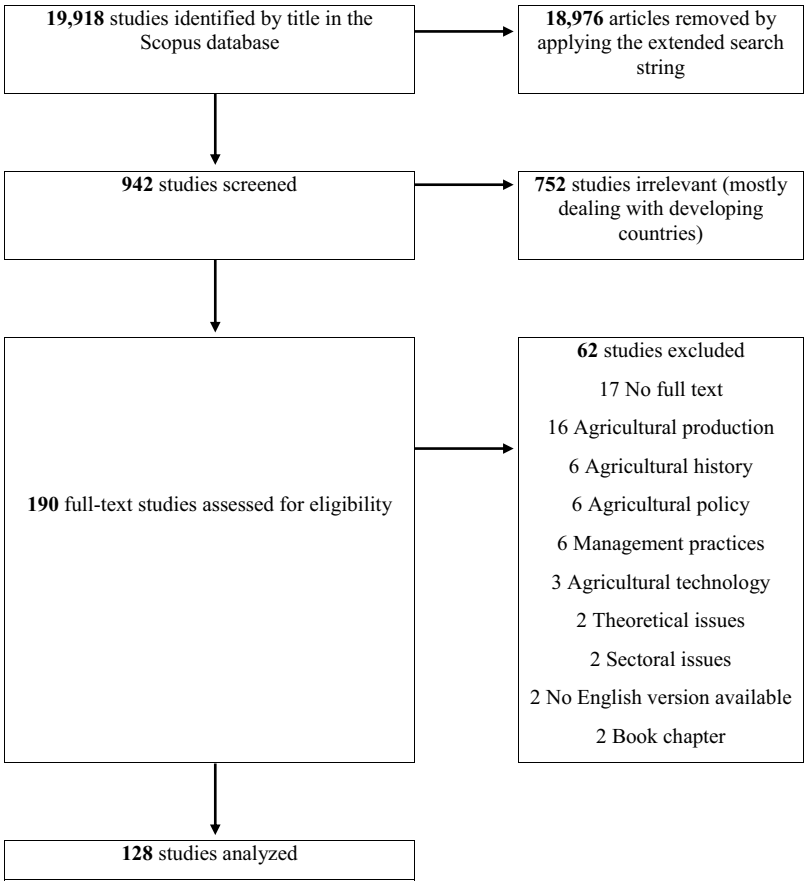

Fig. 2. Second stage – Identification of relevant articles.

segregation.

The recent wave of mechanization and digitization, according to American farmers, may and will reduce the use of migrant labor in agriculture [18], but according to German farmers, it will take a long time for machines to completely replace migrant workers. Digitization leads to increased work intensity and harsher working conditions, which further increases dependence on migrant workers who are forced to accept such working conditions [105,121]. Alarcón [2] found that the increase in agricultural mechanization and digitalization is an obstacle to integrating immigrants primarily through agricultural employment.

EU agriculture is also very dependent on migrant (and seasonal) workers: immigrants make up a significant part of the EU labor force employed in agriculture, who are concentrated on larger and more productive farms, and their presence is positively correlated with the productivity of the farms' labor [26,44,46,98,131]. Being aware of this, the EU created a program for the training of migrants and refugees, which also tries to make it easier for migrants to join agriculture with special training and job search support [7]. This program is much needed, as there is a considerable number of injuries among the growing migrant workforce [16]. There are still great barriers for immigrants to establish their farms (even when land prices are low) due to the lack of connections and various types of capital [48,130]. Great Britain's agriculture is also struggling with a labor shortage, especially after the COVID-19 era, which they try to fill primarily with seasonal workers, mostly migrant workers, whose supply is also limited [1,94].

Some of the articles draw attention to the dangers of agriculture's increasing reliance on migrant workers. According to Molinero-Gerbeau and Avallone [89], in the current phase of capitalism, global agriculture is based on skimming the value produced by cheap migrant workers, even in the face of mechanization. The problem is present in the literature that examines North-America [15,106,143], Australia [113], Great Britain [1,27,121,122] and the EU [2,25,29,33,66,88,89,101,109,118]. For example, the increasing exploitation of Mexican migrant workers employed in the southern states of the US [114,143] often leads to their increasing organization and coordinated strikes [143]. Analyzing Canadian seasonal work programs, Preibisch [106] finds that low-skilled and low value-added workers have difficulty obtaining residence permits and citizenship, and family reunion is not supported. Rosewarne [113] warns about the state of migrant worker exploitation in seasonal labor-dependent Australia. In Great Britain, agricultural migrant workers face several types of exploitation, such as additional fees charged by job brokers, poor quality of allocated accommodation, and hazardous working conditions. Schewe and White (2017) found that the influencing factor of labor exploitation is not ownership structure (family or non-family farm), but farm size.

Due to their vulnerability, immigrants are considered a well-controlled workforce [1,27,89]. The phenomenon replicates in various European countries [29,66,88,101,109]. Paying smugglers and getting in debt is also part of migrant workers entering developed countries [101]. However, an American example shows that higher agricultural activity may lower crime rates [21]. All this is driven by competitive pressure in the global agricultural market led by the rise of large food retailers, which producers try to meet by minimizing wage costs, and the exploitable migrant worker sector contributes to this.

In general, off-farm labor related literature focuses on state temporary off-farm labor programs. Australia and New Zealand introduced special labor mobility programs, however, their employment impact is rather small [73,96,103,135]. In Spain, there are off-farm labor programs planned at the regional level, which create the legal framework for the employment of foreign workers in agriculture but, as mentioned before, they can still be considered a vulnerable group [39]. Migrant workers are legally required to return home after work is completed,

thus preventing their settlement and integration into the Spanish economy [70]. The situation is similar with Canadian temporary off-farm labor programs [106,135], migrant workers come to pre-designated companies which had to assure the Canadian government that they cannot fill vacant positions with Canadian workers. In addition, migrant workers cannot bring their families with them, leading to higher utilization of workers by exclusion of family social activities. Regarding Canadian programs, Reid-Musson [110] notes that family farms limit the mobility of their employed migrant workers, further reducing their place of employment choice. In contrast to these examples, local producers in Italy never initiated the establishment of such programs, so they never appeared. Therefore, the southern regions of Italy are characterized by deregulated immigrant employment in agriculture [33,42]. Corsi and Salvioni [24] found that since past labor is a strong indicator of current off-farm work; policies should focus on education and the promotion of personal skills to foster off-farm employment.

Many Stud. discuss the positive aspects of seasonal work and outline structures in which seasonal work can be beneficial to both the farmer and the seasonal worker [43,50,67,90,95,137]. Nehring and his co-authors (2005) point out that in the United States, seasonal workers contribute significantly to increasing agricultural efficiency. In addition, American seasonal workers are more inclined to choose beef and chicken farms as jobs, as these places have lower economies of scale and, therefore, a greater demand for seasonal workers whose work is valued higher [43]. Migrant workers running their farms in the US are found to often operate sustainably and organically, but lack the education and resources to apply for the organic producer certificate [84]. Labrianidis and Sykas [67] discovered that Albanian migrant workers working in Greece can afford multiple trips due to the proximity of the countries, which helps their social progress. An interesting phenomenon in French agriculture is that full-time workers are being replaced by seasonal (even daily) employees [50]. Nye [95] deals with a special version of seasonal work in which the worker provides not only the work itself but also the tools themselves as a contractor; thus, this type of seasonal work offers the entrepreneur a higher bargaining position. Community-supported agriculture distributes the work among consumers who want to benefit from agricultural products [137].

The problem of farmers turning to off-farm work became important with the outbreak of the COVID-19 epidemic, when closures were introduced, which also limited mobility between countries. In the end, the EU or the USA was forced to make an exception to the measures restricting mobility for migrant workers [80,117]. Although this allowed agricultural production to continue, it led to COVID-19 outbreaks linked to migrant workers in several EU member states. Seasonal workers were particularly impacted by the lockdown measures related to the pandemic [117], and according to some Stud., there was an increase in bargaining power for employed workers [112]. In such circumstances, the role of social workers is essential [45]. The inhuman working conditions of the migrant workers exacerbated the problem. In the past, there was already a proposal to tie EU agricultural subsidies to fair working conditions, but this was rejected by the European Council. This should be renegotiated, as, in many cases, better rules and wages could lead to better housing, well-being and health conditions [25,117].

3.3. Differences between genders and gender equality

In recent years, the fewest publications have been published on gender and gender equality in developed conuntries. It is clear from the literature that women carry out monotonous, less appreciated, and less profitable agricultural activities. It was also observed that more women work in organic farms than in conventional agriculture. However, the increased participation of women cannot be explained by the 'feminine' values present in organic farming, for example, a higher level of attention and more care [52]. Shreck et al. [123] refuted that organic farming is more socially sustainable than conventional farming. Women who work in organic farming cannot secure the incomes and benefits available to workers in other sectors. Bernal [9], however, points out that women workforce in ecological farming leads to better economic results due to the characteristics of women and facilitates population settlement as well by providing flexible work hours.

Women also tend to leave farming due to their increased resistance to the traditional hard-working "farm-wife" role, or at least to strive for equal recognition within the industry [3,31]. Women's unpaid family labor is a common characteristic of small and medium-sized farms [61]. Contzen and Forney [23] suggested that inequality is tied to the position on the farm and not gender. They remark that, with mutual recognition, even these asymmetric arrangements can lead to contented working family members. Reissig et al. [111] found that on organic family farms, women are more involved in family work and less in farm work. In terms of intensive and conventional agriculture, the training of the female workforce is decreasing, and the workforce is becoming feminized and segmented, similar to that of developing countries. There are areas, for example, strawberry or kiwi harvesting, where employers are specifically looking for female workers [25,29]. Women are concentrated in socially less valued physical jobs which are characterized by temporary, unstable, very flexible contractual relationships, worse working conditions and lower wages [30,68], and often feel that they are demeaned, dismissed or excluded because of gender [92]. Female workers tolerate repetitive tasks, painful postures and long working hours, and their ability to handle more loads should be emphasized which can be considered a guarantee of good performance. Business strategies and the devaluation of various agricultural jobs directly contribute to developing an unequal and vulnerable social structure [29].

As farm income increases, farmers invest some of the extra income in their children's education, and educated children are less likely to become farmers (see more in subchapter 3.5). Women who have more children, and thus more potential agricultural offspring, are more likely to leave the agricultural sector. Parents who earn a larger share of their income from agricultural activities and social transfers are less likely to send their children to school (e.g., university), especially not girls. Children of women earning low wages also stay in agriculture, with a few exceptions [8,29,129].

The relationship between migration and gender roles is also worth exploring [106]. A significant part of the labor force entering Canadian agriculture is male due to the nature of agricultural work, and in the interest of minimizing gender tensions, employers are looking for men. In Europe, the most sought-after workforce is men between the ages of 20 and 40 [25]. Furthermore, women working outside of agriculture can help avoid potential "cooperative conflicts" with their husbands [49]. The political and corporate attitude, which allows employers to choose the nationality and gender of their migrant workers, results in various forms of racial and gender segmentation. Women also face a challenge when it comes to succession in family-owned wineries in the Cognac region of France [11].

3.4. Wage

Darpeix et al. [26] distinguish three types of employee wages: wages paid to family members, permanently employed workers, and seasonal workers. Using seasonal workers increases flexibility and reduces costs, but this type of labor is not available in all geographic regions. Family labor can replace both types of labor but is typically used to replace the latter. However, there are cases where hiring a permanent employee is cheaper, for example, when the cost of training, turnover, or work supervision is very high. Agricultural employment is characterized by highly discriminatory wages. There is a significant difference between the wages paid to family members, permanent employees, or migrant workers. Furthermore, migrant workers work for hourly and performance wages and generally do not have the same social rights as citizens, which further increases their vulnerability [5,15,25–27,29,33,36,38,46,66,90,105,109,113,120–123].

When investigating the illegal employment of Romanian migrant workers in Italy, Domșodi [33] draws attention to the fact that the pressure on efficiency on both the upstream and downstream sides of the agricultural supply chain is so great that the cost of labor matters a lot. Shreck et al. [123] also report that the income of migrant workers working in California decreases in real terms; they are not paid overtime, and they are underemployed in the off-season. In Denmark, it is a regular solution that domestic workers are paid more for the same work than seasonal workers, who also lose out on social services (pension, health insurance) [109].

Migrant workers in the UK routinely receive their wages late [27]. From 2021, Germany fixed the minimum hourly wage for seasonal immigrant workers [105]. However, the wage depends only partly on the hours worked, workers earn the other part based on performance, and the performance measurement that results in unfair situations is based on unrealistic expectations [121,122]. In Northern European welfare states, trade unions specifically feared that EU enlargements would depress the wages of seasonal agricultural work. The wage gap between agriculture (and other sectors based on immigrant labor) and other industries strongly supported by trade unions has opened [38,91,109,129]. Mishra and Chang [85] found that income uncertainty in American farm households promotes precautionary savings and household wealth. Jiang and Miller [54] analyzed the wage impact of cannabis legalization in the USA without finding any significant differences in the average wage of the agricultural sector. Furthermore, according to Richards and Rutledge [112], with the increase in bargaining power of workers during COVID-19, agricultural (minimal) wages started to rise, and the higher unemployment benefits increased the equilibrium wages as fewer workers remained in the (agricultural) labor force.

3.5. Education

The rapid development of technology, smart agriculture, and the recording, collection, processing, and proper use of an unimaginable amount of data require different knowledge and skills from agricultural workers than ever before. One of the most essential tools for this is education and training so that professionals with adequate knowledge and experience are present in the sector. With the progressive professionalization of the food industry workforce, next to the demand for manual or low-skilled workers in this sector [68], there is also a need for specialists who can handle and service machines, which requires the development of other skills in education and technology-oriented training [18]. Agricultural consulting and education are the key to improving labor productivity [104,116]. Internship programs can play an important role in this process, as collaborative courses strengthen academia-industry bonds; however, the USDA example shows that only a small percentage of the interns will be long-term employees [32]. Nevertheless, the University Extension Diploma in Food Technology (DEUTA) program is a good example of collaboration between academia and industry [19].

It can be considered a serious challenge that the qualifications of the agricultural workforce are generally lower compared to other sectors [36,46,141], and that the highly qualified workforce does not stay in the agricultural sector for long, mainly due to financial reasons [15,129,132]. One of the critical effects of the increase in farmer's income is that the child(ren) of the producers can receive a higher level of education, because of which they can find a better paid job outside the sector and are less likely to take over their parents' farm [8,59].

Education makes it easier for immigrants and less educated people to find work in agriculture [7,15,27,59]. Special attention must be paid to the safety training of migrant workers, for whom injury rates are generally higher than for the non-migrant workforce [16]. As family labor is found to be less efficient than hired labor, investing in education and training programs for family members is justified [64,65]. A relationship can be demonstrated between farmer education and the ability of the farm to generate income [8,43]. An educated farmer collects and uses more information, has better access to resources, and is more likely to invest in technology and operate a more modern and efficient farm. Succession is usually not a problem on such farms: the next generation is more willing to take over a well-functioning, modern, and profitable farm. The higher the level of farmer education and the higher the percentage of permanent employees, the smaller the proportion of families involved in the work [26]. Policymakers in the EU should focus on rural development payments for education, as it is found to facilitate the increase in human capital and efficiency [75].

3.6. Productivity

As in other sectors, one of the essential means of increasing profits in the agricultural sector is increasing productivity. Production increases through the optimal use of machines and labor, while costs do not change substantially, resulting in higher profits overall. The labor shortage in developed countries further reinforces the need to increase productivity. The decrease in labor use labor through technological developments requires an increase in workers' education level [5]. The productivity of agricultural land grows slower than its labor force, and the growth of agricultural productivity lags that of the sectors that produce inputs [62]. Zhengfei and Lansink [142] show that long-term debt has a positive effect on productivity growth in the farming context. In general, agricultural wages show an increasing trend and its main reason is higher labor productivity [6].

The role of agriculture and the food industry is more significant in the new member states of the EU, compared to the old ones, but the productivity in the old member states can be considered higher. In the case of both groups of countries, the opportunities for employment growth are limited [5,58]. Taking into account CAP subsidies, the smallest farms have the best indicators, as the use of labor per unit of area is inversely proportional to the size of the farm. In the case of smaller farms, this means overemployment, which negatively affects workforce's productivity [13,102]. On the contrary, in the case of American agriculture, the allocation of labor from less efficient to more efficient (typically larger) producers would increase the output and productivity. Agricultural subsidies and programs play a key role in this continent and Europe [43,51,62,69].

In developed countries, family farms do not hinder the increase in productivity, which significantly contributed to the optimization of work organization and the continuous reduction of the workforce due to technological development. Increasing labor productivity increases the return of capital investors (and not wages) [50]. Environmental policy-measures also have an impact on farm labor use. Unay-Gailhard and Bojnec [132] showed that agri-environment measures increase the hired labor on crop farms and the family labor on dairy farms. Increasing the productivity of the farm can be achieved in many ways, for example by increasing the level of education of employees, increasing economies of scale, mechanization and technological development, export orientation, specialization, or supporting young farmers [2,18,40,72,89,93,104,118,131].

Groborz and Juliszewski [47] show that tasks performed by women are in greater need of mechanization due to the effort requirement than tasks performed by men. Since labor availability is a critical factor, production contracts also typically increase productivity [118]. Increasing workforce productivity requires an integrated approach and targeted programs [5,34]. Maietta et al. [75] suggest that rural development payments play the most significant role in improving human capital productivity. Sabasi and Shumway [116] also emphasize the human aspect of agricultural productivity, mainly through education and access to health care, as the main drivers of human capital. Yagi and Hayashi [139] found that overwork is unavoidable on both family and non-family rice farms in Japan due to the extra time requirement of coordinating with part-time workers. Konstantinidis [63] shows that even organic farms in the EU are highly mechanized and productivity-oriented, despite the policymakers' rhetoric of organic

farming promoting small-scale agriculture. Raimondo et al. [107] also highlight how organic farming increases the efficiency of Italian olive farms. Reissig et al. [111] found that farm couples work longer hours on organic farms than on conventional farms, which might also be motivated by work enjoyment. Overall, the agricultural model in developed countries focuses on productivity, the main feature of which is the reduction of labor use to the greatest extent possible [72].

4. Summary and conclusions

4.1. Summary and synthesis of the findings

The challenges experienced in recent years and decades, including factors such as an aging population, changing consumption patterns and a growing demand for organic foods, have significantly burdened the agricultural sector. Furthermore, the recent, suddenly occurring new challenges (e.g., COVID-19 pandemic, the Ukrainian-Russian conflict) have also heavily affected and tested the agri-food sector. Regrettably, agriculture's importance, for example, in the ratio of total GDP and employment, has declined in developed countries. Based on the two-stage, comprehensive systematic literature review presented in this paper, employment in developed countries' agriculture is characterized by specific areas of focus: (1) family farming; (2) unique employment characteristics related to migration and mobility; (3) gender issues; (4) wage disparities; (5) educational considerations; and (6) productivity enhancements. The review included the summarization and synthesis of 128 articles. Most of the articles dealt with the United States, followed by the EU (mainly Italy and Poland) in Fig. 5.

According to the results, *family farms* remain crucial in developed nations' agriculture despite their decreasing number [60]. The decline comes from the increase in the size of farms driven by efficiency pressures, mainly in developed Europe. In least developed countries such as Romania or Bulgaria, family farming is still prevalent, managed mainly by older, low-educated farmers with family help [81,129]. The drop in family farming is driven by socio-economic factors such as smaller families, educated children leaving agriculture, and an aging farmer population. This complex problem is the crux of agriculture in developed countries. For survival, family farms must improve efficiency, specifically in labor costs. Furthermore, the modernization and high degree of mechanization of family farms have an attractive effect on descendants in terms of staying in agriculture [5]. Agricultural policy should encourage the size of holdings that can support a family by consolidating agricultural land and reducing fragmentation.

However, global capitalist agriculture seeks to increase profits by cutting labor costs, leading to reliance on exploiting *migrant workers* for economic gain. This not only subjects migrant workers to inhumane and illegal working conditions [106,114], but also jeopardizes the stability of the global agricultural workforce due to mobility restrictions during epidemics. Governments must find a solution to ensure a predictable food supply through the management of human labor in the future. Seasonal work can benefit farmers and workers in specific structures [43,67,95]. For example, in Great Britain or Canada, a special type of work allows contractors to bring their tools and offer a stronger bargaining position for better wages and conditions, contributing to work sustainability and stability [1,94]. In countries with high wages, strong mechanization and automation are being implemented to replace repetitive, low-value-added work. However, with mechanization, the digital surveillance of workers is also spreading, which could lead to even greater exploitation of migrant workers Fig. 3,Table 10,Table 5, Table 6,Table 7,Table 8,Table 9.

The least amount of research has been done on the topic of *gender (in) equality* in developed countries. Women's jobs in agriculture are increasingly devalued (e.g., monotonous jobs) and require less and less high-level education. As a result of migration, a significant number of men appear in developed countries' agriculture, and the increase in the number of women can only be observed recently [25,106]. It is not surprising since, due to the typical physical load of most agricultural work, most employers are specifically looking for male workers. In the case of women, a clear turning point can be the acquisition of higher education, which allows them to occupy higher positions.

Based on the results, *agricultural wages* show severe discrimination, with significant disparities between wages paid to family members, permanent employees and migrant workers. Low-skilled labor leaves agriculture when wages increase in the industrial sector. Migrant workers often earn lower hourly and performance-based wages and lack the same social rights as citizens, exacerbating their vulnerability [15, 25,36,66]. Seasonal labor offers flexibility and cost savings but may not be accessible everywhere. Family labor can replace both but typically replaces the latter. In some cases [33], hiring a permanent employee may be cheaper, for example, when training, turnover, or supervision costs are high.

As a result of technological development (e.g., mechanization, automation, robotization), different kinds of knowledge and skills are needed [18,68] and professional *education* is generally valued. The problem is that the educational level of the workers in agriculture is typically lower than in other sectors [36,46]. Higher education helps attract agricultural labor but typically results in higher income within the sector. For family farms, encouraging generational change can concentrate the proper education, skills and capital in the hands of a single family in the long term. EU policymakers should prioritize rural development subsidies for education, as this has been shown to foster human capital growth and improve efficiency [75]. Moreover, attracting young people to work in agriculture is key to the development of the sector [14,76]. Technological progress means that short-term, highly practice-oriented training is needed to meet rapidly changing needs. Innovation and know-how are the basis of modern agriculture and the

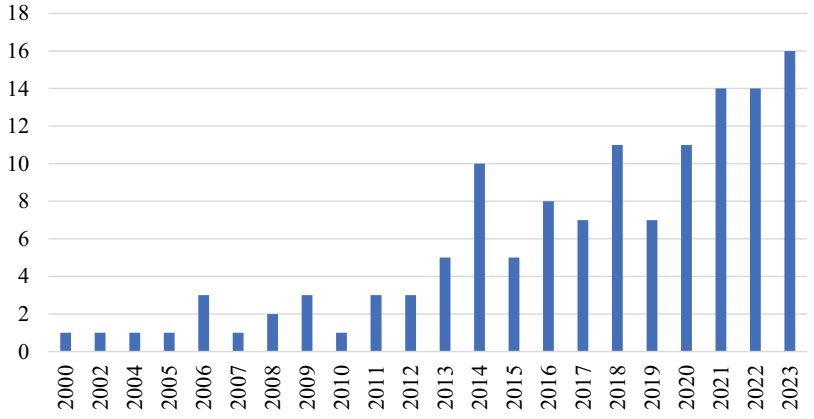

Fig. 3. Annual distribution of the analyzed articles.

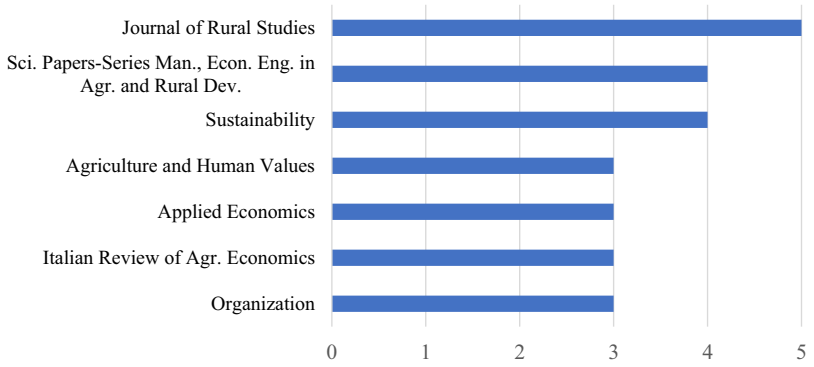

Fig. 4. Journal distribution of the analyzed articles.

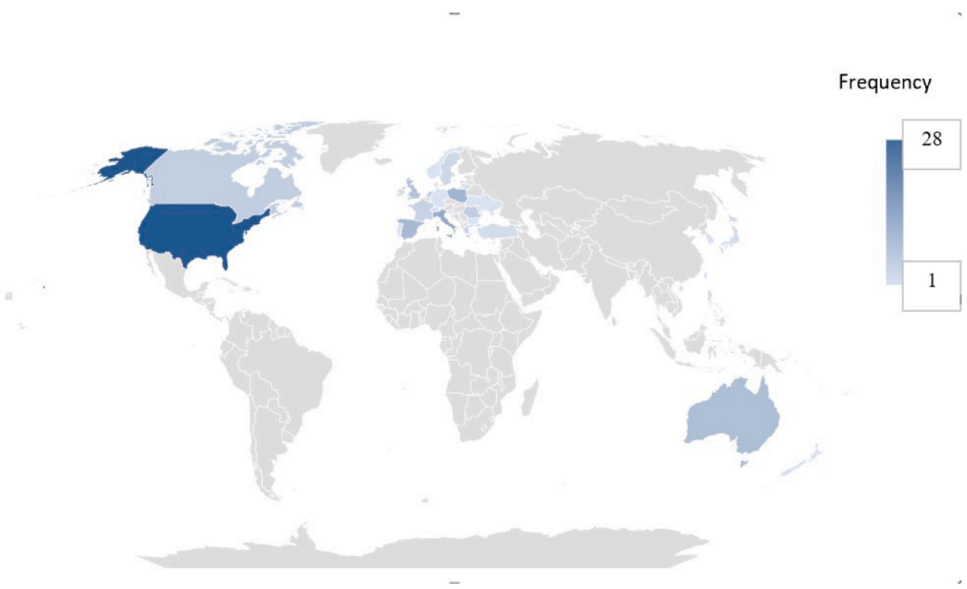

Fig. 5. Geographical distribution of the analyzed articles.

food industry and should be the foundation for future training programs. Secondary and higher education in agriculture should be effectively involved in various R&D activities in which theoretical and practical knowledge can be successfully combined.

Indicators used to measure productivity (value produced by the workforce, gross added value, and agricultural income) are projected onto the labor unit (annual labor unit). Consequently, productivity increases when the value of production increases and/or the use of labor decreases. The tools to increase productivity are production concentration, optimization of the production structure, development of technology (technical innovations that save labor), and support of young people/farmers to start or continue agricultural activities. The family farming model does not prevent the increase in productivity at all. Processing raw materials is essential to increase added value. One of the main outcomes of this research is the close link between the identified themes. Having skilled workers requires education and training. This is important for family farms and even for seasonal workers. Skilled workers should be paid better regardless of their gender. Higher productivity is based on advanced methods including precision agriculture and precision technologies cannot be applied without skilled workers. However, the time aspect of the different policy measures should be highlighted. Even a single support program, such as investments in physical assets, can enhance productivity in the short term. While different types of training are short- or medium-term measures, changing the education system according to the specific need of the sector requires more time. Although fairer wages can be introduced instantly, they are closely linked to higher productivity. Table 11 provides an overview of the identified themes, and the main findings related to them.

4.2. *Policy and managerial implications*

Given the challenges facing the agri-food sector in developed countries, tailored policy (and management) interventions are recommended to strengthen the viability and productivity of family farms, reform labor markets, promote gender equality, and invest in education and technological innovation (Table 12). Policies must focus on programs that encourage the consolidation of farmland to create economies of scale and improve efficiency to ensure the economic sustainability of family farms. Financial and technical support must be increased for modern agricultural technologies that not only increase productivity but also maintain environmental sustainability. Additionally, facilitating the transfer of farms across generations through tax incentives and succession planning programs, can make it financially viable for the younger generation to continue farming traditions. On the one hand, aging is one of the most crucial problems of agriculture, while on the other hand, agriculture is not tempting for the younger generation. Solving this complex problem is the greatest challenge for developed countries.

The exploitation of migrant workers and the precariousness of agricultural work call for urgent reform. It is imperative to implement

Table 5
Summary of the findings on family farming.

Topic	Main results	Supporting literature
Trends in developed countries	Family farms are declining due to efficiency pressures and increasing average farm size; family labor is being replaced by wage or migrant labor.	Biernat-Jarka [13]; Chmieliński & Karwat-Woźniak (2015); Darpeix et al. [26]; Dries & Swinnen [36]; Górny & Kaczmarczyk [46]; Hubert [50]; Karwat-Woźniak [56, 57]; Klikocka et al. [60]; Kroon & Paauwe [66]; Rye et al. [115]; Stępień et al. [128]; Wästfelt & Zhang [136]
Socio-economic drivers of decline	Smaller families, higher education levels, and aging populations lead to fewer successors and increased consolidation.	Alarcón [2]; Alston & Whittenbury [3]; Berlinschi et al. [8]; Carolan [18]; Dries et al. [35]; Dries & Swinnen [36]; Gen et al. [41]; Górny & Kaczmarczyk [46]; Hubert [50]; Kourtesi et al. [64,65]; Kroon & Paauwe [66]; Nye [94]; Sroka et al. [127]
Resilience and return to family labor	Some (organic) farms are returning to family labor; disaster payments can motivate family labor participation.	Schewe [119]; Wu et al. [138]
Succession and urban influence	The high population density and employment increase the likelihood of succession in family farming.	Bertoni & Cavicchioli [10]; Kafle et al. [55]
Age and sustainability	Older farmers are less likely to run sustainable family farms.	Smędzik-Ambroży et al. [125]
Paths to increased efficiency	Training and technology adoption can boost efficiency; off-farm work can increase capital and flexibility.	Babenko & Vasilyeva [5]; Bharadwaj et al. [12]; Corsi & Salvioni [24]; Gillespie & Mishra [43]; Jetté-Nantel et al. [53]
Overall role of family farms	They remain a flexible, resilient backbone of agriculture.	Contzen & Forney [23]; Holzner [49]; Van Vliet et al. [133];

Table 6
Summary of findings on the characteristics of employment.

Topic	Main results	Supporting literature
Profit maximization and labor exploitation	Agriculture in global capitalism increases profits by reducing labor costs, especially through the exploitation of migrant workers.	Degani [30]; López-Sala & Molinero-Gerbeau [71]; Ray et al. [108]
Dependence on migrant labor in developed countries	Developed countries rely heavily on off-farm and seasonal migrant labor, often under poor or illegal conditions.	Bousmah & Grenier [15]; Carolan [18]; Cento & Bahşi [20]; Gallardo & Sauer [40]; Zahniser et al. [140]
Mechanization and digitalization	Mechanization might reduce labor demand but in practice, it increases work intensity and reliance on cheap labor.	Alarcón [2]; Carolan [18]; Prause [105]; Scott [121]
Migrant labor in EU agriculture	Migrants are essential to EU agriculture productivity but face injury risks, integration barriers and capital limitations.	Beni et al. [7]; Caffaro et al. [16]; Darpeix et al. [26]; Gnip [44]; Grubbström & Joosse [48]
Structural exploitation & capitalist dynamics	Global agriculture is structured to exploit migrant labor across regions with short-sighted strategies that harm sector renewal.	de Castro et al. [29]; Molinero-Gerbeau & Avallone [89]; Preibisch [106]; Rosewarne [113]
Labor organizing and vulnerability	Exploitation triggers resistance (e.g., strikes), while vulnerability ensures employer control.	Agar & Manolchev [1]; Preibisch [106]; Schewe & White (2017); Zlolniski [143]
Temporary off-farm labor programs	Temporary programs in countries like Canada, Spain, Australia and NZ restrict migrant integration and family reunification.	Fernández García et al. [39]; López-Sala [70]; Preibisch [106]; Vosko [135]
Positive aspects of seasonal work	In appropriate structures, seasonal work can enhance efficiency and provide social and economic mobility.	Gillespie & Mishra [43]; Hubert [50]; Labrianidis & Sykas [67]; Nehring et al. [90]
COVID-19 and agricultural labor	The pandemic revealed the essential nature of migrant labor and led to policy exceptions, despite health risks and outbreaks.	Martin [80]; Richards & Rutledge [112],[117]
Policy and welfare considerations	Proposals to tie subsidies to fair labor conditions exist but face political resistance; better labor policies could improve health and housing.	Cortignani et al. [25]; Gonzalez Benson et al. [45]

policies that regularize the status of migrant workers, protect them from exploitation, and improve their living and working conditions. It includes providing pathways to citizenship and ensuring that labor rights are universally applied. Furthermore, agricultural subsidies should be linked to compliance with labor standards, including fair wages, safe working conditions, and reasonable working hours. Promoting programs that diversify the agricultural labor market to include more local workers can increase the attractiveness of jobs through higher wages and better conditions. Moreover, addressing the underrepresentation and undervaluation of women in agriculture requires the development of specific programs to support women's participation. These could include grants for women-led agricultural initiatives and businesses, and training programs tailored to women's needs. Campaigns to raise the status of women in agriculture and recognize their contributions could help change cultural perceptions and encourage more women to enter and remain in the sector.

A shift to a highly educated agricultural workforce is essential for the future of agriculture in developed countries Modern technologies do require skilled workers. Increased investment in rural education infrastructure, including secondary and tertiary education focusing on agricultural sciences, is critical. Expanding vocational training programs linked directly to agricultural technologies and smart farming techniques can rapidly upgrade the workforce. Promoting lifelong learning and continuous professional development for farmers and farm workers will keep pace with technological advances. In addition, offering rural development payments tied to education, an unexplored area, could increase human capital, improve farm management and attract youth to the agricultural sector. To address the dual challenges of labor shortages and competitive global markets, it is critical to provide tax incentives and subsidies for the adoption of productivity-enhancing technologies such as automation and precision agriculture. It refers to the crucial importance of education. Increased funding is needed for agricultural research and development programs focused on sustainable farming practices and innovations that increase productivity. In addition, fostering collaboration between government, educational institutions and the private sector can drive innovation in the agricultural sector. Countries that are brave and quick enough to implement reforms are more successful in the long run than countries that focus on short-term gains.

This study also contributes to the theoretical development of agri-food labor research by offering a structured and thematic synthesis across six core employment-related dimensions, rarely analyzed in conjunction. By integrating issues such as family farming dynamics, gendered labor patterns, and productivity metrics within a unified

Table 7
Summary of findings on genders and gender inequality.

Topic	Main results	Supporting literature
Women's role in organic vs. conventional farming	Women are more involved in organic farming but it does not necessarily guarantee better income or recognition.	Bernal [9]; Jansen [52]; Reissig et al. [111]; Shreck et al. [123]
Inequality and unpaid labor in family farming	Gender inequality often stems from labor roles and unpaid work, though mutual recognition can balance this.	Contzen & Forney [23]; Kocabicak [61]
Precarious work in intensive agriculture	Women are concentrated in low-wage, unstable jobs with poor working conditions in intensive agriculture.	Cortignani et al. [25]; de Castro et al. [29]; Degani [30]; Nichols & Carter [92]
High birth rates drive women to agriculture	Low wages and high birth rates among women contribute to generational persistence in agriculture.	Berlinschi et al. [8]; de Castro et al. [29]; Tocco et al. [129]
Gender and migration in agricultural labor	Migration policies and employer preferences reinforce gender segmentation and limit women's opportunities.	Bessière [11]; Cortignani et al. [25]; Holzner [49]; Preibisch [106]

Table 8
Summary of findings on wages.

Topic	Main results	Supporting literature
Types of agricultural wages	Wages differ among family members, permanent and seasonal workers; seasonal labor is cost-effective but not universally accessible.	Darpeix et al. [26]
Wage disparities and social rights	Migrant and seasonal workers are paid less and often lack social rights, increasing their vulnerability.	Babenko & Vasilyeva [5]; Bousmah & Grenier [15]; Darpeix et al. [26]; Davies [27]; de Castro et al. [29]; Refslund [109]; Schmitz & Moss [120]; Scott [121, 122]
Illegal and unfair labor practices	Migrant workers face wage delays, unpaid overtime, underemployment and exploitative performance-based pay.	Davies [27]; Domşodi [33]; Scott [121,122]; Shreck et al. [123]
Welfare state and wage dynamics	Northern European trade unions feared wage suppression due to EU enlargement; wage gaps widened between agriculture and other sectors.	Fayer [38]; Nessabian et al. [91]; Refslund [109]; Tocco et al. [129]
Recent wage trends and policy impacts	COVID-19, cannabis legalization and unemployment benefits have influenced agricultural wage dynamics, with some wage increases reported.	Jiang & Miller [54]; Mishra & Chang [85]; Prause [105]; Richards & Rutledge [112]

Table 9
Summary of findings on education.

Topic	Main results	Supporting literature
Technology and skills development	Modern agriculture requires digital skills, machine handling abilities and technology-oriented training alongside manual labor.	Carolan [18]; Lasso-Dela-Vega et al. [68]
Role of education and training	Agricultural consulting, internships and collaborations between academia and industry improve labor productivity and foster professionalization.	Castelló et al. [19]; Dockry et al. [32]; Popescu et al. [104]; Sabasi & Shumway [116]
Challenges of low educational attainment	Agricultural workers are generally less educated; highly qualified professionals often leave the sector for financial reasons.	Bousmah & Grenier [15]; Dries & Swinnen [36]; Górny & Kaczmarczyk [46]; Tocco et al. [129]; Unay-Gailhard & Bojnec [132]; Zhang & Xu [141]
Education's role in succession and retention	Higher farmer education improves income, technology use and likelihood of generational succession on farms.	Berlinschi et al. [8]; Darpeix et al. [26]; Gillespie & Mishra [43]; Kim et al. [59]
Migrant labor and safety training	Education facilitates migrant employment and reduces injury risks; training for family labor increases productivity.	Beni et al. [7]; Bousmah & Grenier [15]; Caffaro et al. [16]; Davies [27]; Kourtesi et al. [64,65]; Maietta et al. [75]

Table 10
Summary of findings on productivity.

Topic	Main results	Supporting literature
Labor productivity and education	Technological development reduces labor needs, increasing the importance of education for the remaining workers.	Babenko & Vasilyeva [5]
Differences between regions	Old EU member states have higher productivity; small farms in new member states are often overemployed, lowering productivity.	Babenko & Vasilyeva [5]; Biernat-Jarka [13]; Kijek et al. [58]; Petrescu [102]
Subsidies and farm size	Subsidies influence productivity; in the U.S., shifting labor to more efficient farms would increase output.	Gillespie & Mishra [43]; Işcan [51]; Kołodziejczak [62]; Latruffe et al. [69]
Family farms and mechanization	Family farms in developed countries support productivity via efficient work organization and mechanization.	Hubert [50]; Unay-Gailhard & Bojnec [132]
Drivers of productivity growth	Education, scale, technology, specialization and policy support all contribute to improved productivity.	Alarcón [2]; Carolan [18]; Gallardo & Sauer [40]; Macombe [72]; Maietta et al. [75]; Popescu et al. [104]; Sabasi & Shumway [116]

analytical framework, the review establishes a multidisciplinary foundation for future empirical investigations. The study highlights underresearched intersections, such as the link between gender roles and migration status or the dual impact of education on both labor supply and productivity. These connections point to emerging research agendas involving intersectional labor dynamics and long-term structural transformation in agricultural labor markets. Lastly, the review framework developed in this study may serve as a replicable model to analyze employment challenges in other sectors or geographies, thus extending its utility beyond the agri-food domain.

4.3. Research limitations and future research lines

The study is based on a systematic literature review of 128 articles, focusing on English-language scientific articles. Non-English Stud. and grey literature were excluded as part of the review process. As such, there is a risk of language bias, potentially excluding valuable research published in other languages. Moreover, the exclusion of grey literature may lead to publication bias, as Stud. with null or negative results are less likely to be published in high-impact journals. These limitations may lead to an overrepresentation of positive or well-funded Stud. and should be considered when interpreting the results. Future reviews could benefit from expanding inclusion criteria to incorporate non-English and grey literature to capture a more holistic view of the topic. Moreover, this study focuses exclusively on papers published after the year 2000. This exclusion of potentially valuable older research limits the historical perspective on employment trends in the agri-food

Table 11
The significant findings of the articles analyzed.

Identified factors	Main findings
Family farming	Despite the larger farm sizes, family farms still play an essential role.
Seasonal work	Illegal working conditions are present, but there are more and more programs to support migrant workers.
Gender equality	Women's jobs in agriculture are increasingly being devalued.
Wage	Wages are often discriminatory between workers (family member, non-family member, native migrant).
Education and training	Due to technological development, different kinds of knowledge and skills are needed, which challenges current education programs.
Productivity	There are few opportunities to further increase productivity in some well-performing developing countries.

Table 12
Overview of policy recommendations by theme and time horizon.

Theme	Recommendation	Time horizon	Supporting literature
Family farming	Succession planning, land consolidation	Medium–Long	Dries et al. [35]; Klikocka et al. [60]; Sroka et al. [127]
Migrant labor	Link subsidies to labor standards, regularize permits	Short–Medium	Carolan [18]; Molinero-Gerbeau & Avallone [89]; Preibisch [106]
Gender equality	Training & support for women in the agri-food sector	Medium	Bernal [9]; Cortignani et al. [25]; Nichols & Carter [92]
Education and skills	Modernize education, promote R&D-industry training links	Short–Long	Carolan [18]; Castelló et al. [19]; Popescu et al. [104]
Wages and earnings	Modernize education, promote R&D-industry training links	Short–Long	Carolan [18]; Castelló et al. [19]; Jiang & Miller [54]; Popescu et al. [104]; Richards & Rutledge [112]
Productivity and tech	Incentivize automation, precision agri-tech, lifelong learning	Short–Long	Babenko & Vasilyeva [5]; Maietta et al. [75]; Sabasi & Shumway [116]

sector. The challenges in agricultural employment may have evolved over a longer period, and the exclusion of earlier research may omit important context. Thus, extending the time frame could potentially reveal new or additional issues within agricultural employment in developed countries.

This study focuses on employment challenges within national contexts without exploring the interdependence of global supply chains. For example, policies or actions in developed countries often affect labor markets in developing countries, which topic is underexplored in this context. Furthermore, according to the results, there are few Stud. investigating regional migration in large countries, such as Australia, Canada, and the USA. Country level case Stud. based on empirical data could further enrich the existing literature. Building on these gaps, we propose several concrete avenues for future empirical research that could extend and deepen the insights from this review: (1) How do different subsidy regimes affect the long-term sustainability of family farms?; (2) What role does informal labor play in shaping wage dynamics in seasonal agricultural markets?; (3) How does agricultural education impact the adoption rate of smart farming technologies?; (4) What are the comparative effects of gender-targeted policy interventions across different EU member states?

In addition, each of the six identified subtopics warrants further investigation and provides an opportunity to delve more deeply into specific areas in the future. For instance, climatic changes represent a significant challenge in the agri-food system, leading to workforce shortages and threatening overall productivity. Moreover, global events and their impacts on the agri-food sector (e.g., climate change, the Russian-Ukrainian war) provide substantial avenues for examining their effects on employment. It, in turn, could lead to the formulation of recommendations and policy papers that provide valuable insights to help decision-makers address the most pressing and immediate concerns in this area. Testing the feasibility of these policy measures in developing countries would be particularly useful. What could work and what needs to be used more cautiously?

CRediT authorship contribution statement

Zalán Márk Maró: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Formal analysis, Data curation, Conceptualization. **Judit Nagy:** Writing – review & editing, Writing – original draft, Visualization, Validation, Formal analysis, Data curation, Conceptualization, Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Formal analysis, Data curation, Conceptualization. **Endre Mihály Molnár:** Writing – review & editing, Writing – original draft, Validation, Formal analysis, Data curation, Conceptualization. **Tamás Mizik:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

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References

[1] C.C. Agar, C. Manolchev, Migrant labour as space: rhythmanalysing the agri-food industry, Organization 27 (2) (2020) 251–271, https://doi.org/10.1177/1350508419883379.
[2] C. Alarcón, Agrarian questions, digitalisation of the countryside, immigrant labour in agriculture and the official discourses on rural development in the Uppsala region, Sweden, Italian Rev. Agric. Econ. 76 (1) (2021) 19–32, https://doi.org/10.36253/rea-12824.
[3] M. Alston, K. Whittenbury, Does climatic crisis in Australia's food bowl create a basis for change in agricultural gender relations? Agric. Human. Values. 30 (1) (2013) 115–128, https://doi.org/10.1007/s10460-012-9382-x.
[4] M. Avola, Employed but segregated: the exploitation of immigrant work in Mediterranean agriculture, J. Mod. Ital. Stud. 27 (5) (2022) 749–774, https://doi.org/10.1080/1354571X.2022.2040817.
[5] A. Babenko, O. Vasilyeva, Factors of labour productivity growth in agriculture of the agrarian region, Baltic J. Econ. Stud. 3 (4) (2017) 1–6.
[6] A. Babkin, R.A. Dunn, B. Hueth, E. Segarra, Employment and payroll dynamics in support services for agriculture, Appl. Econ. Perspect. Policy. 44 (3) (2022) 1482–1498, https://doi.org/10.1002/aepp.13271.
[7] C. Beni, R. Aromolo, G. Rossi, Territorial networks of social agriculture for the socio-labor inclusion of migrants: experience in the Lazio region, Italian Rev. Agric. Econ. 76 (1) (2021) 91–99, https://doi.org/10.36253/rea-12156.
[8] R. Berlinschi, J. Swinnen, K. Van Herck, Trapped in agriculture credit constraints, investments in education and agricultural employment, Eur. J. Develop. Res. 26 (4) (2014) 490–508, https://doi.org/10.1057/ejdr.2014.30.
[9] E. Bernal, Profitability of ecological agrarian business and female labour productivity, t. Bus. Manage. 5 (2) (2011) 58–65, https://doi.org/10.3923/ibm.2011.58.65.
[10] D. Bertoni, D. Cavicchioli, Farm succession, occupational choice and farm adaptation at the rural-urban interface: the case of italian horticultural farms, Land. use policy. 57 (2016) 739–748, https://doi.org/10.1016/j.landusepol.2016.07.002.
[11] C. Bessière, Female and male domestic partners in wine-grape farms (Cognac, France): conjugal asymmetry and gender discrimination in family businesses,

History Family 19 (3) (2014) 341–357, https://doi.org/10.1080/1081602X.2014.934880.
[12] L. Bharadwaj, J. Findeis, S. Chintawar, US farm households: joint decision making and impact of health insurance on labor market outcomes, Health Econ. Rev. 3 (1) (2013) 1–19, https://doi.org/10.1186/2191-1991-3-16. Article 16.
[13] A. Biernat-Jarka, Structural changes and labour input in Polish agriculture after the accession to the European union, Sci. Papers-Series Manage. Econ. Eng. Agric. Rural Develop. 15 (3) (2015) 73–78.
[14] Á.J. Borda, B. Sárvári, J.M. Balogh, Generation change in agriculture: a systematic review of the literature, Economies 11 (5) (2023) 129, https://doi.org/10.3390/economies11050129.
[15] I. Bousmah, G. Grenier, Labor shortages and immigration: the case of the Canadian agriculture sector, Agribusess (2021), https://doi.org/10.1002/agr.21719.
[16] F. Caffaro, G. Bagagiolo, M.M. Cremasco, E. Cavallo, Participatory ergonomic design of a safety training tool for migrant workers in agriculture, Chem. Eng. Trans. 58 (2017) 25–30, https://doi.org/10.3303/CET1758005.
[17] E.R. Cahyadi, N. Hidayati, N. Zahra, C. Arif, Integrating circular economy principles into agri-food supply chain management: a systematic literature review, Sustainability 16 (16) (2024) 7165, https://doi.org/10.3390/su16167165.
[18] M. Carolan, Automated agrifood futures: robotics, labor and the distributive politics of digital agriculture, J. Peasant Stud. 47 (1) (2020) 184–207, https://doi.org/10.1080/03066150.2019.1584189.
[19] M.L. Castelló, C. Barrera, L. Seguí, Bridging the academia-industry gap in the food sector through collaborative courses and internships, Educ. Chem. Eng. 42 (2023) 33–43, https://doi.org/10.1016/j.ece.2022.11.003.
[20] H. Cento, N. Bahşi, Farmers' opinion about Syrian workers in agricultural sector in Turkey: case study of Gaziantep, New Medit 2022 (4) (2022) 85–95, https://doi.org/10.30682/nm2204g.
[21] D. Charlton, A. James, B. Smith, Seasonal agricultural activity and crime, Am. J. Agric. Econ. 104 (2) (2022) 530–549, https://doi.org/10.1111/ajae.12260.
[22] P. Chmielinski, B. Karwat-Woźniak, Changes in population and labour force in family farming in Poland, Stud. Agric. Econ. 117 (3) (2015) 140–146, https://doi.org/10.7896/j.1511.
[23] S. Contzen, J. Forney, Family farming and gendered division of labour on the move: a typology of farming-family configurations, Agric. Human. Values. 34 (1) (2017) 27–40, https://doi.org/10.1007/s10460-016-9687-2.
[24] A. Corsi, C. Salvioni, Once part-timer always part-timer? Causes for persistence in off farm work state of farmers, Bio-based Appl. Econ. 6 (2) (2017) 159–182, https://doi.org/10.13128/BAE-19162.
[25] R. Cortignani, G. Carulli, G. Dono, COVID-19 and labour in agriculture: economic and productive impacts in an agricultural area of the Mediterranean, Italian J. Agron. 15 (2) (2020) 172–181, https://doi.org/10.4081/ija.2020.1653. Article 1653.
[26] A. Darpeix, C. Bignebat, P. Perrier-Cornet, Demand for seasonal wage labour in agriculture: what does family farming hide? J. Agric.l Econ. 65 (1) (2014) 257–272, https://doi.org/10.1111/1477-9552.12019.
[27] J. Davies, From severe to routine labour exploitation: the case of migrant workers in the UK food industry, Crimol. Crimal Justice 19 (3) (2019) 294–310, https://doi.org/10.1177/1748895818762264.
[28] P. De Bernardi, A. Bertello, C. Forliano, Circularity of food systems: a review and research agenda, British Food J. 125 (3) (2023) 1094–1129, https://doi.org/10.1108/BFJ-05-2021-0576.
[29] C. de Castro, A. Reigada, E. Gadea, The devaluation of female labour in fruit and vegetable packaging plants in Spanish Mediterranean agriculture, Organization 27 (2) (2020) 232–250, https://doi.org/10.1177/1350508419883387.
[30] P. Degani, Domestic/care work and severe exploitation. the limits of Italian migrant regularization schemes, Front. Human Dyn. 4 (2022), https://doi.org/10.3389/fhumd.2022.818351. Article 818351.
[31] J.B. Devine, Hop to the top with the iowa chop": the iowa porkettes and cultivating agrarian feminisms in the midwest, 1964-1992, Agric. Hist. 83 (4) (2009) 477–502, https://doi.org/10.3098/ah.2009.83.4.477.
[32] M.J. Dockry, S.S. Sachdeva, C.L. Fisher, L.S. Kenefic, D.H. Locke, L.M. Westphal, Student trainee and paid internship programs have positive results but do little to influence long-term employee diversity in the USDA forest service, PLoS. One 17 (2022) e0277423, https://doi.org/10.1371/journal.pone.0277423, 11 November.
[33] D. Domşodi, Labour relations and labour structures in mediterranean capitalism. Caporalato and romanian migration in the southern italian agriculture, Studia Universitatis Babes-Bolyai Sociologia 64 (1) (2019) 127–142, https://doi.org/10.2478/subbs-2019-0006.
[34] L. Drake, Surplus labor and subjectivity in urban agriculture: embodied work, contested work, Econ. Geogr. 95 (2) (2019) 179–200, https://doi.org/10.1080/00130095.2018.1492875.
[35] L. Dries, P. Ciaian, D. Kancs, Job creation and job destruction in eu agriculture, Food Policy. 37 (6) (2012) 600–608, https://doi.org/10.1016/j.foodpol.2012.07.007.
[36] L. Dries, J.F.M. Swinnen, Institutional reform and labor reallocation during transition: theory evidence from polish agriculture, World Dev. 30 (3) (2002) 457–474, https://doi.org/10.1016/S0305-750X(01)00118-8.
[37] L.A. Duarte, M.R. Méndez, J. Muñoz-Rojas, Territorial embeddedness of sustainable agri-food systems: a systematic review, Agroecol. Sustaable Food Syst. (2025) 1–41, https://doi.org/10.1080/21683565.2024.2448201.
[38] S.D. Fayer, Agriculture: occupational employment and wages, Mon. Labor Rev. 2014 (7) (2014), https://doi.org/10.21916/mlr.2014.25. Article 2.
[39] M. Fernández García, Y. Molinero-Gerbeau, Z. Sajir, They think you belong to them': migrant workers' perspectives on labour exploitation in Spain, J. Ethn. Migr. Stud. 49 (15) (2023) 3976–3995, https://doi.org/10.1080/1369183X.2023.2235896.
[40] R.K. Gallardo, J. Sauer, Adoption of labor-saving technologies in agriculture, Annu Rev. Resour. Econ. 10 (2018) 185–206, https://doi.org/10.1146/annurev-resource-100517-023018.
[41] S.. Gen, Y.. Kunimitsu, Y. Satoshi, E.C. Thompson, Transition of farmland use in a Japanese mountainside settlement: an analysis of the residents' career histories, Geogr. Rev. Japan Ser. B 93 (1) (2020) 15–26, https://doi.org/10.4157/GEOGREVJAPANB.93.15.
[42] Y.M. Gerbeau, G. Avallone, Producing cheap food and labor: migrations and agriculture in the capitalistic world-ecology, Relaciones ternacionales-Madrid (33) (2016) 31–51.
[43] J. Gillespie, A. Mishra, Off-farm employment and reasons for entering farming as determinants of production enterprise selection in us agriculture, Australian J. Agric. Resour. Econ. 55 (3) (2011) 411–428, https://doi.org/10.1111/j.1467-8489.2011.00542.x.
[44] A.G. Gnip, The determinants of regional migration in Croatia, Zbornik radova Ekonomskog fakulteta u Rijeci /Proceedgs of Rijeka Faculty of Economics 41 (2) (2023) 427–448, https://doi.org/10.18045/zbefri.2023.2.427.
[45] O. Gonzalez Benson, F. Cross, C.S. Montalvo, Demanding migrant/immigrant labor in the coronavirus crisis: critical perspectives for social work practice, J. Ethnic Cult. Diversity Social Work 31 (3–5) (2022) 275–279, https://doi.org/10.1080/15313204.2022.2070894.
[46] A. Górny, P. Kaczmarczyk, A known but uncertain path: the role of foreign labour in Polish agriculture, J. Rural. Stud. 64 (2018) 177–188, https://doi.org/10.1016/j.jrurstud.2017.12.015.
[47] A. Groborz, T. Juliszewski, Comparison of farmers workload by manual and mechanical tasks on family farms, Ann. Agric. Environ. Med. 20 (2) (2013) 356–360.
[48] A. Grubbström, S. Joosse, New entrants in agriculture - the case of young immigrant farmers in Sweden, Eur. Countryside 13 (1) (2021) 22–37, https://doi.org/10.2478/euco-2021-0002.
[49] B.M. Holzner, Agrarian restructuring and gender - designing family farms in central and eastern Europe, Gender Place Culture 15 (4) (2008) 431–443, https://doi.org/10.1080/09663690802155652.
[50] C. Hubert, Capital/labour separation in french agriculture: the end of family farming? Land. Use Policy 77 (2018) 553–558, https://doi.org/10.1016/j.landusepol.2018.05.062.
[51] T.B. Işcan, Allocative inefficiency and sectoral allocation of labor: evidence from U.S. agriculture, Econ. Model. 43 (2014) 305–320, https://doi.org/10.1016/j.econmod.2014.08.006.
[52] K. Jansen, Labour, livelihoods and the quality of life in organic agriculture in europe, Biol. Agric. Horticul. 17 (3) (2000) 247–278, https://doi.org/10.1080/01448765.2000.9754845.
[53] S. Jetté-Nantel, D. Freshwater, A.L. Katchova, M. Beaulieu, Farm income variability and off-farm diversification among Canadian farm operators, Agric. Fance Review 71 (3) (2011) 329–346, https://doi.org/10.1108/00021461111177602.
[54] S. Jiang, K. Miller, Watching the grass grow: does recreational cannabis legalization affect retail and agricultural wages? J. Cannabis Res. 4 (1) (2022) 42, https://doi.org/10.1186/s42238-022-00149-6.
[55] A. Kafle, J. Hopeward, B. Myers, Modelling the benefits and impacts of urban agriculture: employment, economy of scale and carbon dioxide emissions, Horticulturae 9 (1) (2023) 67, https://doi.org/10.3390/horticulturae9010067.
[56] B. Karwat-Woźniak, Income situation of farmer families in Poland in the light of economic transformations and European integration, J. Int. Stud. 1 (1) (2008) 126–136.
[57] B. Karwat-Woźniak, Changes in the socio-economic characteristics of persons employed in the polish agriculture under the conditions of growing competition, Econ. Sociol. 7 (3) (2014) 60–75, https://doi.org/10.14254/2071-789X.2014/7-3/5.
[58] A. Kijek, T. Kijek, A. Nowak, Club convergence of labour productivity in agriculture: evidence from eu countries, Agric. Econ. 66 (9) (2020) 391–401, https://doi.org/10.17221/178/2020-AGRICECON.
[59] K. Kim, A.K. Chaudhary, A.R. Han, S. Ma, M.D. Threeton, Factors associated with employment intentions of agriculture school students in South Korea, J. Agric. Educ. Extension (2021), https://doi.org/10.1080/1389224X.2021.1942091.
[60] H. Klikocka, A. Zakrzewska, P. Chojnacki, Characteristics of models of farms in the european union, Sustainability 13 (9) (2021) 4772, https://doi.org/10.3390/su13094772.
[61] E. Kocabicak, Gendered property and labour relations in agriculture: implications for social change in Turkey, Oxford Development Stud. 50 (2) (2022) 91–113, https://doi.org/10.1080/13600818.2021.1929914.
[62] W. Kołodziejczak, Employment and gross value added in agriculture versus other sectors of the European Union Economy, Sustainability 12 (14) (2020), https://doi.org/10.3390/su12145518. Article 5518.
[63] C. Konstantinidis, Capitalism in green disguise: the political economy of organic farming in the European Union, Rev. Radical Polit. Econ. 50 (4) (2018) 830–852, https://doi.org/10.1177/0486613417717482.
[64] S. Kourtesi, K. De Witte, A. Polymeros, Technical efficiency in the agricultural sector-evidence from a conditional quantile - based approach, Agric. Econ. Review 17 (2) (2016) 100–123, https://doi.org/10.22004/ag.econ.262443.

[65] S. Kourtesi, P. Fousekis, A. Polymeros, Technical efficiency of Greek olive growing farms: a robust approach with panel data, Span. J. Agric. Res. 11 (4) (2013) 908–918, https://doi.org/10.5424/sjar/2013114-4423.
[66] B. Kroon, J. Paauwe, Structuration of precarious employment in economically constrained firms: the case of Dutch agriculture, Human Resour. Manage. J. 24 (1) (2014) 19–37, https://doi.org/10.1111/1748-8583.12024.
[67] L. Labrianidis, T. Sykas, Geographical proximity and immigrant labour in agriculture: albanian immigrants in the Greek countryside, Sociol. Ruralis. 49 (4) (2009) 394–414, https://doi.org/10.1111/j.1467-9523.2009.00494.x.
[68] E. Lasso-Dela-Vega, J.A. Campos-Soria, A. García-Pozo, An analysis of educational mismatch on wages in the agroindustrial sector, Agribusess (2023), https://doi.org/10.1002/agr.21897.
[69] L. Latruffe, K. Balcombe, S. Davidova, K. Zawalinska, Determinants of technical efficiency of crop and livestock farms in Poland, Appl. Econ. 36 (12) (2004) 1255–1263, https://doi.org/10.1080/0003684042000176793.
[70] A. López-Sala, Induced circularity for selective workers. the case of seasonal labor mobility schemes in the Spanish agriculture, Arbor. 192 (777) (2016) a287, https://doi.org/10.3989/arbor.2016.777n1003.
[71] A. López-Sala, Y. Molinero-Gerbeau, Coming out of the shadows? Housing conditions of irregular migrant workers in spanish agricultural enclaves, Calitatea Vietii 33 (2) (2022), https://doi.org/10.46841/RCV.2022.02.02.
[72] C. Macombe, Work: a necessary sacrifice or a suffered chore? Labor and farm continuity in alternative agriculture in France, Renewable Agric. Food Syst. 22 (4) (2007) 282–289, https://doi.org/10.1017/S1742170507001858.
[73] S. MacWilliam, A road with no end": making the south pacific a permanent labour reserve, J. Contemp. Asia 52 (5) (2022) 830–854, https://doi.org/10.1080/00472336.2021.1975306.
[74] G. Magnano, L. Falasconi, C. Giordano, Exploring the nexus between social and environmental sustainability within eu organic agriculture: a systematic literature review, Front. Sustainable Food Syst. 8 (2024) 1502085, https://doi.org/10.3389/fsufs.2024.1502085.
[75] O.W. Maietta, B. De Devitiis, S. Destefanis, D. Suppa, Human capital and rural development policy: evidence from European FADN regions, Bio-based Appl. Econ. 8 (3) (2019) 239–259, https://doi.org/10.13128/bae-8888.
[76] Z.M. Maró, Á. Borda, J. Balogh, Challenges and trends in agricultural employment: the case of Hungary, Agric. On-le Papers Econ. Info. 16 (16) (2024) 109–128, https://doi.org/10.7160/aol.2024.160409.
[77] Z.M. Maró, G. Maró, Z. Jámbor, P. Czine, Á. Török, Profiling the consumers of farmers' markets: a systematic review of survey-based empirical evidence, Renewable Agric. Food Syst. 38 (2023) e53, https://doi.org/10.1017/S1742170523000467.
[78] Z.M. Maró, Á. Török, P. Czine, Examining consumer preferences for basic foodstuffs in a highly inflationary economic environment: the case of price-capped chicken breast fillet in Hungary, Heliyon (1) (2024) 11, https://doi.org/10.1016/j.heliyon.2024.e41279.
[79] A. Martín-Martín, E. Orduna-Malea, M. Thelwall, E.D. López-Cózar, Google scholar, web of science, and scopus: a systematic comparison of citations in 252 subject categories, J. Formetr. 12 (4) (2018) 1160–1177, https://doi.org/10.1016/j.joi.2018.09.002.
[80] P. Martin, Covid and US farm labor, J. Immigrant Refugee Stud. 21 (1) (2023) 45–58, https://doi.org/10.1080/15562948.2022.2142886.
[81] N. Mateoc-Sirb, T. Mateoc, C. Manescu, I. Grad, Research on the labour force from Romanian agriculture, Sci. Papers-Series Manage. Econ. Eng. Agric. Rural Develop. 14 (1) (2014) 215–218.
[82] P. Mayring, Forum: qualitative social research sozialforschung, 2. history of content analysis, Forum (2000).
[83] R. Merli, M. Preziosi, A. Acampora, How do scholars approach the circular economy? a systematic literature review, J. Clean. Prod. 178 (2018) 703–722, https://doi.org/10.1016/j.jclepro.2017.12.112.
[84] L.A. Minkoff-Zern, R. Welsh, M.T. Ludden, Immigrant farmers, sustainable practices: growing ecological and racial diversity in alternative agrifood spaces, Agroecol. Sustain. Food Syst. 44 (7) (2020) 947–972, https://doi.org/10.1080/21683565.2019.1666076.
[85] A.K. Mishra, H.H. Chang, Factors affecting precautionary savings of self-employed farm households, Agric. Fance Rev. 69 (3) (2009) 300–313, https://doi.org/10.1108/00021460911002680.
[86] T. Mizik, J. Nagy, E.M. Molnár, Z.M. Maró, Challenges of employment in the agrifood sector of developing countries—A systematic literature review, Human. Soc. Sci. Commun. 12 (1) (2025) 1–16, https://doi.org/10.1057/s41599-024-04308-3.
[87] D. Moher, A. Liberati, J. Tetzlaff, D.G. Altman, Preferred reporting items for systematic reviews and meta-analyses: the Prisma statement, BMJ (2009) 339, https://doi.org/10.1136/bmj.b2535.
[88] Y. Molinero-Gerbeau, The problem is not COVID-19, it's the model! industrial agriculture and migrant farm labour in the EU, EuroChoices (2021), https://doi.org/10.1111/1746-692X.12308.
[89] Y. Molinero-Gerbeau, G. Avallone, Migration and labour force needs in contemporary agriculture: what drives states to implement temporary programs? a comparison among the cases of huelva, lleida (Spain) and piana del sele (Italy)12, Calitatea Vietii 29 (1) (2018) 3–22.
[90] R. Nehring, J. Fernandez-Cornejo, D. Banker, Off-farm labour and the structure of US agriculture: the case of corn/soybean farms, Appl. Econ. 37 (6) (2005) 633–649, https://doi.org/10.1080/0003684042000323582.
[91] S. Nessabian, S. Ghavidel, M. Damankeshideh, Study of gap's factor of labor force's wage between agriculture and non-agriculture sectors in oecd countries, Middle East J. Sci. Res. 11 (3) (2012) 367–373.
[92] C. Nichols, A. Carter, It doesn't bother me: an intersectional analysis of discrimination among white women farmers in the US corn belt, J. Rural. Stud. 101 (2023) 103054, https://doi.org/10.1016/j.jrurstud.2023.103054.
[93] R. Nielsen, F. Asche, M. Nielsen, Restructuring European freshwater aquaculture from family-owned to large-scale firms – lessons from danish aquaculture, Aquac. Res. 47 (12) (2016) 3852–3866, https://doi.org/10.1111/are.12836.
[94] C. Nye, The 'blind spot' of agricultural research: labour flexibility, composition and worker availability in the south west of england, Cahiers Agricultures 27 (3) (2018) 35002, https://doi.org/10.1051/cagri/2018018.
[95] C. Nye, Agriculture's 'other' contingent labour source. agricultural contractors and relationships of interdependence at the farmer-contractor interface, J. Rural. Stud. 78 (2020) 223–233, https://doi.org/10.1016/j.jrurstud.2020.06.031.
[96] M. O'Brien, The impact of public sector employment on regional economic activity: countering seasonal fluctuations and economic shocks, Labour Indus. 33 (1) (2023) 123–141, https://doi.org/10.1080/10301763.2022.2137544.
[97] M.J. Page, J.E. McKenzie, P.M. Bossuyt, I. Boutron, T.C. Hoffmann, C.D. Mulrow, L. Shamseer, J.M. Tetzlaff, E.A. Akl, S.E. Brennan, The prisma 2020 statement: an updated guideline for reporting systematic reviews, BMJ (2021) 372, https://doi.org/10.1136/bmj.n71.
[98] A.G. Papadopoulos, L.M. Fratsea, S. Spyrellis, P. Baltas, Exploring the contribution of migrant labour in Greek agriculture, Italian Rev. Agric. Econ. 76 (1) (2021) 33–48, https://doi.org/10.36253/rea-12574.
[99] J. Paul, A.R. Criado, The art of writing literature review: what do we know and what do we need to know? Int. Busess Review 29 (4) (2020) 101717 https://doi.org/10.1016/j.ibusrev.2020.101717.
[100] J. Paul, W.M. Lim, A. O'Cass, A.W. Hao, S. Bresciani, Scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR), Int. J. Consum. Stud. 45 (4) (2021) O1–O16, https://doi.org/10.1111/ijcs.12695.
[101] C. Pereira, A. Pereira, A. Budal, S. Dahal, J. Daniel-Wrabetz, J. Meshelemiah, J. Carvalho, M.J. Ramos, R.M. Carmo, R.P. Pires, If you don't migrate, you're a nobody': migration recruitment networks and experiences of Nepalese farm workers in Portugal, J. Rural. Stud. 88 (2021) 500–509, https://doi.org/10.1016/j.jrurstud.2021.04.019.
[102] I.E. Petrescu, Factor analysis of labor productivity in agriculture in terms of sustainable development, Sci. Papers-Series Manage. Econ. Eng. Agric. Rural Develop. 14 (3) (2014) 247–251.
[103] K. Petrou, J. Connell, Our 'Pacific family'. Heroes, guests, workers or a precariat? Australian Geographer 54 (2) (2023) 125–135, https://doi.org/10.1080/00049182.2023.2203348.
[104] A. Popescu, C. Tindeche, A. Marcuta, L. Marcuta, A. Hontus, Labor productivity in Romania's agriculture in the period 2011-2020 and its forecast for 2021-2025 horizon, Sci. Papers-Series Manage. Econ. Eng. Agric. Rural Develop. 21 (3) (2021) 673–678.
[105] L. Prause, Digital agriculture and labor: a few challenges for social sustainability, Sustainability 13 (11) (2021), https://doi.org/10.3390/su13115980. Article 5980.
[106] K. Preibisch, Pick-your-own labor: migrant workers and flexibility in Canadian agriculture, Int. Migration Rev. 44 (2) (2010) 404–441, https://doi.org/10.1111/j.1747-7379.2010.00811.x.
[107] M. Raimondo, F. Caracciolo, C. Nazzaro, G. Marotta, Organic farming increases the technical efficiency of olive farms in Italy, Agriculture 11 (3) (2021) 1–15, https://doi.org/10.3390/agriculture11030209. Article 209.
[108] S. Ray, I. Haqiqi, A.E. Hill, J.E. Taylor, T.W. Hertel, Labor markets: a critical link between global-local shocks and their impact on agriculture, Environ. Res. Lett. 18 (3) (2023) 035007, https://doi.org/10.1088/1748-9326/acb1c9.
[109] B. Refslund, Intra-European labour migration and deteriorating employment relations in Danish cleaning and agriculture: industrial relations under pressure from EU8/2 labour inflows? Econ. Indus. Democracy 37 (4) (2016) 597–621, https://doi.org/10.1177/0143831X14550421.
[110] E. Reid-Musson, Grown close to home™: migrant farmworker (Im)mobilities and unfreedom on Canadian family farms, Ann. Am. Assoc. Geographers 107 (3) (2017) 716–730, https://doi.org/10.1080/24694452.2016.1261683.
[111] L. Reissig, A. Kohler, R. Rossier, Workload on organic and conventional family farms in Switzerland, Organic Agric. 6 (3) (2016) 225–242, https://doi.org/10.1007/s13165-015-0131-5.
[112] T.J. Richards, Z. Rutledge, Food system labor and bargaining power, Food Policy. 119 (2023) 102502, https://doi.org/10.1016/j.foodpol.2023.102502.
[113] S. Rosewarne, The structural transformation of australian agriculture: globalisation, corporatisation and the devalorisation of labour, J. Australian Polit. Econ. 2019 (84) (2019) 175–218.
[114] Z. Rutledge, P. Martin, More jobs and less seasonal employment in California agriculture since 1990, Calif. Agric. 77 (2) (2023) 49–56, https://doi.org/10.3733/ca.2023a0008.
[115] J.F. Rye, M.H. Slettebak, H. Bjørkhaug, From family to domestic and global labour? a decade of proletarisation of labour in the Norwegian horticulture industry, Eur. Countryside 10 (4) (2018) 528–542, https://doi.org/10.2478/euco-2018-0030.
[116] D. Sabasi, C.R. Shumway, Climate change, health care access and regional influence on components of U.S. agricultural productivity, Appl. Econ. 50 (57) (2018) 6149–6164, https://doi.org/10.1080/00036846.2018.1489504.
[117] L. Salaris, A. Iacob, V. Anghel, G. Contu, The impact of the first covid-19 wave on migrant workers: the case of Romanians in Italy, Central Eastern Eur. Migrat. Rev. 11 (1) (2022) 23–48, https://doi.org/10.54667/ceemr.2022.06.
[118] L. Salvia, The restructuring of Italian agriculture and its impact upon capital–labour relations: labour contracting and exploitation in the fresh fruit and

vegetable supply chain of the Lazio Region, Central Italy, J. Agrarian Change 20 (1) (2020) 98–112, https://doi.org/10.1111/joac.12340.
[119] R.L. Schewe, Letting go of 'Conventionalisation': family labour on new zealand organic dairy farms, Sociol. Ruralis. 55 (1) (2015) 85–105, https://doi.org/10.1111/soru.12066.
[120] A. Schmitz, C.B. Moss, Mechanized agriculture: machine adoption, farm size, and labor displacement, AgBioForum 18 (3) (2015) 278–296.
[121] S. Scott, Labour, migration and the spatial fix: evidence from the UK food industry, Antipode 45 (5) (2013) 1090–1109, https://doi.org/10.1111/anti.12023.
[122] S. Scott, Informalisation in low-wage labour markets: a case study of the UK food industry, Population Space Place (7) (2017) 23, https://doi.org/10.1002/psp.2043.
[123] A. Shreck, C. Getz, G. Feenstra, Social sustainability, farm labor, and organic agriculture: findings from an exploratory analysis, Agric. Human Values 23 (4) (2006) 439–449, https://doi.org/10.1007/s10460-006-9016-2.
[124] V. Silvestri, S. Turco, P. Piscopo, M. Guidobaldi, F. Perna, M. Sulfaro, F. Amore, Biofeedback stimulation in the visually impaired: a systematic review of literature, Ophthalmic Physiol. Opt. 41 (2) (2021) 342–364, https://doi.org/10.1111/opo.12787.
[125] K. Smędzik-Ambroży, M. Guth, A. Majchrzak, A.C. Muntean, S.S. Maican, The socio-economics factors in family farms with different economic sustainability levels from central and eastern Europe, Sustainability 13 (15) (2021) 8262, https://doi.org/10.3390/su13158262.
[126] H. Snyder, Literature review as a research methodology: an overview and guidelines, J. Bus. Res. 104 (2019) 333–339, https://doi.org/10.1016/j.jbusres.2019.07.039.
[127] W. Sroka, M. Dudek, T. Wojewodzic, K. Król, Generational changes in agriculture: the influence of farm characteristics and socio-economic factors, Agriculture 9 (12) (2019), https://doi.org/10.3390/agriculture9120264. Article 264.
[128] S. Stępień, K. Smędzik-Ambroży, M. Guth, A. Muntean, S. Maican, C. Pastiu, The importance and determinants of market integration of small family farms in selected countries of Central and Eastern Europe, Econ. Res. 35 (1) (2022) 5757–5776, https://doi.org/10.1080/1331677X.2022.2037445.
[129] B. Tocco, S. Davidova, A. Bailey, Labour adjustments in agriculture: evidence from romania, Stud. Agric.l Econ. 116 (2) (2014) 67–73, https://doi.org/10.7896/j.1406.
[130] D. Traikova, J. Möllers, M. Petrick, Go west? Emigration intentions of young Bulgarian agricultural specialists, J. Rural. Stud. 62 (2018) 134–145, https://doi.org/10.1016/j.jrurstud.2018.07.008.
[131] F. Uleri, F. Zadra, A. Piccoli, D.J. Durán Sandoval, S. Elsen, Fruit production and exploited labor in northern Italy: redefining urban responsibility toward the agrarian ground, City Soc. 35 (3) (2023) 215–227, https://doi.org/10.1111/ciso.12472.
[132] İ. Unay-Gailhard, Š. Bojnec, The impact of green economy measures on rural employment: green jobs in farms, J. Clean. Prod. 208 (2019) 541–551, https://doi.org/10.1016/j.jclepro.2018.10.160.
[133] J.A. Van Vliet, A.G.T. Schut, P. Reidsma, K. Descheemaeker, M. Slingerland, G.W. J. Van de Ven, K.E. Giller, De-mystifying family farming: features, diversity and trends across the globe, Glob. Food Sec. 5 (2015) 11–18, https://doi.org/10.1016/j.gfs.2015.03.001.
[134] W. Vesperi, R. Coppolino, Inter-organizational relationships in agri-food sector: a bibliometric review and future directions, British Food J. 125 (1) (2023) 82–95, https://doi.org/10.1108/BFJ-06-2021-0712.
[135] L.F. Vosko, Through the back-door: how Australia and Canada use working holiday programs to fulfill demands for migrant work via cultural exchange, J. dustrial Relations 65 (1) (2023) 88–111, https://doi.org/10.1177/00221856221131579.
[136] A. Wästfelt, Q. Zhang, Reclaiming localisation for revitalising agriculture: a case study of peri-urban agricultural change in Gothenburg, Sweden, J. Rural. Stud. 47 (2016) 172–185, https://doi.org/10.1016/j.jrurstud.2016.07.013.
[137] D.J. Watson, Working the fields: the organization of labour in community supported agriculture, Organization 27 (2) (2020) 291–313, https://doi.org/10.1177/1350508419888898.
[138] K. Wu, H.H. Chang, L.C. Sun, Agricultural disaster programs and family farm labor supply in Taiwan, J. Agribusess Develop. Emerg. Econ. 8 (4) (2018) 642–655, https://doi.org/10.1108/JADEE-10-2017-0101.
[139] H. Yagi, T. Hayashi, Working conditions and labor flexibility in non-family farms: weather-based labor management by Japanese paddy rice corporations, Int. Food Agribusess Manage. Rev. 24 (2) (2021) 249–266, https://doi.org/10.22434/IFAMR2020.0013.
[140] S. Zahniser, T. Hertz, P. Dixon, M. Rimmer, Immigration policy and its possible effects on U.S. agriculture and the market for hired farm labor: a simulation analysis, Am. J. Agric. Econ. 94 (2) (2012) 477–482, https://doi.org/10.1093/ajae/aar082.
[141] Y. Zhang, D. Xu, Service on the rise, agriculture and manufacturing in decline: the labor market effects of high-speed rail services in Spain, Transport. Res. Part A 171 (2023), https://doi.org/10.1016/j.tra.2023.103617. Article 103617.
[142] G. Zhengfei, A.O. Lansink, The source of productivity growth in Dutch agriculture: a perspective from finance, Am. J. Agric. Econ. 88 (3) (2006) 644–656, https://doi.org/10.1111/j.1467-8276.2006.00885.x.
[143] C. Zlolniski, Export agriculture, transnational farmworkers, and labor resistance in the Mexico–US borderlands, Dialect. Anthropol. 42 (2) (2018) 163–177, https://doi.org/10.1007/s10624-018-9491-z.