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Opportunities and obstacles for landrace cereal cultivation in Sweden

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Landrace cereals are locally adapted, traditional grain varieties increasingly recognized for their potential contributions to sustainable agriculture, food system resilience, and cultural heritage preservation. In Sweden, where modern agriculture has marginalized diverse cereal varieties, landraces offer an ecologically resilient and culturally embedded alternative. This study explores the dual landscape of opportunities and obstacles associated with landrace cereal cultivation, assessing their potential role in transitioning toward more sustainable, resilient, and locally rooted food systems in Sweden and worldwide. A qualitative research design was employed using semi-structured interviews with Swedish farmers cultivating landrace cereals on a commercial scale. Nine participants were selected based on their engagement with landraces and geographic diversity. Data were analyzed thematically following Braun and Clarke's six-phase approach to identify shared patterns and divergent perspectives. Five key themes emerged: (1) High potential with easy cultivation and consumer interest; (2) Difficult sales channels; (3) Independence and self-advocacy; (4) Cultural history and future investment; and (5) Passion for cultivation and biodiversity. While participants emphasized the ecological benefits, resilience to climate stress, and cultural value of landraces, they also highlighted significant structural barriers, including a lack of processing infrastructure, limited consumer awareness, and bureaucratic hurdles. The results suggest that landrace cereals can play a crucial role in building more localized and resilient food systems, but doing so requires policy support, investment in small-scale infrastructure, and increased knowledge-sharing networks. The study contributes to broader discussions on sustainable food transitions by examining the experiences of farmers who are preserving and innovating with traditional crops in contemporary agricultural contexts.

KEYWORDS

biodiversity, climate change, landrace cereals, local food, resilient food systems, sustainable agriculture

1 Introduction

1.1 A planet under pressure

The global consequences of land use, specifically humans' use of natural resources, disregard the importance of ecosystems in sustaining food systems, maintaining air and water quality, and regulating climate. Managing trade-offs between immediate human needs and maintaining the biosphere's capacity is crucial for supporting the planet's long-term life (Foley

et al., 2005; Richardson et al., 2023). With human activity being the most significant driver of planetary change and agriculture being at the forefront, a paradigm shift in agricultural development is critical to feeding humanity and living within the planet's biophysical boundaries (Rockström et al., 2017). Globally, it is estimated that approximately 75% of crop genetic diversity was lost during the twentieth century as industrial agriculture and standardized varieties expanded (FAO, 2010). While Nordic countries share some exposure to globalized supply chains, preparedness and food contingency planning vary substantially across the region; for instance, Finland maintains institutionalized security-of-supply and emergency stockpiling, whereas Sweden's preparedness structures were significantly reduced after the Cold War, contributing to different vulnerability profiles (Eriksson et al., 2020; Finnish Institute of International Affairs, 2020).

A long agrarian history has shaped the current food system in Sweden, alongside the Industrial Revolution and the development of a market-based economy, which led to a focus on resource extraction and economic growth (Morell and Myrdal, 2011). These shifts brought about increased specialization, intensification, and dependency on global trade, fossil fuels, and agrochemicals (Baur, 2024). This process of specialization has further concentrated food production in fewer, larger, and more technically specialized operations, reducing the number of people directly engaged in agriculture. As production systems increasingly prioritize efficiency, standardization and scale, a narrower range of crops, skills, and practices is maintained by a smaller group of professional producers, contributing to a growing distance between much of the population and agricultural knowledge, practices, and decision-making (Liu et al., 2020; Nowack et al., 2023). As a result, Sweden is highly dependent on imported food products and agricultural inputs, with approximately 50% of total food consumption reliant on imports, and an even higher dependency for key commodities such as cereals, fruits, and vegetables, leaving the national food system vulnerable to external shocks (Horn et al., 2022; Gren et al., 2024). This vulnerability was exposed during the COVID-19 pandemic and the following inflation crisis, which saw a rapid rise in food prices (Gren et al., 2024). During these periods, Sweden experienced growing food insecurity, with food price inflation reaching historically high levels and a documented increase in households requiring food assistance (Gren et al., 2024; Hjelm, 2023).

The increasing complexity and globalization of food systems have distanced consumers from the origins of their food, with many large "faceless" food producers, leading to reduced trust and a diminished perception of value (Vittersø et al., 2019). In contrast, short food chains foster direct relationships between producers and consumers, enhancing transparency, accountability, and social embeddedness, with previous research showing that local food networks thrive on trust and openness, enabling more resilient social and organizational processes among small-scale producers (Dubois, 2019). Ideal food chains would include fewer intermediaries and foster close relationships between producers and consumers, with consumers understanding the true value of food (Dubois, 2019; Vittersø et al., 2019). Consumers today increasingly value the quality, origin, and production methods of their food, and research suggests that fostering closer ties between consumers and producers, or what Forney and Häberli (2014) refer to as "social kinship," can help reinforce local food economies and enhance community resilience.

1.2 The need for resilient food systems

As global food systems face increasing ecological and socio-economic challenges, attention is shifting toward more resilient and

sustainable agricultural practices. The concept of resilient food systems has gained traction in recent years as a means to address sustainability issues in modern food systems. The concepts of resilience and sustainability are interrelated and can be seen as components of one another (Marchese et al., 2018). Sustainability is increasingly defined not only in terms of long-term resource use but also in terms of maintaining the integrity of social-ecological systems. According to Clark and Harley (2020), sustainability refers to the capacity of human-environment systems to thrive over time by balancing environmental limits, social well-being, and economic viability. This integrated perspective reflects a shift from static resource-based definitions to more dynamic, systems-oriented frameworks, particularly relevant for rethinking food systems in the face of climate and geopolitical uncertainty. Resilience is increasingly understood as a system's ability not only to absorb shocks but also to adapt and transform in response to disturbances while maintaining its core functions and structure. According to Folke et al. (2016), resilience refers to the capacity to persist in the face of change and continue to develop in ever-changing environments. This systems-based understanding is particularly relevant in the context of food systems, which face growing ecological, economic, and social pressures. Tendall et al. (2015) expand on this by defining food system resilience as "the capacity over time of a food system and its units at multiple levels to provide sufficient, appropriate, and accessible food to all, in the face of various and even unforeseen disturbances." Such perspectives underscore the importance of fostering diversity, adaptability, and local embeddedness within food systems, principles embodied by the cultivation of traditional landrace cereals.

Following the events of the Second World War and during the Cold War, Sweden's civil defense policy included designing an extensive contingency system to achieve self-sufficiency in food production and distribution during a national crisis. However, following the end of the Cold War, this contingency system was dismantled and primarily ignored due to the absence of war or environmental and trade crises (Eriksson et al., 2020). Furthermore, a report from 2013 by the Swedish Institute for Agricultural and Environmental Technology (now formally RISE – Research Institutes of Sweden's Agriculture and Food in Biosciences and Materials division) investigated the potential consequences of a sudden decrease in fossil fuels, potentially caused by a natural disaster or political unrest, on the Swedish food system. In such a hypothetical situation, the food supply chain would collapse, and food prices would skyrocket, leaving many people struggling to make ends meet. However, the report suggests that survival in a crisis scenario is possible if significant reforms are implemented in the agricultural system, such as reverting to low-input methods and utilizing available arable land (Baky et al., 2013). Notably, Sweden has sufficient arable land to feed approximately 13.5 million people, well above its current population of around 10 million, yet the proportion of the population engaged in agriculture has declined sharply from around 80% historically to just 2% today (Dahlström et al., 2006). Reintegrating traditional, low-input crops such as landrace cereals into contemporary agriculture may contribute to a more resilient and sustainable food future; however, such diversification should be understood as a complementary strategy rather than a comprehensive solution to food insecurity, which also depends on broader structural, economic, and policy conditions.

Furthermore, the COVID-19 pandemic exposed the vulnerabilities of industrialized food systems and underscored the importance of fostering ecological resilience. Resilience in food systems depends on

diversity, modularity, and feedback loops that enable adaptation to shocks, with more localized, community-based food systems (Worstell, 2020). At the time of the pandemic, Sweden's food self-sufficiency rate was estimated at approximately 50%, reinforcing concerns about dependence on external supply chains during periods of crisis (RISE, 2024). Building resilient food systems requires shifting toward more decentralized, ecologically grounded agricultural systems that prioritize local knowledge, collaboration, and sustainability.

1.3 The promise of landrace cereals

Modern agriculture has led to a decline in genetic biodiversity and environmental degradation due to unsustainable cultivation and harvesting practices, and is heavily reliant on fossil fuel inputs, including fertilizers, pesticides, and machinery production (Woods et al., 2010). In contrast, landrace cereals, which are locally adapted, traditional varieties developed over generations, retain high genetic diversity and are well-suited to low-input, sustainable farming systems (Zeven, 1998; Pasam et al., 2014). Previous research highlights the adaptive advantages of landrace cereals. During the extreme heatwave of 2018 in Sweden, nearly half (47%) of landrace cultivars produced typical yields, compared to just 17% of modern cultivars (Gerhardt et al., 2019). Their inherent tolerance to abiotic stressors, diseases, and poor soil conditions makes them vital components in strategies to build food system resilience (Newton et al., 2011; Ortman, 2024; Winge, 2014). Moreover, a case study on food security in Sweden identified cereal imports as one of the more climate-sensitive components of the national food supply (Horn et al., 2022). Reviving domestic grain production using resilient varieties, such as landraces, could thus be a key adaptation measure.

The importance of conserving traditional crop varieties has been formally recognized in international agreements such as the International Treaty on Plant Genetic Resources for Food and Agriculture (FAO, 2019). Landraces represent a living link between agricultural heritage and future food security and are defined as “domesticated, locally adapted, traditional varieties grown by farmers and their successors since ancient times” (Camacho Villa et al., 2005; Venkateswaran et al., 2019). In this study, landraces are understood as “dynamic populations of a cultivated plant that have a historical origin, a distinct identity, and lack formal crop improvement, while being genetically diverse, locally adapted, and associated with traditional farming systems” (Camacho Villa et al., 2005). Landraces often have strong ties to regional identity and traditional culinary practices, and their cultivation can support the preservation of cultural heritage, particularly when marketed through short supply chains (Britwum and Demont, 2022).

Modern cultivators generally yield higher than landrace cereals, but only under optimal conditions. Previous studies comparing landraces with modern cultivars found that landraces had equal, and in some cases, higher grain yields at lower production sites, which can be attributed to their ability to withstand challenging conditions (Ortman, 2024; Yahiaoui et al., 2014). Beyond yield comparisons, research also highlights broader ecosystem and resilience benefits associated with traditional varieties, including improved performance under low-input conditions and enhanced ecosystem services such as soil functioning and resilience to climatic stress (Ficiciyan et al., 2018; Scandurra et al., 2024). Further examples from across Europe demonstrate the viability of landrace cultivation in contemporary farming. In the Italian Alps, rye cultivation supports regional identity and biodiversity, though technical training remains crucial to support

inexperienced farmers, many newcomers, or hobbyists (Leoni et al., 2021). In Scotland, barley landraces have been revived due to growing consumer interest in sustainable, local, and heritage food products. Farmers are motivated by agronomic benefits, cultural stewardship, and market opportunity (Mahon et al., 2016; Ortman et al., 2023). However, technical support in training and workshops is necessary to assist farmers, especially since many landrace farmers are newcomers or hobby farmers who lack extensive experience (Leoni et al., 2021).

This study explores the opportunities and obstacles associated with landrace cereal cultivation, assessing its potential role in transitioning toward more sustainable, resilient, and locally rooted food systems in Sweden and globally.

2 Methodology

To address the study aim, a qualitative research design was employed, using semi-structured, in-depth interviews to generate rich, contextual insights into the experiences and perspectives of Swedish landrace cereal farmers. A qualitative approach is well-suited for exploring complex social and environmental phenomena where meaning-making, values, and lived experience are central (Creswell and Poth, 2016; Denzin and Lincoln, 2011). Given the study's emphasis on understanding the opportunities and obstacles farmers face, qualitative interviewing provided the depth and flexibility needed to capture diverse viewpoints across a relatively small, geographically dispersed population, and allowed for consistency across interviews while retaining the flexibility to explore emergent themes and tailor questions to individual participants' experiences (Kallio et al., 2016).

2.1 Data collection

Data collection focused on capturing diverse, experience-based perspectives from farmers actively engaged in landrace cereal cultivation across different regional and agronomic contexts in Sweden. Participants were identified through a targeted, purposive sampling strategy designed to capture a diverse and information-rich sample of active landrace cereal farmers in Sweden. A web-based search was conducted using keywords such as “landrace cereal,” “heritage grains,” and “farmer's variety crops” in Swedish-language contexts. This search included regional farming networks, social media profiles, farm websites, and agricultural directories to identify eligible participants. Inclusion criteria required that participants be currently cultivating landrace cereals on a commercial or semi-commercial basis (i.e., selling products to consumers or other buyers) and manage at least 10 hectares of farmland, with a portion explicitly dedicated to landrace cereals. The 10-hectare threshold was applied to distinguish commercial or semi-commercial farming operations from hobbyist or subsistence-level cultivation. This criterion ensured that participants had sufficient production scale to engage meaningfully with market dynamics, infrastructure constraints, and institutional frameworks relevant to landrace cereal cultivation. Exclusion criteria included hobbyist or non-commercial farmers and farms cultivating landrace cereals solely for research or personal consumption. Participants reported sourcing their landrace cereal grains primarily through Allkorn, a Swedish non-profit organization dedicated to the preservation and development of landrace cereals, either via its seed bank or through seed exchange facilitated within its network (Allkorn, n.d.).

From this process, 19 potential participants were identified. All were contacted via publicly available email addresses and invited to participate in the study. Of these, five did not respond, four declined due to time constraints, and one interview was excluded due to incompleteness, resulting in a final sample of nine participants (See [Table 1](#) and [Figure 1](#)). The nine participants represented a geographically diverse cross-section of Sweden, with farms located in mid-northern regions, including coastal, inland, and more isolated rural areas. This distribution was intentional and guided by an effort to include a variety of agronomic conditions, regional food cultures, and institutional settings in order to better understand the structural and ecological dynamics of landrace cereal cultivation across the country. Although modest in number, this sample size aligns with qualitative research norms emphasizing depth over breadth and prioritizing information power, where the adequacy of the sample is determined by the richness and relevance of the data in relation to the study's aims rather than by statistical representativeness ([Malterud et al., 2016](#)). In line with the concept of information power ([Malterud et al., 2016](#)), the sample size was considered adequate due to the highly specific and niche nature of the study population. Commercial and semi-commercial landrace cereal growers constitute a very small and specialized group within Swedish agriculture, particularly given the exclusion of hobbyist and experimental producers. Furthermore, the sample achieved data saturation, defined as the point at which no new themes emerge from additional data ([Guest et al., 2006](#)).

Semi-structured interviews were conducted online by the use of Zoom during February and March 2024. This digital format was chosen for its accessibility and convenience for participants living in remote rural areas ([Gray et al., 2020](#)). Each interview lasted between 20 and 45 min, with an average duration of 32 min. All interviews were recorded with participants' consent and followed an interview guide designed to elicit rich narrative accounts of participants' motivations, farming practices, institutional experiences, and visions for the future of landrace cereals. The interview guide included both closed and open-ended questions, ranging from basic farm profile information to broader reflections on topics such as biodiversity, seed saving, local food economies, and policy support (see [Table 2](#)).

2.2 Data analysis

The interview data were analyzed using reflexive thematic analysis, as outlined by [Braun and Clarke \(2006, 2019\)](#). This method was selected for its systematic yet flexible approach to

identifying, analyzing, and interpreting patterns of meaning and themes within qualitative data. Thematic analysis is particularly well-suited for exploratory, practice-oriented research where the goal is to capture participants' lived experiences, values, and situated perspectives while remaining grounded in the empirical material ([Nowell et al., 2017](#); [Braun and Clarke, 2021](#)). Given the study's focus on exploring both the opportunities and obstacles of landrace cereal cultivation in Sweden, thematic analysis provided the analytical clarity needed to handle diverse participant narratives while allowing for both convergence and divergence in the data.

All interviews were first transcribed verbatim in Swedish using Amberscript. The transcripts were subsequently translated into English for analysis. While the Swedish transcripts can be considered verbatim, the English translations represent interpretive translations, with particular attention paid to preserving idiomatic expressions and culturally specific meanings relevant to agricultural and food systems contexts. While translation inevitably involves some interpretive work, efforts were made to maintain consistency through researcher triangulation and memo-writing during the translation and transcription process ([Van Nes et al., 2010](#)). Although no formal back-translation or systematic member-checking was conducted, translation decisions were made collaboratively within a research team including both native Swedish and native English speakers, helping to preserve aesthetic and emotional nuances. No dedicated qualitative data analysis software was used; coding and theme development were conducted manually to allow for close, iterative engagement with the data.

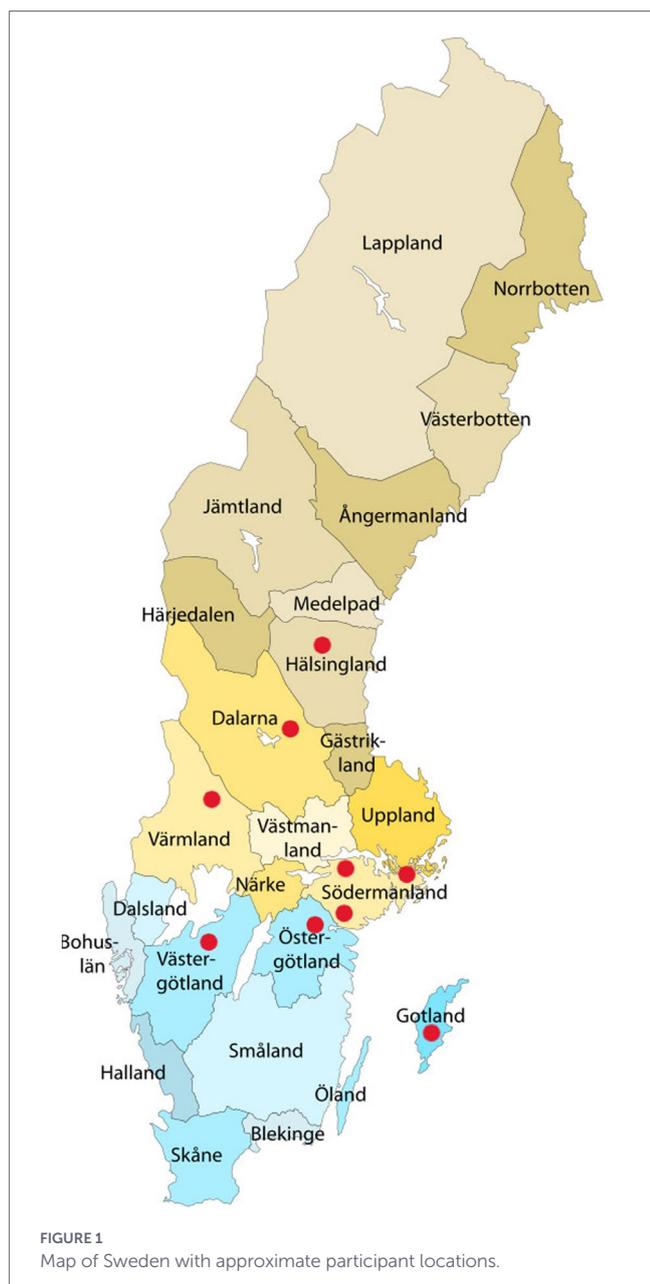
The analysis followed Braun and Clarke's established six-phase approach to reflexive thematic analysis, moving iteratively from data familiarization through coding and theme development to the production of the final report. This reflexive approach acknowledges the active role of the researcher in interpreting the data and generating meaning, emphasizing transparency and reflexivity rather than claims of objectivity.

2.3 Ethical considerations

All participants were over the age of 18 and provided informed verbal consent before they participated in the study. They were informed in writing about the purpose of the research, the voluntary nature of their participation, their right to withdraw at any time without consequence, and the measures taken to ensure confidentiality

TABLE 1 Description of participants.

Participants	County	Grain type	Hectares	Cultivating since
Farmer #1	Värmland	Värmland Wheat	10	2016
Farmer #2	Östergötland	Östgöta grey rye, Fylgia red wheat	30	2012
Farmer #3	Hälsingland	Svedje rye, Dala county wheat	15	2009
Farmer #4	Gotland	Gute barley	10	2008
Farmer #5	Södermanland	Svedje rye	50	2019
Farmer #6	Västra Götaland	Ölands wheat	45	2019
Farmer #7	Stockholm	Ölands wheat, Svedje Rye	60	2017
Farmer #8	Dalarna	Ölands wheat	60	2009
Farmer #9	Södermanland	Emmer wheat, Enkorn, Spelt	40	2004



and anonymity in data handling and reporting. Pseudonyms and general regional identifiers (e.g., “Farmer #2, Östergötland”) were used in the final manuscript to protect participant identities while allowing for contextual understanding. These procedures followed the ethical principles of voluntary participation, informed consent, respect for autonomy, and confidentiality in research involving human subjects (Orb et al., 2001).

No sensitive personal data was collected beyond professional and contextual farming experiences, and all digital data, including recordings and transcripts, was stored securely in password-protected environments in accordance with the General Data Protection Regulation (GDPR). Data handling and analysis followed principles of transparency and integrity, and the study was reviewed internally to ensure compliance with ethical standards commonly upheld in agricultural and social science research in Sweden.

This research did not require formal ethical approval from an ethics review board under Swedish law, as it did not involve vulnerable

TABLE 2 Summary of interview questions.

Generic questions
What kind of cereals do you cultivate?
How long have you been cultivating Landrace cereals?
How many hectares of land are used for Landrace cultivation?
How many people are in the household?
How many people are full-time farmers? Do you have a secondary income?
Broader questions
Why did you start cultivating Landrace cereals?
What was important for you when choosing varieties?
Is any support available for farmers growing/wanting to start growing landraces?
How has it been easy for you to cultivate landraces? How has it been difficult?
Is there a market for landrace cereals?
What, in your opinion, are the pros and cons of growing landraces?
Do you want to increase the quantity you are growing? If so, what do you need?

populations or sensitive personal data (Swedish Ethical Review Act SFS 2003:460, n.d.). However, the researchers adhered to rigorous ethical procedures and scholarly best practices throughout the study design, data collection, and dissemination processes.

3 Results

The interviews revealed a nuanced landscape of both opportunities and obstacles in cultivating landrace cereals in Sweden, reflecting farmers’ agronomic experiences, market conditions, and broader socio-cultural motivations. The following key themes emerged from the analysis, reflecting shared experiences as well as individual differences among the farmers:

- 1 High potential with easy cultivation and consumer interest
- 2 Difficult sales channels
- 3 Independence and self-advocacy
- 4 Passion for cultivation and biodiversity
- 5 Cultural history and future investment

3.1 High potential with easy cultivation and consumer interest

3.1.1 Easy cultivation

Across all interviews, farmers consistently spoke of the ease of cultivating landrace cereals, specifically the low input required and the ability of landraces to thrive in unideal conditions. Most farmers used seed from the previous year’s harvests and required much less and, in some cases, no fertilizer or pesticides, making landraces a cheaper variety to cultivate than modern cereals. One farmer mentioned almost giving up cultivating landrace cereals because they had a very low harvest, only to discover they were fertilizing too much. Once they stopped altogether, the cereals grew abundantly. This was corroborated by other farmers who stated that

landrace cereals require much less nitrogen fertilizer than modern cereals.

Given that all farmers had previously grown modern cereals, they could easily compare the two, with one noting *“We’ve always had decent harvests since growing landraces, despite the weather and drought and whatever else comes their way, they pull through and have deep roots, which are good for the soil and organic farming, plus they seem to keep the weeds at bay”* (Farmer # 2, Östergötland). Others had noted a stark difference in performance during adverse weather events, particularly during Sweden’s extremely hot and dry summer of 2018. While neighboring farms suffered crop failures, the landraces continued to perform well.

However, it should be noted that the farmers provided mixed responses regarding the harvest volume. Approximately half stated that their landrace cereals gave the same, if not more, harvest as modern cereals, while others said that landraces gave slightly less. They also stated that landrace cereals were more complex to thresh than modern cereals and that landraces rarely provide as much seed after being threshed. Summer 2023 began with hot, dry weather, which saw landrace cereals thrive. However, the following months had uncharacteristically high rainfall, and two of the farmers stated that they had experienced a bad harvest due to the wet weather and humidity.

3.1.2 Consumer interest

All farmers stated that there is good consumer interest in landraces, and demand is rising. New customers react positively to products based on landraces and usually become repeat customers. Five farmers who own farm shops reported that landrace cereals are one of their biggest sellers, with their customer base increasing through word-of-mouth and increased consumer awareness of landraces, and one stated, *“I notice straight away that people are interested in buying and that it is exciting for them with these old varieties of grain. They are aware of the benefits and so on”* (Farmer #6, Västra Götaland). They also mentioned an increasing interest among artisan bakers, particularly those interested in sourdough bread baking; and mentioned selling their products to professional and hobby bakers. They reported that customer feedback indicates that products made from landrace cereals have a deeper, richer taste and texture.

However, a few farmers expressed that convincing new consumers to pay a premium price for landrace cereal can be difficult. One farmer noted that consumers often fail to appreciate the time and energy required to produce high-quality products like landrace cereals, highlighting a significant issue of consumer education. Although interest is high, customers often hesitate to pay premium prices due to being unaware of the labor and variability associated with landrace cultivation: *“People do not understand the effort that goes into producing a simple product like flour and how many hours, workforce, and dollars are involved. Knowledge is important because customers do not understand that this year’s weather and harvest affect next year’s price and availability”* (Farmer # 6, Västra Götaland).

3.2 Difficult sales channels

3.2.1 Limited sales channels

Despite positive cultivation experiences and growing demand, farmers face substantial difficulties in bringing landrace cereals to

market. Many noted that while scaling up production is feasible, marketing and distribution present significant barriers, and farmers are forced to take on the role of the processor, the marketer, the intermediary, and the seller. One farmer highlighted how the burden of managing every aspect of production and sales can be overwhelming, especially when time and energy are already stretched thin: *“It all depends on me, how much time and energy I can put into getting the product out there. The problem is I do not have much energy left after the rest of the work that needs to be put into running a farm”* (Farmer #5, Södermanland).

While local farmers’ markets and grocery stores offer some avenues for sales, they are not always viable. Many said they are doing too much work for too little profit, considering that the farmers are responsible for the processing, packaging, and transportation to sell a small number of products for a small profit. Local grocery stores have shown interest in landrace cereals; however, bigger supermarkets or stores located outside of the local area were more challenging to reach, as many landrace cereals are only “relevant” in the area in which they originated from, for example, Värmland’s wheat in Värmland, Östtagöta grey rye in Östtagötland. One participant explained that even when landrace products make it onto grocery store shelves, the lack of staff knowledge and customer engagement often results in poor sales: *“Selling to regular grocery stores does not work, we have tried that. What happens is you end up with an expensive flour sitting on the shelf with staff that do not have time to explain what’s so special about it, so it does not sell well”* (Farmer #8, Dalarna).

Furthermore, selling to bigger retail chains involved *“a lot of bureaucracy, work, and filling out lots of papers and applications”* (Farmer #3, Hälsingland). One farmer mentioned needing a ‘barcode subscription’ with one of the bigger retail chains in Sweden, which involved paying very high sums of money for a yearly contract to use an individual barcode for their product to be sold at the chain. They said that the cost and effort involved were not realistic for them.

Alternatively, farmers lucky enough to run a farm shop or bakery could sell directly to consumers without the hassle of finding an intermediary. Having one’s own farm store or bakery was also described as an excellent tool for marketing and taste testing. One farmer expressed that their farm bakery was essential in supporting their landrace cultivation: *“I would not be able to make it with just my bakery, or by just selling the flour, or just having a farm store. It’s the big picture that makes everything work”* (Farmer #6, Västra Götaland). However, farmers were limited to a customer base that visited their shop or bakery, as online sales were not an option for many due to high postage prices, which brought the price up to almost double per kilo. Some farmers found an alternative in supplying bakeries that buy large quantities at one time; however, this was noted as a rare occurrence, as most bakeries preferred to purchase smaller quantities.

3.2.2 Need for more flour mills

Another significant barrier identified was the lack of flour mills willing to process landrace cereals. They stated that landrace cereals are too much of a niche product for larger mills to be interested in. One farmer said, *“We need more small-scale mills that are willing to take on landrace cereals”* (Farmer #9, Södermanland). Furthermore, many mills that only accept landrace cereals are KRAV certified, a Swedish organization regulating ecologically sustainable agriculture. Two farmers explained that landrace cereals fulfill the requirements

for KRAV certification but were unwilling to undergo the certification process and pay the hefty fees. One participant on why there is a lack of mills that are willing to take landrace cereals: *“There were old men that could do it, but they stopped because they got too old and could not take it anymore, or they passed away and there was no one to take over”* (Farmer # 6, Västra Götaland).

Four of the farmers had invested in their own flour mills, but for others, this required such a significant financial investment that they had not taken the step yet. They stressed that owning their own mill would ease their work, with one stating that it has been *“a long-term dream of mine.”* Farmers who did not own mills usually dropped off their grains to be milled and then picked up the flour later to sell themselves.

3.3 Independence and self-reliance

Due to an apparent lack of support and information, a reasonable amount of self-reliance is required to cultivate landrace cereals. When cultivating landraces, some of the farmers expressed feeling like they were “going out on a limb” and taking a potential financial risk. Three of the farmers said that the leading agricultural organizations in Sweden, such as the Federation of Swedish Farmers, were uninterested in landraces. Others reported difficulty with support from the County Administrative Board (Länstyrelsen), which offers financial grants within the agricultural sector, with one farmer saying, *“If you do not mass-produce, then you do not have a chance.”* Another described their path into landrace cultivation as a solitary journey that relied on personal research and trial-and-error learning: *“We had to do it the hard way, which is alone, of course. We made many mistakes, but we have learned a lot along the way”* (Farmer # 4, Gotland). However, a few participants noted that independent organizations such as *Allkorn*, a Swedish association dedicated to the preservation and development of landrace cereals, have played a role in providing information, seed exchange opportunities, and occasional support. While this is not a substitute for structural institutional backing, such associations offer valuable resources and networking opportunities for farmers otherwise left to rely heavily on self-initiative.

The lack of institutional interest extended to agricultural cooperatives, such as the Swedish agricultural cooperative “Lantmännen,” which acts as an intermediary for many farmers by selling, processing, and distributing grains. As discussed in the previous theme, farmers often have difficulty reaching their consumers, which is directly linked to Lantmännen only purchasing large quantities of modern, homogenous cultivators. As one farmer put it, *“They are not interested in small quantities of odd varieties, and I would not want to sell to them anyway because I would get much less money for my grains”* (Farmer #8, Dalarna).

However, one farmer said that financial support is available if one knows where to look, but added that *“it’s like finding a needle in a haystack.”* However, others acknowledged sporadic support from universities and NGOs, such as seminars or research projects. Still, the overarching sentiment was that success in landrace cultivation depends primarily on one’s own initiative. In light of this, most of the farmers called for stronger cooperation across the sector, suggesting that shared efforts could lead to the development of industry standards and greater visibility for landrace cereals, one farmer saying, *“It can feel like a bit lonely doing this, I think we need better communication between us growers”* (Farmer # 3, Hälsingland).

3.4 Passion for cultivation and biodiversity

Sustainable agriculture and biodiversity were essential for all the farmers, making landrace cultivation more than just income generation. One farmer referred to landrace cereals as a *“climate-smart product,”* stating that they support the environment in which they grow and the cultivation process. Taking the risk to start growing landraces and facing potential financial losses was considered worth it because they were passionate about sustainable farming methods and encouraging biodiversity.

Most farmers had a more holistic approach to farming, with two of them running regenerative farms focused on conservation, soil rehabilitation, and increasing biodiversity. They expressed that landraces fit perfectly into this organic, low-intensity farming type. One participant spoke of how the humus content of the soil has increased dramatically since using landrace cereals, stating that healthy soil removes the need to fertilize crops and that wholesome, fertile soil is a *“prerequisite for a healthy and productive farm”* (Farmer #3, Hälsingland). Another farmer stated, *“We believe in regenerative agriculture. People always want to talk about financial and economic benefits, but it’s the social and environmental aspects that matter to us. We want to live in harmony with nature and think about the future of the planet”* (Farmer #2, Östergötland).

For the most part, the farmers seemed to share an affinity for nature. Cultivating landrace cereals was part of a holistic lifestyle they wished to embody and pursue. The farmers seemed to feel connected to the natural environment, and their passion for cultivation often shone through when talking about their experiences with landraces. One farmer captured the emotional and aesthetic connection to growing landraces, *“There were different colors, there were different shapes. It was a lovely experience to watch them grow (.). They enrich the landscape in which they grow because there is contrast and diversity, and that’s beautiful to watch. It’s a lifestyle. I usually joke that it’s a bit like a drug, you become addicted to it”* (Farmer #4, Gotland).

3.5 Cultural history and future investment

In addition to an affinity for nature and preservation, the farmers felt a sense of pride and connection to their cultural history in relation to landrace cereals. Farmers saw landrace cereals as a vital part of Swedish food culture and history, the antithesis of monoculture, and something worth preserving. Farmers saw themselves as stewards of Sweden’s agrarian history, especially because the grains they cultivated often originated from the regions they now farm, with one farmer stating: *“It is so important to keep these old grains alive, and it feels like an investment for future generations because I’m proud of our history, and I want to preserve it”* (Farmer #3, Hälsingland). Similarly, another farmer emphasized, *“Landraces are an important part of Sweden’s history and they have been cultivated for hundreds of years. This is what our ancestors grew”* (Farmer #8, Dalarna).

Just as they felt an affiliation with the past, the farmers spoke of the future of food production and the need to ensure future food stability. They spoke of the need for reforms in the food system to minimize environmental impact while still producing enough food to feed the population. The importance of cultivating a certain level of self-sufficiency in food production within smaller communities to foster resilience in the face of future disturbances was also emphasized. For context, this study was undertaken several years after the COVID-19 pandemic and a couple of years after the start of the Russia–Ukraine

war, making self-sufficiency and resilience relevant discussion topics: “We can count ourselves lucky that we were not involved in the two world wars. But on the other hand, now we have almost nothing, we are not self-sufficient in this country. We feed ourselves on imports, and it wasn’t until the pandemic that we realized how unsustainable that is” (Farmer #1, Värmland).

The farmers also spoke of how small-scale production is vital for the development of rural areas, with one farmer saying, “It benefits the countryside to have small-scale farms and bakeries” (Farmer #6, Västra Götaland). Another farmer noted that having various small-scale production entities is more sustainable than a single large monoculture production, and it has the potential to shorten the food chain by bringing the consumer closer to the producer.

Another aspect of cultivation raised by farmers was the loss of traditional knowledge, with one stating, “the knowledge is dying out, and not many people are interested in it.” Four of the farmers noted that skills like seed saving and soil care are disappearing as older generations retire, and there is little support for passing this knowledge on, emphasizing a need for renewed efforts to preserve and share practical farming knowledge.

4 Discussion

The results of this study illuminate the obstacles and opportunities of cultivating landrace cereals in Sweden through the experiences of small-scale farmers. While the results reveal strong enthusiasm for landrace cultivation, especially regarding ecological sustainability, ease of growing, and cultural significance, they also highlight considerable structural and institutional challenges that need to be addressed to support this form of agriculture. Drawing on the voices of farmers actively engaged in this niche but important segment of agriculture, the results explore how landrace cereals can contribute to resilient, sustainable, and culturally rich food systems. The findings align with broader scholarly discussions on sustainable agriculture, resilient food systems, and the reconnection of consumers with place-based food traditions (Foley et al., 2005; Rockström et al., 2017; Dubois, 2019). These insights also tie into the broader context of global sustainability transitions and the restructuring of food systems toward shorter supply chains. Together, these findings point to landrace cereal cultivation as a multidimensional practice shaped by ecological conditions, cultural meanings, institutional arrangements, and market relations.

4.1 Landraces and ecological resilience

The most consistent theme among the farmers was the ecological suitability of landrace cereals for low-input, environmentally sensitive farming. All farmers described landraces as more adaptable to local conditions and more resilient during environmental stresses, particularly drought. These observations support prior research demonstrating that landrace cereals often outperform modern cultivars in low-input systems and under suboptimal environmental conditions (Pasam et al., 2014; Yahiaoui et al., 2014). This resonates with findings from Gerhardt et al. (2019), who reported that nearly half of landrace varieties achieved typical yields during Sweden’s 2018 heatwave, compared to a much lower success rate among modern cultivars. This also aligns with broader evidence that landrace varieties possess high genetic diversity, enabling them to withstand abiotic stressors and

poor soil conditions, as their deep rooting systems, strong weed suppression, and compatibility with organic methods make them particularly well-suited for regenerative agricultural practices (Newton et al., 2011; Ortman, 2024; Pasam et al., 2014).

While farmers consistently described landrace cereals as requiring less nitrogen and performing better under drought conditions, these accounts reflect experiential observations embedded within specific management contexts rather than controlled physiological measurements. However, such perceptions are supported by agronomic research indicating that landraces often perform comparatively well under low-input and stress-prone conditions. For example, Gerhardt et al. (2019) documented substantially higher yield stability among landrace cereals during Sweden’s extreme drought of 2018, while Ortman (2024) found that landraces can perform on par with modern cultivars in low-input organic systems. Similarly, studies from other European contexts suggest that landraces exhibit greater yield stability and resilience under reduced nitrogen availability and water stress, particularly in rainfed or low-input systems (Ficiciyan et al., 2018; Scandurra et al., 2024). Taken together, these findings suggest that the perceived “ease of cultivation” reported by farmers likely reflects an interaction between landrace genetic diversity and the regenerative, low-input management systems in which they are commonly cultivated, rather than a simple genotype-driven reduction in nitrogen demand.

Building on this interactional understanding of landraces and management practices, these findings also align with broader principles of regenerative agriculture, which emphasize system-level approaches to soil health and reduced reliance on fossil fuel-based inputs (Woods et al., 2010; Baur, 2024). Importantly, reported improvements in humus content and soil structure reflect farmers’ experiential assessments rather than measured soil parameters. Participants themselves often linked these changes not solely to the cultivation of landrace cereals, but to broader shifts toward regenerative management practices, including reduced tillage, diversified crop rotations, and increased use of cover crops and organic amendments. In this sense, landrace cereals were described as being embedded within, and supportive of, these management systems rather than acting as isolated causal factors.

These ecological strengths also make landrace cereals particularly relevant in the context of future disturbances, including geopolitical conflict, climate change, and supply chain disruptions. As previous studies warn, Sweden’s heavy dependence on imported food and fossil fuels could become a critical vulnerability in the event of a crisis (Baky et al., 2013; Horn et al., 2022). Landrace cereals, by contrast, offer a pathway toward national food security through self-sufficiency and locally adapted, low-input systems. These agronomic strengths situate landrace cereals as a potential tool for building resilience within food systems. As Worstell (2020) argues, food systems that are decentralized, diverse, and rooted in local knowledge are better equipped to respond to shocks such as pandemics or climate disruptions. His systems-thinking approach highlights how centralized, efficiency-driven models collapsed under the stress of COVID-19, while community-based food systems demonstrated greater flexibility. The experiences of Swedish landrace farmers echo this observation, suggesting that landrace cereal cultivation can be seen as a resilience strategy within the broader transition to ecologically grounded food systems. Furthermore, Tendall et al. (2015) define food system resilience as the capacity to deliver sufficient and appropriate food amid disturbances. Landrace contribution to healthy soil and reduced

dependency on agrochemicals also aligns with the sustainability imperatives described by Rockström et al. (2017) and Foley et al. (2005), who argue that future food systems must stay within planetary boundaries. These ecological advantages form an important foundation for the cultural, social, and economic dimensions of landrace cultivation discussed in the following sections.

4.2 Cultural heritage as a motivator and asset

Building on the ecological suitability of landrace cereals, this section explores how cultural heritage and identity further motivate farmers' engagement with these crops. The findings demonstrate that cultural heritage and regional identity are central motivations for landrace cultivation among Swedish farmers. Landraces carry deep cultural meaning, which was evident in how farmers described their pride in contributing to the continuity of Swedish food culture. For many of the farmers, cultivating landrace cereals is not just an agricultural activity but a cultural act of preservation. This was particularly evident in how several of the farmers viewed these crops as living symbols of Sweden's agrarian heritage. Landrace cereals are living embodiments of Sweden's agrarian past, with regional varieties such as Östergöta grey rye or Värmland wheat representing not just culinary traditions but socio-ecological memory (Camacho Villa et al., 2005; Venkateswaran et al., 2019). These crops link the past to the future, and for many farmers, their cultivation is an investment in long-term food security, environmental care, and community identity.

These findings align with research showing that landraces serve both sustainability goals and cultural resilience, particularly when tied to regional identities (Britwum and Demont, 2022; Venkateswaran et al., 2019). As other studies have shown in European contexts, from Bere barley in Scotland to rye in the Italian Alps, landrace cereals can support biodiversity and regional identity (Mahon et al., 2016; Leoni et al., 2021). In Sweden, where rural depopulation and agricultural industrialization have hollowed out local economies (Morell and Myrdal, 2011), supporting landrace cultivation could help revitalize rural areas. As highlighted in the results, small-scale farming and local bakeries provide food, livelihoods, and community cohesion, and the farmers viewed landraces as a long-term investment in future food security and rural development. This holistic approach offers a template for regenerative food systems that go beyond yield maximization. Their commitment mirrors what Baur (2024) describes as a necessary systemic diversification away from fossil fuel-intensive models of agriculture. These cultural motivations not only sustain farmer commitment but also shape how knowledge, skills, and values surrounding landrace cultivation are maintained and transmitted.

4.3 Rebuilding knowledge systems

The cultural importance attributed to landrace cereals highlights the need for knowledge systems capable of supporting their continued cultivation and development. The findings highlight a significant gap in institutional support and knowledge transmission related to landrace cereal cultivation, underscoring the need to rebuild and disseminate traditional agricultural knowledge. A key implication of these findings is the need to rebuild and disseminate traditional agricultural knowledge. Associations such as *Allkorn* already contribute to this by maintaining seed collections and facilitating farmer-to-farmer knowledge exchange. Their role highlights the importance of

complementing the gaps left by formal agricultural institutions. A recurring topic in the interviews was the importance of traditional knowledge, much of which has eroded with the modernization of agriculture. Cultivating landraces often requires traditional knowledge about soil, climate, and post-harvest practices that may have been lost or eroded in time, especially during the modern agricultural revolutions. While this knowledge gap can be a barrier for new farmers or those transitioning from conventional systems, it should be seen as crucial knowledge and skills that can be leveraged in the face of climate change. Farmers expressed frustration at "doing it the hard way" without guidance, highlighting the need to rebuild knowledge networks that support the continuation of the skills involved in cultivating landraces, which are disappearing due to weak institutional support and limited access to relevant knowledge networks. As Woods et al. (2010) and Winge (2014) suggest, the modern agri-food system has depleted biological resources and marginalized the socio-cultural practices that sustained them. Therefore, the preservation of traditional knowledge could aid a shift to more sustainable agricultural practices.

As Sweden seeks to enhance resilience and reduce import dependence (Horn et al., 2022), revitalizing lost knowledge around seed saving, low-input farming, and post-harvest handling becomes critical. These practices represent adaptive capacity in a changing climate (Foley et al., 2005; Tendall et al., 2015). Addressing this gap is crucial, especially given the challenges posed by climate change. Universities, independent researchers, and NGOs have an important role to play in bridging this knowledge divide by offering training or facilitating peer exchange. This knowledge must also be embedded within policy, especially considering that Sweden's current structure of agricultural support is typically focused on large-scale monoculture, marginalizing landrace farmers, which aligns with study findings where farmers described navigating the learning curve primarily on their own. A policy realignment is necessary to recognize traditional cereals' ecological, cultural, and resilience benefits. This includes lowering barriers to certification, investing in infrastructure like small-scale mills, and offering financial incentives to sustain and grow this vital, yet currently relatively small sector. At the same time, the rebuilding of knowledge systems is closely linked to how landrace cereals are valued and accessed within broader food networks.

4.4 Reconnecting consumers and producers

Beyond production and knowledge systems, one of the most significant opportunities landrace cereals present lies in their potential to reconnect consumers with the origins and values of their food. The farmers reported a growing consumer interest in landrace cereals, particularly from artisan bakers and health-conscious customers, noting that landrace-based products were top sellers in their farm shops. This suggests strong alignment with findings by Vittersø et al. (2019) and Forney and Häberli (2014), who argue that short food chains can foster trust and allow consumers to better understand and value the origins of their food. The importance of direct relationships between farmers and buyers was apparent throughout this study.

However, as the farmers noted, consumer education is still a hurdle, and others noted that many customers are not yet willing to pay the premium prices required to make landrace cultivation financially viable. Many consumers fail to understand why landrace cereals are more expensive, often due to a lack of direct interaction or

intermediary storytelling. This knowledge gap reflects the “facelessness” of modern food systems and the challenges of conveying product value in extended supply chains (Dubois, 2019). While demand exists, better consumer education is needed to sustain and grow the market for landrace cereals. As a result, selling to conventional grocery stores, especially national chains, has proven unfeasible for many farmers. Some farmers emphasized the importance of farm shops and bakeries as vital points of contact where the story of these cereals can be conveyed alongside the product, adding perceived value and deepening consumer loyalty. This echoes global calls to shorten food chains and re-localize food systems, which are essential for sustainability and regaining food sovereignty and economic justice for farmers (FAO, 2019; Britwum and Demont, 2022).

Additionally, it is also important to consider the broader socioeconomic constraints related to income, food affordability, and the well-documented value–action gap in sustainable consumption (Shaw et al., 2016; Vermeir and Verbeke, 2006). While landrace cereals can command premium prices in short supply chains and artisan markets, this pricing structure limits their accessibility for large segments of the population, positioning them more as niche or quality-differentiated products than as staple foods within the mainstream market (Li and Kallas, 2021). Rather than representing a universal solution to food insecurity, the findings suggest that landraces contribute primarily at the level of system resilience, in line with broader food systems scholarship that emphasizes diversity, adaptability, and robustness over yield maximization (Baur, 2024; Woods et al., 2010). In this way, landrace cereals contribute indirectly to food security by enhancing adaptive capacity within the food system, even if their direct role in feeding the general population remains limited under current economic conditions (Tendall et al., 2015; FAO, 2019). Thus, the realization of these relational and market-based opportunities depends heavily on supportive infrastructures and institutional conditions.

4.5 Structural barriers: infrastructure, bureaucracy, and fragmentation

Despite the ecological, cultural, and social potential identified above, farmers face a range of structural barriers that constrain the scaling and stabilization of landrace cereal cultivation. As discussed in the results, farmers face substantial difficulties accessing viable sales channels and infrastructure, which hampers scaling and profitability, and hinders broader adaptation of landraces. The most pressing constraint is the absence of adequate sales channels and infrastructure. Farmers are often forced to assume multiple roles, namely farmer, processor, marketer, and retailer, which places unsustainable burdens on their time and resources. This confirms findings from Dubois (2019), who observed that short supply chains in remote areas often rely on a limited number of intermediaries, if any, placing disproportionate responsibility on producers. The lack of small-scale flour mills willing to process landrace grains exacerbates these challenges. The results indicated that much of the artisanal knowledge of milling has disappeared due to generational loss, a trend documented in similar European contexts (Leoni et al., 2021). Furthermore, certification requirements and cost barriers associated with organizations like KRAV (a sustainable food certification in Sweden) further complicate access to processing facilities, effectively excluding some smallholders who already follow sustainable practices.

Other farmers cited the difficulty of fulfilling the bureaucratic demands of larger retail chains and minimal support from public

institutions such as the Federation of Swedish Farmers or the County Administrative Board. This echoes Winge’s (2014) observation that regulations often favor industrial agriculture while creating disproportionate burdens for small-scale, diverse systems. Similarly, research by Leoni et al. (2021) highlights that new or hobby farmers often lack technical support, and this is another gap that is echoed in this study. These findings indicate a misalignment between agricultural policy and the needs of farmers pursuing sustainable, localized models. While civil defense planning once prioritized food self-sufficiency (Eriksson et al., 2020), current structures inadequately support alternative farming. Shared infrastructure, co-ops, and knowledge exchange platforms could help lower barriers for new entrants and spread the burden of marketing and distribution. The fragmentation of support structures undermines the feasibility of landrace cultivation as a tool for food system transformation. While these findings offer important insights into landrace cereal cultivation and food system resilience, they should be interpreted in light of the study’s methodological scope and limitations.

4.6 International relevance and transferability

Although this study is grounded in the Swedish context, the opportunities and constraints identified are relevant to broader debates on sustainable and resilient food systems. Many of the structural barriers faced by landrace cereal farmers, such as limited processing infrastructure, bureaucratic certification systems, weak institutional support, and the erosion of traditional agronomic knowledge, are documented in industrialized agri-food systems beyond Sweden (Woods et al., 2010; Winge, 2014; Dubois, 2019; Leoni et al., 2021). Likewise, the reported benefits of landraces, including low-input cultivation, ecological resilience, and strong alignment with short food supply chains, resonate with international efforts to diversify food systems under climate and geopolitical uncertainty (Newton et al., 2011; Ficiyan et al., 2018; Worstell, 2020; Tendall et al., 2015; Vittersø et al., 2019).

The transferability of these findings is nevertheless context dependent. Agro-ecological conditions shape the performance of specific landrace varieties, meaning that Swedish landraces cannot be directly replicated elsewhere. However, the broader principle of cultivating genetically diverse, locally adapted cereal populations is applicable across a wide range of regions, including Mediterranean, semi-arid, and mountain contexts, where landraces have similarly demonstrated yield stability under stress (Yahiaoui et al., 2014; Ficiyan et al., 2018; Leoni et al., 2021; Scandurra et al., 2024). In this sense, the global relevance of landraces lies less in particular crops than in the production paradigm they represent. The Swedish case illustrates how centralized processing infrastructures and standardized regulatory frameworks tend to disadvantage small-scale, diversified cereal systems, a challenge mirrored in many other countries (Winge, 2014; Dubois, 2019; Leoni et al., 2021; Woods et al., 2010). Without targeted policy support and investment in decentralized infrastructure, landrace cultivation is likely to remain marginal or confined to niche markets.

The findings in this study highlight the importance of cultural meaning and place-based identity in sustaining landrace cultivation. While the specific historical narratives are locally rooted, the role of heritage crops in linking food production to culture, landscape, and community is widely observed globally (Camacho Villa et al., 2005;

Britwum and Demont, 2022; Mahon et al., 2016; Leoni et al., 2021). This study suggests that landrace cereals should not be viewed as a universal solution to food insecurity, but as a complementary strategy that enhances food system resilience through diversification, local adaptation, and cultural embeddedness.

4.7 Contributions to policy and practice

The findings of this study highlight the need for more supportive and inclusive agricultural policy to unlock the full potential of landrace cereals within sustainable and resilient food systems. Subsidies or tax relief aimed at on-farm processing, such as flour milling or grain threshing and cleaning, would help reduce farmers' reliance on scarce and centralized infrastructure, allowing greater control over value-added production. Strengthening consumer education at local and national levels is equally important, particularly in raising awareness about the cultural, ecological, and nutritional value of landrace cereals. Better-informed consumers are more likely to support small-scale producers and accept the price premiums needed to sustain low-input, regenerative farming. Certification schemes also need to be reformed to accommodate the realities of smallholders; lowering costs and bureaucratic barriers would make it feasible for more producers to participate in sustainability labelling programs without sacrificing autonomy. Beyond these measures, there is clear potential for increased investment in collaborative networks, such as farmer cooperatives, regional platforms, or municipal procurement programs, that can reduce isolation, pool resources, and increase market access for landrace growers.

Current Swedish and EU food policy frameworks largely prioritize productivity, competitiveness, and large-scale production as core strategies for food system resilience and crisis preparedness. For example, the Swedish Food Agency and Swedish Board of Agriculture emphasize a competitive and sustainable food supply chain through increased production, profitability, and structural transformation across the value chain (Swedish Board of Agriculture, 2024; Swedish Food Agency, 2023) while Sweden's CAP Strategic Plan under the EU Common Agricultural Policy aims to enhance productivity, viability, and competitiveness of the agricultural sector (European Commission, 2025). Although the CAP also includes rural development and environmental instruments, these are generally designed around standardized practices and competitive frameworks that offer limited targeted support for on-farm processing infrastructure or small-scale diversified cereal producers. To better support landrace cereal cultivation and localized regenerative practices, these policy instruments could be amended to explicitly include investment schemes and eligibility criteria that incentivize small-scale milling, cleaning, and storage facilities as part of rural development and eco-scheme design. Together, these interventions could support a more just and diversified agricultural landscape in Sweden and beyond.

4.8 Limitations

While this study provides valuable insights into the opportunities and obstacles associated with landrace cereal cultivation in Sweden, several limitations must be acknowledged. Firstly, the sample size was relatively small, consisting of nine participants. Although this aligns with qualitative research norms that prioritize depth over breadth and the goal of data saturation, the limited number of participants may restrict the generalizability of the findings. The perspectives captured,

while rich and diverse, may not represent all landrace cereal farmers in Sweden, particularly those cultivating for non-commercial or hobbyist purposes.

Secondly, the study relied on self-reported data, which can introduce biases related to memory, selective disclosure, or the desire to present one's practices in a favorable light. While thematic analysis allowed for the identification of recurring patterns, it is possible that some nuances or contradictory experiences were underreported.

While the study includes participants from diverse geographic contexts within Sweden, the limited number of commercial landrace cereal growers means that the findings should not be interpreted as statistically representative of all regional farming conditions. Rather, the results capture shared patterns and meaningful variation within a highly specialized and relatively small farming population. Future research could expand the sample to explore regional differences in greater detail or combine qualitative insights with broader survey-based approaches.

Additionally, all interviews were conducted in Swedish and later translated into English for analysis. Although care was taken to ensure accurate translation and preserve participants' meanings, some subtleties of expression may have been lost or misinterpreted in the translation process. Future research could address these limitations by incorporating longitudinal studies, comparative analyses across regions or countries, and mixed method approaches that triangulate qualitative findings with quantitative data on yield, market performance, or environmental impact. Such efforts would deepen understanding of landrace cereals' role in sustainable and resilient food systems.

5 Conclusion

This study affirms that landrace cereals are more than just a niche product or a relic from the past but are key to reimagining agriculture for the future. They are a viable pathway toward more resilient, sustainable, and culturally meaningful food systems. Through the voices of Swedish farmers, we see that landraces align with the goals of sustainable agriculture, including ecological balance, cultural preservation, and community empowerment. Their strong performance under extreme weather, low input requirements, and deep roots in agrarian heritage position them as a potential tool for regenerative, localized food systems. Farmers described landraces as more than crops; they are part of a sustainable, biodiverse, and culturally rooted lifestyle. However, this potential is hampered by significant barriers, including a lack of small-scale processing infrastructure, limited consumer awareness, bureaucratic certification systems, limited institutional support, and informal networks.

Landraces offer a practical and symbolic response to food systems' multiple crises. They connect past and future, providing climate-adaptive and culturally grounded models of agriculture. Realizing this potential requires targeted investment, supportive policy, and renewed societal commitment to valuing the knowledge and practices of landrace farmers. As one farmer poignantly asked, "How will we cope with food production in the future if we continue the way we are going?" The answer, perhaps, lies in embracing and supporting the small-scale, diverse, and deeply rooted practices represented by landrace cereal cultivation. These seeds may hold not just genetic diversity but also the promise of more resilient and sustainable food futures.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical approval was not required for the studies involving humans because ethical approval was not required under Swedish law at the time of data collection (early 2024), as the study did not involve sensitive personal data, vulnerable populations, or medical interventions. According to the [Swedish Ethical Review Act \(SFS 2003:460\) \(n.d.\)](#), only research involving such elements requires formal approval from the Swedish Ethical Review Authority. Nevertheless, the researchers adhered to established ethical standards, including informed consent, confidentiality, and voluntary participation, and a detailed “Ethical Considerations” section is provided in the manuscript. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

HK: Writing – original draft, Methodology, Investigation, Data curation, Formal analysis, Conceptualization, Writing – review & editing. KG: Supervision, Conceptualization, Writing – review & editing. KW: Supervision, Conceptualization, Writing – review & editing.

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References

- Allkorn. (n.d.). Om Allkorn [About Allkorn]. <https://www.allkorn.se>
- Baky, A., Widerberg, A., Landquist, B., Norberg, I., Berlin, J., Engström, J., et al. (2013). Sweden's primary production and supply of food – possible consequences of a lack of fossil energy. Swedish Institute for Agricultural and Environmental Technology Report: Agriculture and Industry. (in Swedish): 22180426 (osti.gov)
- Baur, P. (2024). Agrifood systems' deep dependence on fossil fuels was 150 years in the making: undoing this “lock-in” requires rapid and systemic diversification
- Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. *Qual. Res. Psychol.* 3, 77–101. doi: 10.1191/1478088706qp063oa
- Braun, V., and Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qual. Res. Sport Exerc. Health* 11, 589–597. doi: 10.1080/2159676x.2019.1628806
- Braun, V., and Clarke, V. (2021). Can I use TA? Should I use TA? Should I not use TA? Comparing reflexive thematic analysis and other pattern-based qualitative analytic approaches. *Counselling and Psychotherapy Research*, 21, 37–47.
- Britwum, K., and Demont, M. (2022). Food security and the cultural heritage missing link. *Glob. Food Secur.* 35:100660. doi: 10.1016/j.gfs.2022.100660
- Camacho Villa, T. C., Macted, N., Scholten, M., and Ford-Lloyd, B. (2005). Defining and identifying crop landraces. *Plant Genet. Resour.* 3, 373–384. doi: 10.1079/pgr.200591
- Clark, W. C., and Harley, A. G. (2020). Sustainability science: toward a synthesis. *Annu. Rev. Environ. Resour.* 45, 331–386. doi: 10.1146/annurev-environ-012420-043621
- Creswell, J. W., and Poth, C. N. (2016). *Qualitative inquiry and research design: choosing among five approaches*. Los Angeles, CA: Sage publications.
- Dahlström, A., Cousins, S. A. O., and Eriksson, O. (2006). The history (1620–2003) of land use, people and livestock, and the relationship to present plants species diversity in a rural landscape in Sweden. *Environ. Hist.* 12, 191–212. doi: 10.3197/096734006776680218
- Denzin, N. K., and Lincoln, Y. S. (2011). *The sage handbook of qualitative research*. Thousand Oaks, CA: sage.
- Dubois, A. (2019). Translocal practices and proximities in short quality food chains at the periphery: the case of north Swedish farmers. *Agric. Hum. Values* 36, 763–778. doi: 10.1007/s10460-019-09953-y
- Eriksson, C., Fischer, K., and Ulfbecker, E. (2020). Technovisions for food security as Sweden restores its civil defence. *Sci. Technol. Soc.* 25, 106–123. doi: 10.1177/0971721819889924
- European Commission. (2025). Sweden – CAP strategic plan. Directorate-general for agriculture and rural development. Available online at: https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/sweden_en (Accessed September 16, 2025).
- FAO (2010). “Chapter 1: the state of diversity” in *The second report on the state of the world's plant genetic resources for food and agriculture* (Rome, Italy: Food and Agriculture Organization of the United Nations (FAO)). (The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture)
- FAO (2019). “The state of the world's biodiversity for food and agriculture” in *FAO commission on genetic resources for food and agriculture assessments*. eds. J. Bélanger and D. Pilling (Rome, Italy: Food and Agriculture Organization of the United Nations (FAO)).

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2026.1697367/full#supplementary-material>

- Ficiciyan, A., Loos, J., Sievers-Glotzbach, S., and Tscharnkte, T. (2018). More than yield: ecosystem services of traditional versus modern crop varieties revisited. *Sustainability* 10:2834. doi: 10.3390/su10082834
- Finnish Institute of International Affairs (2020). *Rebuilding Sweden's crisis preparedness: Lack of clarity impedes implementation*. Helsinki, Finland: Finnish Institute of International Affairs.
- Foley, J. A., Defries, R., Asner, G. P., Barford, C., Bonen, G., Carpenter, S. R., et al. (2005). Global consequences of land use. *Science* 309, 570–574. doi: 10.1126/science.1111772
- Folke, C., Biggs, R., Norström, A. V., Reyers, B., and Rockström, J. (2016). Social-ecological resilience and biosphere-based sustainability science. *Ecol. Soc.* 21. doi: 10.5751/es-08748-210341
- Forney, J., and Häberli, I. (2014). Introducing 'seeds of change' into the food system? Localisation strategies in the Swiss dairy industry. *Sociol. Ruralis* 56, 135–156. doi: 10.1111/soru.12072
- Gerhardt, K., Wallman, D., and Axelsson, L. W. (2019). *Landrace cereals and the extreme weather of 2018 – How did it go? Future foods reports 8*. Uppsala, Sweden: Swedish University of Agricultural Sciences Available online (in Swedish): aldre-sorters-spanmal-ff8-web.pdf (slu.se).
- Gray, L. M., Wong-Wylie, G., Rempel, G. R., and Cook, K. (2020). Expanding qualitative research interviewing strategies: zoom video communications. *Qual. Rep.* 25, 1292–1301. doi: 10.46743/2160-3715/2020.4212
- Gren, I. M., Jonasson, L., Andersson, H., and Knutsson, R. (2024). Economic impact and food security effects of trade disruptions in agricultural products for Sweden. *Agric. Food Secur.* 13:28. doi: 10.1186/s40066-024-00483-3
- Guest, G., Bunce, A., and Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods* 18, 59–82. doi: 10.1177/1525822x05279903
- Hjelm, S. M. (2023). Allt fler människor har inte råd med mat [more and more people cannot afford food]. Sveriges Stadsmissioner [Sweden's City missions]. Available online (in Swedish): Allt fler människor har inte råd med mat - Sveriges stadsmissioner
- Horn, B., Ferreira, C., and Kalantari, Z. (2022). Links between food trade, climate change, and food security in developed countries: a case study of Sweden. *Ambio* 51, 943–954. doi: 10.1007/s13280-021-01623-w
- Kallio, H., Pietilä, A. M., Johnson, M., and Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *J. Adv. Nurs.* 72, 2954–2965. doi: 10.1111/jan.13031
- Leoni, V., Pedrali, D., Zuccolo, M., Roadri, A., Giupponi, L., and Giorgi, A. (2021). The importance of technical support in the return of traditional crops in the Alps: the case of Rye in Carmonica Valley. *Sustainability* 13:13818. doi: 10.3390/su132413818
- Li, S., and Kallas, Z. (2021). Meta-analysis of consumers' willingness to pay for sustainable food products. *Appetite* 163:105239. doi: 10.1016/j.appet.2021.105239
- Liu, Y., Barrett, C. B., Pham, T., and Violette, W. (2020). The intertemporal evolution of agriculture and labor over a rapid structural transformation: lessons from Vietnam. *Food Policy* 94:101913. doi: 10.1016/j.foodpol.2020.101913
- Mahon, N., McGuire, S., and Islam, M. M. (2016). Why bother with Bere? An investigation into the drivers behind the cultivation of landrace barley. *J. Rural. Stud.* 45, 54–65. doi: 10.1016/j.jrurstud.2016.02.017
- Malterud, K., Siersma, V. D., and Guassora, A. D. (2016). Sample size in qualitative interview studies: guided by information power. *Qual. Health Res.* 26, 1753–1760. doi: 10.1177/1049732315617444
- Marchese, D., Reynolds, E., Bates, M. E., Morgan, H., Clark, S. S., and Linkov, I. (2018). Resilience and sustainability: similarities and differences in environmental management applications. *Sci. Total Environ.* 613, 1275–1283. doi: 10.1016/j.scitotenv.2017.09.086
- Morell, M., and Myrdal, J. (2011). *The agrarian history of Sweden: from 4000 BC to AD 2000*. Sweden: Nordic Academic Press.
- Newton, A. C., Akar, T., Baresel, J. P., Bebeli, P. J., Bettencourt, E., Bladenopoulos, K. V., et al. (2011). Cereal landraces for sustainable agriculture. *Sustainable Agriculture* 2, 147–186. doi: 10.1007/978-94-007-0394-0_10
- Nowack, W., Popp, T. R., Schmid, J. C., and Grethe, H. (2023). Does agricultural structural change lead to a weakening of the sector's social functions?—a case study from north-west Germany. *J. Rural. Stud.* 100:103034. doi: 10.1016/j.jrurstud.2023.103034
- Nowell, L. S., Norris, J. M., White, D. E., and Moules, N. J. (2017). Thematic analysis: striving to meet the trustworthiness criteria. *Int J Qual Methods* 16:1609406917733847.
- Orb, A., Eisenhauer, L., and Wynaden, D. (2001). Ethics in qualitative research. *J. Nurs. Scholarsh.* 33, 93–96. doi: 10.1111/j.1547-5069.2001.00093.x
- Ortman, T. (2024). New potential in old varieties. *Acta Univ. Agric. Suec.* 2024. doi: 10.54612/a.cdn08d64f
- Ortman, T., Sandström, E., Bengtsson, J., Watson, C. A., and Bergkvist, G. (2023). Farmers' motivations for landrace cereal cultivation in Sweden. *Biol. Agric. Hortic.* 39, 247–268. doi: 10.1080/01448765.2023.2207081
- Pasam, R. K., Sharma, R., Walther, A., Özkan, H., Graner, A., and Kilian, B. (2014). Genetic diversity and population structure in a legacy collection of spring barley landraces adapted to a wide range of climates. *PLoS One* 9:e116164. doi: 10.1371/journal.pone.0116164
- Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S. E., Donges, J. F., et al. (2023). Earth beyond six of nine planetary boundaries. *Science Advances*, 9:eadh2458.
- RISE (2024). *Could we run out of food?* RISE – Research Institutes of Sweden.
- Rockström, J., Williams, J., Daily, G., Noble, A., Matthews, N., Gordon, L., et al. (2017). Sustainable intensification of agriculture for human prosperity and global sustainability. *Ambio: J. Env. Soc.* 46, 4–17. doi: 10.1007/s13280-016-0793-6
- Scandurra, A., Corinzia, S. A., Caruso, P., Cosentino, S. L., and Testa, G. (2024). Productivity of wheat landraces in rainfed and irrigated conditions under conventional and organic input in a semiarid Mediterranean environment. *Agron.* 14:2338. doi: 10.3390/agronomy14102338
- Shaw, D., McMaster, R., and Newholm, T. (2016). Care and commitment in ethical consumption: an exploration of the 'attitude-behaviour gap'. *J. Bus. Ethics* 136, 251–265. doi: 10.1007/s10551-014-2442-y
- Swedish Board of Agriculture [Jordbruksverket] (2024). Common agricultural policy 2023–2027 (Strategiska planen för EU:s jordbrukspolitik 2023–2027). Available online at: <https://jordbruksverket.se/languages/english/swedish-board-of-agriculture/rural-development-support/common-agricultural-policy-2023-2027> (Accessed September 16, 2025).
- Swedish Ethical Review Act (2003:460). (n.d.) Lag om etikprövning av forskning som avser människor (Act on the Ethics of Research Involving Humans). Available online at: [https://Lag\(2003:460\)ometikprövningavforskning_som_avser_människor|Sveriges_riksdag](https://Lag(2003:460)ometikprövningavforskning_som_avser_människor|Sveriges_riksdag)
- Swedish Food Agency [Livsmedelsverket]. (2023). A robust food supply during crises and periods of increased preparedness (En robust livsmedelförning vid kriser och höjd beredskap). Swedish Food Agency. Available online at: https://www.livsmedelsverket.se/globalassets/publikationsdatabas/rapporter/2021/2020_03221-en-robust-livsmedelsforsorjning-vid-kriser-och-hojd-beredskap.pdf (Accessed October 12, 2025).
- Tendall, D. M., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q. B., et al. (2015). Food system resilience: defining the concept. *Glob. Food Sec.* 6, 17–23. doi: 10.1016/j.gfs.2015.08.001
- Van Nes, F., Abma, T., Jonsson, H., and Deeg, D. (2010). Language differences in qualitative research: is meaning lost in translation? *Eur. J. Ageing* 7, 313–316. doi: 10.1007/s10433-010-0168-y
- Venkateswaran, K., Elangovan, M., and Sivaraj, N. (2019). "Origin, domestication and diffusion of *Sorghum bicolor*, Breeding Sorghum for diverse end uses" in Woodhead publishing series in food science, technology, and nutrition, 15–31.
- Vermeir, I., and Verbeke, W. (2006). Sustainable food consumption: exploring the consumer "attitude-behavioral intention" gap. *J. Agric. Environ. Ethics* 19, 169–194. doi: 10.1007/s10806-005-5485-3
- Vittersø, G., Torjusen, H., Laitala, K., Tocco, B., Biasini, B., Csillag, P., et al. (2019). Short food supply chains and their contributions to sustainability: participants' views and perceptions from 12 European cases. *Sustainability* 11:4800. doi: 10.3390/su11174800
- Winge, T. (2014). "Seed legislation in Europe and crop genetic diversity" in Sustainable agriculture reviews, vol. 15, 1–64.
- Woods, J., Williams, A., Hughes, J. K., Black, M., and Murphy, R. (2010). Energy and the food system. *Philos. Trans. R. Soc. Lond. Ser. B Biol. Sci.* 365, 2991–3006. doi: 10.1098/rstb.2010.0172
- Worstell, J. (2020). Ecological resilience of food systems in response to the COVID-19 crisis. *J. Agric. Food Syst. Community Dev.* 9, 23–30. doi: 10.5304/jafscd.2020.093.015
- Yahiaoui, S., Cuesta-Marcos, A., Gracia, M. P., Medina, B., Lasa, J. M., Casas, A. M., et al. (2014). Spanish barley landraces outperform modern cultivators at low-productivity sites. *Plant Breed.* 133, 218–226. doi: 10.1111/pbr.12148
- Zeven, A. C. (1998). Landraces: a review of definitions and classifications. *Euphytica* 104, 127–139. doi: 10.1023/a:1018683119237