CEEweb for Biodiversity

Climate Resilience Assessment for Central and Eastern European Local Food Systems

An analysis of selected case studies from Estonia, Slovakia and Czechia

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REBOOT FOOD

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Introduction

Resilience of food systems is one of the most important challenges of climate change. If we are not able to transform our food production and distribution systems into new, adaptive structures, we may experience hardship in Europe that was unseen for centuries on our continent. Yet, the Intergovernmental Panel on Climate Change (IPCC) predicts that the most likely level of global warming will be 3°C by the end of the century.

The European Union is often seen one of the most progressive international players in climate policy, but its current efforts are most probably insufficient, not to mention the other large industrial powers, whose decarbonization pathways are even less promising. It is clear therefore that climate adaptation and resilience is a crucial matter.

As this report shows, there are many initiatives that address food systems sustainability in the Central and Eastern European (CEE) region, and several of them explicitly address climate adaptation in their actions. The initiatives are local, often highly sophisticated and democratic. While many of them are theoretically scalable, we have to admit, that in their wider context they still seem to be outliers who will not change the unfolding climate scenarios fundamentally.

In resilience theory, every loalized system is part of a larger regional and an even larger global context. This Panarchy of systems will define together the social and ecological outcomes in any specific place. The concept of Panarchy may give both hope or despair. It is indeed possible (and there are documented cases) that localized initiatives with initially limted scope change their wider context with transformative power – while it is also true, that it is challenging to maintain pockets of resilience in a shifting landscape.

In 2027 the European Union will start its new Multiannual Financial Framework (MFF) and with this, a new cycle will start in the Common Agricultural Policy (CAP). These instruments would have the access and power to scale up examples of resilience food systems to a continental level. The localized initiatives could provide crucial knowledge and experience for such a step and perhaps even more importantly they would provide a narrative, a vision for a different food system.

Resilience in Food Systems

What is resilience?

Resilience has emerged as a crucial concept for understanding the dynamics of complex systems, particularly in the context of social-ecological interactions. Resilience is the capacity of a system to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (Folke *et al.* 2010). This definition highlights the dynamic nature of resilience, emphasising the ability of systems to persist and adapt in the face of disturbances rather than simply returning to a static equilibrium.

Early interpretations of resilience, often referred to as engineering resilience, focused on the speed of return to equilibrium after a disturbance. However, this perspective fails to capture the full complexity of ecological systems, which may exhibit multiple stable states and undergo transformations that alter their fundamental characteristics (Holling 1973; B. Walker *et al.* 2004; Folke 2006).

Ecological resilience, in contrast, recognises the potential for multiple stable states and emphasises the size of the stability domain. This perspective acknowledges that systems can exist in different configurations and that disturbances can shift them from one domain of attraction to another, potentially leading to altered functions and structures (Folke 2006).

The concept of resilience has been further expanded to encompass social-ecological systems (SESs), which are integrated systems of ecosystems and human society with reciprocal feedback and interdependence. This broader understanding recognises the intertwined nature of human and natural systems and the importance of considering social factors in resilience assessments (Folke *et al.* 2010).

Three key aspects of resilience are crucial for understanding the dynamics of SESs (B. Walker *et al.* 2004; Folke *et al.* 2010):

- **Resilience:** The capacity to persist within a stability domain, adapting and changing while remaining within critical thresholds.
- **Adaptability:** The capacity of actors within the system to influence resilience, adjusting responses to changing external drivers and internal processes.
- **Transformability:** The capacity to create fundamentally new systems when existing structures become untenable, crossing thresholds into new development trajectories.

Specified resilience refers to the resilience of a particular part of a system to a specific disturbance, while general resilience encompasses the ability of the entire system to cope with all kinds of shocks, including novel ones. Resilience is not about maintaining a constant state but rather about navigating change and uncertainty. Systems that are overly optimised for efficiency and stability can become vulnerable to unexpected disturbances. Embracing diversity, redundancy, and flexibility are crucial for building resilience in the face of complex challenges (B. H. Walker 2020).

Food Systems' Resilience

Food systems, encompassing the production, processing, distribution, and consumption of food, are complex and dynamic social-ecological systems. They are influenced by various factors, including environmental conditions, socio-economic forces, and political decisions. Building resilience into food systems is crucial for ensuring food security and sustainable development in the face of global challenges like climate change, economic shocks, and geopolitical instability.

Globally, the drive for efficiency and productivity in food production has led to the simplification and intensification of agricultural systems. This has resulted in a global production ecosystem characterised by homogeneity, high connectivity, and weakened internal feedback mechanisms. While these features have contributed to high and predictable yields in the short term, they have also increased the system's vulnerability to novel and pervasive risks. For instance, the increasing reliance on monocultures and globalised supply chains makes food systems susceptible to large-scale disruptions from disease outbreaks, extreme weather events, or economic downturns (Nyström *et al.* 2019).

Europe's food system exemplifies the complexities and vulnerabilities associated with globalised food production. The European Union's Common Agricultural Policy (CAP), while contributing to food security and economic growth, has also been criticised for promoting intensive farming practices and contributing to environmental degradation. The CAP has historically incentivised specialisation and intensification, leading to a decline in agrodiversity and the simplification of agricultural landscapes. This has implications for the resilience of European food systems, as reduced diversity and connectivity can amplify the impacts of disturbances (Nyström *et al.* 2019; Lam *et al.* 2022).

The COVID-19 pandemic and the conflict in Ukraine have highlighted the fragility of global food systems and their vulnerability to disruptions. These events have exposed the risks associated with over-reliance on global trade, just-in-time supply chains, and concentrated production. They have also underscored the importance of regional and local food systems as potential buffers against global shocks.

Several key areas require attention to enhance the resilience of European and global food systems:

- **Promoting agrodiversity:** Diversifying agricultural production, both within and between farms, can enhance ecological resilience by providing a wider range of options for adapting to changing conditions. This involves supporting diverse farming systems, encouraging the cultivation of a wider range of crops and livestock breeds, and integrating agroforestry and other sustainable land management practices (Nyström *et al.* 2019).
- **Strengthening local and regional food systems:** Shortening supply chains and promoting regional food markets can reduce reliance on global trade and enhance the resilience of food systems to external shocks. Initiatives like community-supported agriculture (CSAs), farmers' markets, and local food networks can connect producers and consumers more directly, fostering greater transparency and resilience in food supply chains (Pixová and Plank 2024).
- **Tightening feedback loops:** Improving communication and information flow between producers, consumers, and policymakers is essential for adaptive management of food systems. This includes facilitating knowledge exchange between farmers, promoting consumer awareness about sustainable food choices, and integrating environmental and social considerations into agricultural policy (Sundkvist, Milestad, and Jansson 2005).
- **Rethinking agricultural policies:** Policy frameworks, such as the CAP, need to shift from a focus on production efficiency to a more holistic approach that considers environmental sustainability, social equity, and resilience to shocks. This involves promoting agroecological farming practices, supporting rural livelihoods, and incentivising the diversification of food production (Nyström *et al.* 2019).
- **Addressing power imbalances:** The concentration of power within global food supply chains, dominated by large corporations, can undermine the resilience of small-scale producers and local food systems. Supporting fair trade practices, promoting producer cooperatives, and empowering local communities can help create a more equitable and resilient food system (Nyström *et al.* 2019).

Resilience in the local context

Local agroecosystem and food system resilience is essential for sustainable food production and community well-being. Resilience in this context refers to the capacity of agroecosystems and food systems to absorb disturbances, adapt to change, and continue to function while providing essential services. This concept stems from ecological resilience theory and the framework of social-ecological systems (SES), which recognizes the interconnectedness of human actions and decisions with the resilience of agroecosystems. **Resilience thinking goes beyond simply returning to a previous state, as that state might be characterized by inequality and injustice.** It is important to question "resilience of what to what?" and consider for whom resilience is being built. **True resilience involves transforming systems to address underlying issues of power dynamics and ensure a just and sustainable future for all stakeholders** (Darnhofer, Fairweather, and Moller 2010; Cabell and Oelofse 2012; Córdoba, Triviño, and Toro Calderón 2020).

Several key characteristics define a resilient system: its **latitude** (the range of conditions under which it can persist), **resistance** (the ease or difficulty of changing it), **precariousness** (how close it is to a threshold beyond which recovery is difficult), and **panarchy** (how it is influenced by dynamics at scales above and below). **Building resilience in local agroecosystems and food systems requires considering these characteristics and the interplay between different scales.** Actions at the farm level can influence the broader landscape, and global events can trigger local shifts (Milestad and Darnhofer 2003; Cabell and Oelofse 2012; Córdoba, Triviño, and Toro Calderón 2020).

Diversity is fundamental for building resilience in agroecosystems. This includes diversity in species (cultivating various crops and livestock breeds), genetics (maintaining a pool of adaptive traits), practices (employing diverse farming methods), and landscapes (having a mosaic of different land uses). Diversity acts as a buffer. If one component fails, others can compensate (Moonen and Bàrberi 2008; Frei *et al.* 2020).

Strong local networks are also crucial, as they facilitate collaboration, enhance social capital, improve market access, and strengthen local governance. Networks allow sharing of knowledge and resources, which can lead to collective learning and adaptive management (Milestad and Darnhofer 2003; Sundkvist, Milestad, and Jansson 2005; Darnhofer, Fairweather, and Moller 2010).

Adaptive capacity, or the ability to learn, experiment, and adjust practices in response to changing conditions, is another critical element of resilience. Measures to enhance this include promoting learning through farmer-to-farmer networks and workshops, encouraging experimentation with new crops and practices, monitoring key indicators of agroecosystem health, and embracing flexibility in governance structures and policies. For instance, farmers' markets can function as spaces where both farmers and consumers learn and adapt to each other (Milestad *et al.* 2010).

While resilience aims to maintain essential system functions, transformational resilience is needed when current practices are unsustainable. This involves fundamental shifts in a system's structure and function to achieve greater sustainability. Examples of such transformational measures include challenging dominant agricultural paradigms, empowering marginalized groups, re-localizing food systems, and investing in agroecological research and development. **Transformational change often requires overcoming ingrained power structures and promoting equity in access to resources.** For example, the authors of one study observed that a Brazilian community with more equitable land distribution and stronger peasant agency (particularly through political formation, organization, and women's participation) was able to transform the structural conditions that restricted resilience, leading to improved livelihoods and dignity (Sundkvist, Milestad, and Jansson 2005; Córdoba, Triviño, and Toro Calderón 2020; Lam *et al.* 2022).

However, operationalizing resilience thinking at the farm level is challenging. **It is difficult to identify specific, predictive indicators or models that can be universally applied, as farming systems are incredibly complex and variable.** Instead of precise measurements, resilience thinking suggests using general 'rules of thumb' to guide management decisions (Darnhofer, Fairweather, and Moller 2010).

It is important to note that the **increasing complexity and globalization of food systems** can make building resilience at the local level more difficult. The dominance of industrial agriculture, global market forces, the loss of traditional knowledge, and the impacts of climate change all pose significant challenges. Addressing these challenges requires multi-faceted approaches that involve collaboration across different scales, sectors, and disciplines (Cabell and Oelofse 2012; Pixová and Plank 2024; Milestad *et al.* 2010; Schneider *et al.* 2023; Lam *et al.* 2022; Frei *et al.* 2020).

In conclusion, **building resilience in local agroecosystems and food systems requires a multifaceted approach that addresses both social and ecological dimensions.** Promoting diversity, strengthening local networks, enhancing adaptive capacity, and embracing transformative change are crucial for creating food systems that can thrive in a changing world.

Expected impacts of Climate Change in Central and Eastern Europe

Based on the 6th Assesment Report (AR6) of the IPCC (IPCC 2022, ch 13), climate change is already impacting natural and human systems in Europe, including food systems. Warming in Europe will continue to rise faster than the global mean, leading to unevenly distributed risks across the continent in the 21st century. Central and Eastern Europe (CEE) may experience an expansion of desert biomes.

In a 2°C global warming scenario, most of the key risks identified for Europe will become more severe with low to medium adaptation. **Agriculture in CEE may experience losses in wheat production. Drought, excessive rain, and compound hazards like drought and heat have increased costs and caused economic losses in forest productivity and livestock farming in EEU.**

Habitats suitable for cold-adapted species are projected to decline. Warming will decrease suitable habitat space for current terrestrial and marine ecosystems and irreversibly change their composition, increasing in severity above 2°C. **Peatlands are expected to shrink in CEE, potentially becoming carbon sources at a 3°C warming level.** Fire-prone areas are projected to expand across Europe, threatening biodiversity and carbon sinks.

With a potential 3°C increase in global warming, severe risks will persist for many sectors in Europe, even with high levels of adaptation. **The number of people exposed to key risks and economic losses are projected to at least double compared to a 1.5°C scenario. At 3°C, peatlands in CEE are expected to transition from carbon sinks to carbon sources. Economic losses and damages in CEE from multiple climate risks are projected to increase significantly.** In many parts of Europe, existing and planned adaptation measures are not sufficient to avoid the residual risk, especially beyond 1.5°C. Residual risk can result in losses of habitat and ecosystem services, heat related deaths, crop failures, water rationing during droughts in Southern Europe, and loss of land. **The risk of simultaneous breadbasket failures, coupled with trade restrictions, raises concerns about food supply.** Climate change impacts on European agriculture could threaten global food security.

Case study analysis framework

Data collection

A collection of local food sustainability initiatives was assembled through desktop research using Google Search and Perplexity AI, conducting searches in both English and relevant local languages. Content in Estonian, Slovak, and Czech was translated using DeepL translation software. The available information was analyzed using a standardized framework to facilitate comparison between initiatives and highlight key aspects of resilience building capacity.

The identified initiatives all focus on food sustainability at the local level and often receive funding from foundations or EU sources – thus their data provision often seemed to be connected with project reporting obligations. While the constrained research methodology, time and resources (only desk research) most likely did not allow to capture all existing initiatives in these countries, the analyzed case studies provide valuable insights into the characteristics of such projects. Another important limitation is that the information available about the case studies was often less then sufficient, written with different intentions from our purposes and there was no option to verify the claims independently.

Although these cases cannot offer a comprehensive assessment of climate resilience across the three countries, their analysis reveals common strengths and limitations of typical food sustainability initiatives in the broader region. This allows us to draw some conclusions about the effectiveness of current approaches to building food system resilience in the region.

Analytical framework

The methodology for assessing food system initiatives in Central and Eastern Europe employs a structured analytical framework focused on resilience-building capacity. The analysis draws primarily from online sources including project websites, reports, and institutional documentation in both English and local languages. While the data sources are generally credible, they sometimes lack comprehensive details about implementation and measured impacts, requiring careful distinction between projected and actual outcomes.

The assessment framework evaluates three key dimensions of resilience: ecological, social, and climate resilience. Based on the theoretical foundations discussed above (with an emphasis on expected climate impacts) and the available data, the following aspects were assessed for each dimension:

- **Ecological:** habitat quality, water management, soil quality
- **Social resilience:** knowledge sharing, stakeholder involvement, food securit
- **Climate resilience:** drought resistance, flood tolerance, severe weather recovery

Each dimension contains three specific criteria scored on a scale from 0 to 3. The scoring system is designed to clearly differentiate between initiatives with no relevant impact (0), speculative or indirect impacts (1), directly evidenced impacts at limited scale (2), and directly evidenced impacts at significant scale (3). Importantly, scores of 2 or 3 require explicit evidence from source materials demonstrating implemented actions or measured impacts, rather than planned or theoretical outcomes.

The *scalability assessment* qualitatively considers both the spatial reach of the initiative and its replication potential as interconnected aspects. This evaluation examines the initiative's current geographic scope relative to regional challenges, while also analyzing the practical requirements and constraints for wider implementation. The assessment particularly focuses on resource requirements, institutional capacity needs, and the adaptability of the approach to different contexts.

The *overall assessment* synthesizes these components into a comprehensive analysis that considers the initiative's strengths and limitations within the broader context of regional climate challenges. This final evaluation emphasizes practical implementation aspects and achieved outcomes rather than theoretical potential, while also considering the initiative's contribution to long-term regional resilience. Throughout the analysis, information gaps and uncertainties are explicitly acknowledged to maintain analytical transparency.

Evaluation of case studies

The collection of eighteen sustainable food and agriculture initiatives from Central and Eastern Europe (see table 1) provides a glimpse of how different actors in the region are preparing for climate change and broader environmental challenges. These initiatives, spanning research projects, practical implementations, and governance structures, reveal both promising approaches and persistent gaps in the region's preparation for climate impacts, while also showing emerging pathways for successful scaling of resilient agricultural practices.

The initiatives demonstrate particular strength in building social infrastructure and networks, which will be crucial for community resilience in the face of climate change. Most projects excel at creating knowledge-sharing networks and engaging diverse stakeholders, from local farmers to research institutions. This social foundation is essential - as climate impacts intensify, communities will need strong social bonds and efficient knowledge-sharing mechanisms to adapt and respond to challenges. The consistently high scores in stakeholder engagement (average 2.83 out of 3) and knowledge sharing (2.78) across initiatives reflect this strength.

Agricultural innovation and soil health improvement represent increasingly robust elements in these efforts. Several projects, such as VIKING and the newer Carbon Farming CE initiative, are working on developing climate-adapted crops and improving agricultural systems, while initiatives like Krakovany-Stráže demonstrate successful implementation at scale. The focus on soil carbon sequestration, enhanced root systems, and comprehensive soil health improvement shows growing understanding of the fundamental requirements for agricultural resilience. These projects often successfully integrate traditional knowledge with modern approaches, creating solutions that are both scientifically sound and culturally appropriate.

Regional coordination, particularly in the Nordic-Baltic region, shows how cross-border collaboration can enhance resilience efforts. The integration of research institutions with practical implementation, and good connections to EU-level frameworks and funding, provides a foundation for scaling successful approaches. This coordination will be increasingly important as climate impacts cross national boundaries and require coordinated responses.

However, when compared to IPCC projections for the region, significant gaps remain in these initiatives' approaches to climate resilience. Central and Eastern Europe faces increased drought risk and more extreme precipitation events, yet most initiatives still show limited capacity in this area. While this may partly reflect the limitations of desk research in identifying water-focused initiatives, the pattern remains concerning. Even successful cases like Krakovany-Stráže, which demonstrates impressive water retention improvements, represent isolated examples rather than systemic solutions.

The scale of these initiatives relative to the challenges ahead remains a concern, though with important caveats. While many projects show promising approaches, they often remain locally focused. However, initiatives like Carboneg and Carbon Farming CE demonstrate viable pathways for scaling through carbon credit systems and standardized measurement protocols. These examples suggest that the gap between project scale and challenge scale could be bridged when proper business models and verification systems are in place.

Recent initiatives have made progress in addressing previously identified gaps, particularly in economic resilience. The emergence of carbon farming programs with clear business models and measurement frameworks shows how environmental benefits can be aligned with economic viability. This represents a crucial step toward wider adoption of resilient agricultural practices. However, these market-based approaches will need careful monitoring to ensure they deliver genuine resilience benefits alongside carbon sequestration.

While increased crop diversity, soil carbon sequestration, and monitoring systems, as demonstrated in several initiatives, will be crucial in facing climate change, these efforts must be integrated with more comprehensive water management strategies to be truly effective. The region faces a future of more extreme precipitation events alternating with more severe droughts, yet current initiatives show limited capacity to manage these water-related challenges at scale, even as individual projects demonstrate promising approaches.

In conclusion, while these initiatives demonstrate valuable approaches to building agricultural resilience, they still need to be significantly strengthened to meet the scope of climate challenges projected for Central and Eastern Europe. The region faces increased temperature extremes, changing precipitation patterns, and more frequent severe weather events. While the social foundation being built is valuable, and market-based scaling approaches show promise, there needs to be much stronger focus on water management and systematic climate adaptation. These initiatives provide good building blocks and increasingly viable models for scaling, but need to be integrated into more comprehensive approaches to regional resilience. The emergence of successful large-scale implementations and market-based mechanisms provides hope, but the gap between the scale of the challenge and the scale of current responses remains substantial.

There needs to be a significant improvement in how major policy instruments like the Common Agricultural Policy (CAP) and National Energy and Climate Plans (NECPs) support climate-friendly practices. This includes strengthening support for agroecological approaches like organic farming, agroforestry, and peatland restoration; improving requirements for soil health and permanent grassland protection; tying livestock support payments to clear environmental standards; and developing better advisory services for farmers. Currently, these policies deliver limited climate benefits, with most funding going to practices that don't meaningfully reduce emissions or enhance resilience (Larsen *et al.* 2024).

Case study collection

	Habitat Quality	Water Management	Soil Quality	Knowledge Sharing	Stakeholder Engagement	Food Security	Drought Resistance	Flood Tolerance	Severe Weather Recovery	average
NordPlant/UPSCALE	2	3	2	3	2	3	3	2	2	**2,44**
MainPotRe	1	1	2	3	3	3	2	1	2	**2,00**
Estonian Einkorn & Rye	2	1	2	3	3	2	1	1	2	**1,89**
VIKING	3	3	3	3	3	2	3	2	2	**2,67**
SoilProtection	3	2	3	3	3	2	2	2	2	**2,44**
Tartu Food Council	0	0	0	2	3	1	0	0	0	**0,67**
FabaNova	2	3	2	3	2	3	3	1	2	**2,33**
Farmársky Košík	0	0	1	2	3	2	0	0	1	**1,00**
Farmárske trhy	1	0	1	2	3	2	1	0	1	**1,22**
Food Bank Slovakia	1	0	1	3	3	3	1	0	2	**1,56**
Sustainable Food Systems Košice	1	0	1	2	3	2	1	0	1	**1,22**
Karva Earth Market	2	1	2	3	3	2	1	1	1	**1,78**
Living Lab Regenerative Agriculture	2	3	3	3	3	2	2	2	2	**2,44**
EATingCRAFT	1	1	2	3	3	2	1	0	1	**1,56**
MetroFarm Network Prague	2	1	2	3	3	2	1	1	2	**1,89**
Carbon Farming CE	2	1	3	3	3	2	2	1	2	**2,11**
Krakovany-Stráže	3	3	3	3	2	2	3	2	2	**2,56**
Carboneg	2	3	3	3	3	2	3	2	2	**2,56**
Average	**1,67**	**1,44**	**2,00**	**2,78**	**2,83**	**2,17**	**1,67**	**1,00**	**1,61**	

Table 1: overview of scores for the assessed initiatives.

NordPlant/UPSCALE

Type: Research and practical implementation
Primary Objective: To promote sustainable agricultural and forestry production in future Nordic climates through advanced plant phenotyping and remote sensing
Key Stakeholders: Five Nordic universities (Swedish University of Agricultural Sciences, University of Helsinki, University of Copenhagen, Lund University, University of Tromsø), farmers, agricultural researchers, Nordic Council of Ministers
Geographic Scope: Nordic-Baltic region

URL: https://www.nordplant.org/

Summary: NordPlant is a consortium established in 2018 that combines research infrastructure and expertise across five Nordic universities to address climate change challenges in agriculture. The initiative focuses on plant phenotyping and remote sensing technologies to monitor crop performance and adapt agriculture to changing climatic conditions. Its successor project UPSCALE (2023-2026) extends this work by linking satellite and field biosignatures for large-scale crop monitoring.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**2**	Direct evidence of monitoring and improving crop-environment interactions through phenotyping; focus on root establishment studies for carbon fixation
Water Management	**3**	Significant work on drought monitoring and water stress response, including micro-drought detection and adaptation strategies
Soil Quality	**2**	Root phenotyping research to improve soil carbon fixation and root system development

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Extensive network of 5 universities, 42 published papers, regular annual meetings, and established Nordic-Baltic Plant Phenotyping Network
Stakeholder Engagement	**2**	Direct engagement with universities, commercial companies, and farmers; established private-public breeding partnerships
Food Security	**3**	Significant focus on crop resilience, new variety testing, and adaptation to changing conditions; explicit goal of increasing regional self-sustainability

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**3**	Comprehensive monitoring and adaptation strategies for micro-droughts, detailed research on plant responses to water stress
Flood Tolerance	**2**	Direct monitoring of extreme rainfall impacts, though less emphasized than drought resistance
Severe Weather Recovery	**2**	Evidence of monitoring and improving crop resilience to extreme weather events through phenotyping data

Scaling Assessment

The initiative demonstrates strong scaling potential through its integration of satellite remote sensing with field-level monitoring, allowing coverage of large agricultural areas. The successful expansion from NordPlant to UPSCALE and the Nordic-Baltic Plant Phenotyping Network shows proven scalability. The standardization of data handling (FAIR principles) and the establishment of common platforms (PHIS system) further supports replication across regions.

Overall Assessment

NordPlant/UPSCALE represents a sophisticated approach to building agricultural resilience through advanced monitoring and adaptation strategies. The initiative's strength lies in its comprehensive integration of research, technology, and practical applications, particularly in addressing unpredictable climate patterns. The combination of detailed plant-level phenotyping with satellite monitoring creates a powerful framework for understanding and adapting to climate change impacts. The initiative has demonstrated significant success in knowledge production and network building, while maintaining a clear focus on practical applications for agricultural resilience.

MainPotRe

Type: Policy and practical implementation
Primary Objective: To enhance community self-sufficiency and food security by improving access to local potato cultivars
Key Stakeholders: Potato breeders, gene bank holders, research institutions, authorities, NGOs, local communities
Geographic Scope: Northern Baltic Region (Latvia, Estonia, Finland)

URL: https://metk.agri.ee/en/mainpotre

Summary: MainPotRe is a collaborative initiative supported by the Interreg Baltic Sea Region program (2021-2027) that aims to improve access to local and heritage potato varieties. The project works to identify and address legislative bottlenecks, develop policy recommendations, and create distribution mechanisms for small-quantity seed potato access while engaging communities through educational and awareness activities.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**1**	Indirect impact through promotion of crop diversity, but no direct habitat improvement actions documented
Water Management	**1**	No specific water management actions, though potato cultivation generally requires less water than other staple crops
Soil Quality	**2**	Implementation of traditional cultivation practices and focus on small-scale farming contributes to soil health maintenance

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Extensive evidence of knowledge transfer through public workshops, educational events with schools, research sharing, and community engagement activities
Stakeholder Engagement	**3**	Strong multi-stakeholder collaboration demonstrated through gene bank exchanges, community events, and involvement of local authorities, schools, and researchers
Food Security	**3**	Direct focus on improving food security through enhanced access to seed potatoes, preservation of genetic diversity, and promotion of self-sufficiency

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**2**	Focus on local varieties adapted to harsh climates, though specific drought resistance measures not detailed
Flood Tolerance	**1**	No specific flood tolerance measures documented
Severe Weather Recovery	**2**	Emphasis on genetic diversity and local adaptation contributes to system recovery capacity

Scaling Assessment

The initiative demonstrates strong scaling potential through its multi-country approach and established institutional partnerships. The project's focus on policy recommendations and legislative changes provides a framework for broader implementation, while its community-based approach ensures local adaptation. The creation of safety duplicate collections between countries and standardized toolboxes for non-commercial growers further supports scalability.

Overall Assessment

MainPotRe effectively combines policy advocacy, practical implementation, and community engagement to build food system resilience. The initiative's strength lies in its comprehensive approach to preserving genetic diversity while simultaneously addressing regulatory barriers and community needs. The project demonstrates particular success in social resilience building through knowledge sharing and stakeholder engagement, though ecological resilience aspects could be strengthened. The initiative's focus on traditional varieties and local adaptation contributes to long-term system resilience, while its policy work addresses structural barriers to sustainable food systems.

Estonian Einkorn and Rye Cultivation Project

Type: Research and practical implementation
Primary Objective: To study and develop cultivation methods for einkorn wheat in Estonian conditions and optimize rye grain sprouting ability
Key Stakeholders: METK (Estonian Rural Research Center), Rannu Seeme PLC, TALTECH, TFTAC, Puratos Malt, Muhu Leib OÜ
Geographic Scope: Estonia

URL: https://metk.agri.ee/en/network-innovate-crop-biodiversity

Summary: A comprehensive research project (2021-2025) investigating the cultivation potential of einkorn wheat in Nordic conditions while also studying rye grain optimization. The initiative combines agricultural research with practical applications in food production, particularly focusing on developing cultivation methods suitable for Estonia's climate and exploring food processing applications.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**2**	Testing different varieties in organic and conventional conditions, includes catch crop trials
Water Management	**1**	Indirect benefits through winter hardiness trials and adaptation studies
Soil Quality	**2**	Studies include organic cultivation methods and soil-crop interactions

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Regular field seminars, workshops, public outreach activities, strong multi-stakeholder collaboration
Stakeholder Engagement	**3**	Multiple partners involved across research, farming, and food processing sectors
Food Security	**2**	Developing alternative grain options with higher nutritional value, though still in research phase

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**1**	Initial variety testing includes climate adaptation, but specific drought resistance data not yet available
Flood Tolerance	**1**	Part of general climate adaptation studies but no specific flood tolerance data
Severe Weather Recovery	**2**	Strong focus on winter hardiness testing and variety selection for local conditions

Scaling Assessment

The initiative demonstrates strong scaling potential through its comprehensive approach involving research institutions, farmers, and food processors. The multi-stakeholder structure provides a solid foundation for knowledge transfer and practical implementation. However, scaling is currently limited by winter survival challenges and the need to develop appropriate dehulling methods.

Overall Assessment

This initiative represents a well-structured approach to introducing climate-resilient ancient grains into the Estonian agricultural system. The combination of research, practical field trials, and end-product development creates a complete value chain approach. While facing significant technical challenges, particularly around winter survival and processing methods, the project's systematic approach and strong stakeholder engagement suggest good potential for developing viable cultivation methods. The focus on both conventional and organic systems provides flexibility for different farming approaches.

VIKING (Validating the Introduction of Kernza in the Nordic-Baltic Region)

Type: Research and practical implementation
Primary Objective: To develop and validate perennial cereal production systems across Nordic-Baltic countries using Kernza
Key Stakeholders: Research institutions, farmers, food industry, advisors, policy makers
Geographic Scope: Nordic-Baltic region (Sweden, Norway, Finland, Estonia, Lithuania, Denmark)

URL: https://www.slu.se/en/departments/biosystems-technology/current-projects/ongoing/CSE/introduction-of-kernza-in-the-nordic-baltic-region/

Summary: VIKING is a comprehensive research initiative exploring the adaptation and potential of Kernza, a perennial wheat relative, across Nordic-Baltic countries. The project combines field experiments, stakeholder engagement, and climate impact assessment to develop sustainable agricultural systems. It specifically focuses on optimizing grain and forage production while evaluating environmental benefits.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**3**	Strong evidence of soil community complexity enhancement (Sprunger *et al.*, 2019 citation), continuous soil cover, and increased root biomass (Duchene *et al.*, 2020 citation)
Water Management	**3**	Direct evidence of reduced nitrate leaching (Jungers *et al.*, 2019 citation), deep root systems for water retention, and improved water use efficiency demonstrated in intercropping trials
Soil Quality	**3**	Documented increases in soil carbon content (Culman *et al.*, 2013 citation), enhanced soil health through continuous root systems, reduced tillage requirements

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Extensive research collaboration across six countries, dedicated WP5 for demonstration sites and stakeholder outreach, international network engagement
Stakeholder Engagement	**3**	Multi-stakeholder involvement across entire value chain, including farmers, food industry, advisors, and policymakers; dedicated demonstration sites
Food Security	**2**	Direct contribution to food system diversification through new grain variety, but current grain yields reported as insufficient for primary income source

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**3**	Demonstrated drought tolerance through deep root systems, successful performance during 2018 drought conditions in intercropping trials
Flood Tolerance	**2**	Deep root systems and continuous soil cover suggest good water management, though specific flood tolerance data not provided
Severe Weather Recovery	**2**	Cold tolerance specifically noted, perennial nature aids recovery, but specific recovery metrics not provided

Scaling Assessment

The initiative demonstrates strong scaling potential through its multi-country research network and established stakeholder engagement structure. The project's comprehensive approach to addressing both production and value chain aspects supports replication, while the inclusion of demonstration sites facilitates practical knowledge transfer. Resource requirements for scaling are being systematically evaluated through dedicated work packages examining climate impact and adaptation to local conditions.

Overall Assessment

VIKING represents a highly integrated approach to building agricultural system resilience through the introduction of perennial grain crops. The project's strength lies in its comprehensive consideration of both ecological and socio-economic factors, supported by robust scientific methodology and strong stakeholder engagement. While grain yield remains a challenge for economic viability, the multiple benefits demonstrated across soil health, water management, and climate resilience suggest significant potential for contributing to sustainable agriculture transformation. The initiative's structured research approach and international collaboration provide a strong foundation for generating actionable insights for scaling perennial grain systems across the Nordic-Baltic region.

SoilProtection

Type: Research and practical implementation
Primary Objective: Develop and implement environmentally friendly farming practices that can be easily incorporated into current agricultural production
Key Stakeholders: Estonian farmers, research institutions, technology companies, policy makers
Geographic Scope: Estonia, with potential for EU-wide application

URL: https://soilprotection.earth/

Summary: SoilProtection is a farmer-led initiative comprising nine soil-centered innovative practices designed for easy integration into existing farming operations. The project combines precision agriculture, cover crop techniques, organic ertilization methods, and soil health research, supported by data-driven decision-making technologies. Operating since 2015, it has secured significant EU funding and established a collaborative network of farmers, researchers, and industry partners.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**3**	Direct evidence of comprehensive soil biodiversity programs, implementation of cover crop systems, and biological plant protection methods with demonstrated results across multiple farms
Water Management	**2**	Implementation of precision agriculture and cover crop techniques showing direct impact on water retention, though scale is still limited
Soil Quality	**3**	Extensive soil quality improvement through multiple approaches: biochar application, organic fertilizers, cover crops, with documented improvements in soil pH and nutrient content

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Strong evidence of systematic knowledge transfer through open communication channels, demonstrations, and direct farmer engagement with documented uptake of practices
Stakeholder Engagement	**3**	Active participation of 22 member organizations, collaboration with research institutions, a nd demonstrated influence on policy makers
Food Security	**2**	Direct evidence of improved crop yields through better soil management, though full supply chain resilience impacts are still being evaluated

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**2**	Implementation of soil organic matter improvement and water retention practices, with direct but limited-scale evidence
Flood Tolerance	**2**	Cover crop systems and improved soil structure showing positive impacts on water management
Severe Weather Recovery	**2**	Enhanced soil resilience through multiple interventions, though specific severe weather recovery data is limited

Scaling Assessment

The initiative demonstrates strong scaling potential through its modular approach to practice implementation and robust knowledge-sharing framework. The current network of 22 member organizations provides a solid foundation for regional expansion, while the EU funding structure (EAFRD and Horizon 2020) enables broader European application. The focus on practices that require minimal additional investment reduces barriers to adoption, though some components (like organic fertilisation with liquid manure) require additional policy support for widespread implementation.

Overall Assessment

SoilProtection represents a highly effective model for building agricultural resilience through its integrated approach to soil health, biodiversity, and sustainable farming practices. The initiative's strength lies in its farmer-led design and practical focus on solutions that can be implemented with existing resources, while maintaining scientific rigor through research partnerships. The demonstrated success in areas such as precision agriculture and cover crop implementation, combined with ongoing innovation in biological plant protection and soil monitoring, suggests strong potential for long-term impact. However, the full scaling of some practices remains dependent on supportive policy frameworks and continued demonstration of economic viability.

Tartu Food Council

Type: Governance/Policy
Primary Objective: Reduce food waste and increase sustainable food consumption in Tartu
Key Stakeholders: Tartu City Government, e-Governance Academy, city residents, food sellers, distributors, food conservation organizations
Geographic Scope: Tartu City, Estonia

URL: www.tartu.ee/toidukogu-registreerimine

Summary: The Tartu Food Council is a participatory governance initiative launched in 2024 to address food waste reduction through citizen engagement. The initiative combines expert input with citizen participation through a structured discussion forum of 30 selected participants, aiming to develop concrete proposals for the Tartu County circular economy roadmap.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality in source material	0	No direct actions or impacts on habitat quality mentioned
Water Management described	0	No specific water management actions or impacts
Soil Quality	0	No soil quality improvement measures mentioned

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	2	Direct evidence of structured knowledge sharing through citizen forums and expert involvement; survey of 339 residents conducted; public discussion day planned
Stakeholder Engagement	3	Strong evidence of multi-stakeholder engagement: structured selection of 30 diverse participants, expert involvement, public surveys, and integration with city planning processes
Food Security	1	Indirect impact through waste reduction initiatives, but specific food security outcomes not yet demonstrated

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	0	No drought resistance measures mentioned
Flood Tolerance	0	No flood tolerance actions described
Severe Weather Recovery	0	No severe weather recovery mechanisms discussed

Scaling Assessment

The initiative demonstrates strong potential for replication in similarly-sized municipalities, with its structured approach to citizen engagement and integration with broader circular economy planning. The resource requirements are relatively modest, primarily requiring organizational capacity and stakeholder commitment. The model of combining citizen input with expert knowledge and policy development provides a clear framework for adaptation in other contexts.

Overall Assessment

The Tartu Food Council initiative represents a sophisticated approach to addressing food waste through participatory governance, with particularly strong performance in stakeholder engagement and knowledge sharing. While the initiative shows promise in building social resilience, its impact on ecological and climate resilience remains to be demonstrated through specific implementation measures. The integration with the broader circular economy roadmap suggests potential for systemic impact, though concrete outcomes will depend on the successful implementation of proposals generated through the council process.

FabaNova: Climate-ready Faba Beans for the Nordic and Baltic Region

Type: Research/practical implementation
Primary Objective: To improve faba bean resilience and adaptation for Nordic/Baltic agriculture through enhanced disease resistance, drought tolerance, and growing season optimization
Key Stakeholders: University of Helsinki, Swedish University of Agricultural Sciences, Norwegian Institute of Bioeconomy Research, Norwegian University of Life Sciences, Centre of Estonian Rural Research and Knowledge, researchers, plant breeders, farmers
Geographic Scope: Nordic and Baltic Region

URL: https://www.helsinki.fi/en/researchgroups/legume-science

Summary: FabaNova is a comprehensive research initiative running from 2023-2026 that aims to develop climate-resilient faba bean varieties for the Nordic and Baltic regions. The project combines advanced genomics, phenotyping, and gene editing to improve resistance to chocolate spot disease, drought tolerance, and adaptation to shorter growing seasons, while supporting regional protein security and sustainable agriculture.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**2**	Direct evidence of soil improvement through nitrogen fixation capabilities (~29% protein content). Project includes detailed root architecture studies to understand soil-plant interactions.
Water Management	**3**	Comprehensive drought response research program including root trait analysis, controlled environment studies, and rain-out shelter experiments at NMBU with clear implementation pathway.
Soil Quality	**2**	Natural nitrogen fixation improves soil fertility, reducing fertilizer needs. Integration into crop rotations explicitly mentioned as improving overall soil health.

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Strong multi-institutional collaboration across 4 countries, explicit knowledge dissemination plan, integration of research findings into breeding tools.
Stakeholder Engagement	**2**	Multiple research institutions involved, though farmer engagement level not explicitly detailed. Clear pathway for breeder engagement through tool development.
Food Security	**3**	Direct evidence of potential impact - could replace 238kt of imported protein, doubles regional production capacity, improves regional self-sufficiency.

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**3**	Dedicated work package studying drought responses, including field trials, controlled environment studies, and root trait analysis.
Flood Tolerance	**1**	Not directly addressed in the research program, though general climate adaptation is considered.
Severe Weather Recovery	**2**	Research on early maturity traits and disease resistance contributes to weather resilience, supported by development of disease forecasting systems.

Scaling Assessment

The initiative demonstrates strong scaling potential through its multi-country research network and focus on developing practical breeding tools. The geographic scope covers the entire Nordic-Baltic region, with research sites across multiple latitudes. The project's emphasis on creating selection tools for breeders and establishing disease forecasting systems suggests high replication potential. However, the current yield gap (5 t/ha potential vs. 1.5-2 t/ha actual) indicates significant implementation challenges that need to be addressed for successful scaling.

Overall Assessment

FabaNova represents a sophisticated, well-structured approach to building climate resilience in regional food systems through targeted crop improvement. The project's integration of advanced genomics with practical breeding objectives, combined with

its focus on key resilience traits (disease resistance, drought tolerance, and season adaptation), positions it to make significant contributions to regional food security. The multi-institutional collaboration and emphasis on developing practical tools for breeders suggests strong potential for long-term impact. However, the substantial yield gap between potential and actual production indicates that additional focus on agronomic practices and knowledge transfer to farmers may be needed to fully realize the benefits of the improved germplasm.

Farmársky Košík (Farmer's Basket)

Type: Practical implementation
Primary Objective: To provide high-quality Slovak food products through a network of local farm shops while supporting small and medium-sized local producers
Key Stakeholders: Family business owners, local farmers, Slovak producers, local communities, consumers
Geographic Scope: Western Slovakia (Pezinok, Modra, Čierna Voda near Bratislava)

URL: www.farmarskykosik.sk

Summary: Farmársky Košík is a family-owned business established in 2014 that operates three retail locations offering locally sourced Slovak food products. The initiative combines traditional retail with zero-waste shopping options, focusing on supporting small and medium-sized local producers while providing fresh, quality food products to consumers.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**0**	No direct evidence of actions to improve habitat quality
Water Management	**0**	No evidence of water management initiatives
Soil Quality	**1**	Indirect impact through supporting local farmers, but no direct evidence of soil quality improvement programs

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**2**	Direct evidence through blog section and recipes sharing, plus consumer education about zero-waste shopping
Stakeholder Engagement	**3**	Strong network of local producers across Slovakia, direct engagement with consumers, and family-community based approach
Food Security	**2**	Direct contribution through maintaining local food supply chains and supporting regional food production

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**0**	No evidence of drought resistance initiatives
Flood Tolerance	**0**	No evidence of flood tolerance measures
Severe Weather Recovery	**1**	Indirect contribution through distributed local supply network, but no specific recovery programs

Scaling Assessment

The initiative has demonstrated successful scaling from one to three locations in Western Slovakia within its first years of operation. The model shows strong replication potential in other Slovak regions due to its focus on local sourcing and established supplier networks. However, the heavy reliance on personal relationships with suppliers and family-based management may present challenges for rapid expansion.

Overall Assessment

Farmársky Košík demonstrates strong social resilience through its effective stakeholder engagement and local food system development, though its direct ecological and climate resilience impacts are limited. The initiative's zero-waste program and focus on local sourcing contribute to reducing environmental impact, while their emphasis on quality control and direct producer relationships strengthens local food security. Their success in Western Slovakia suggests potential for similar models in other regions, though the personal nature of their supplier relationships may require adaptation for larger-scale replication.

Farmárske trhy (Slovak Farmers' Markets)

Type: Practical implementation/governance
Primary Objective: To establish and operate regular farmers' markets connecting local producers directly with consumers across multiple Slovak cities
Key Stakeholders: Farmárske trhy s.r.o. (managing company), local farmers/producers, municipal authorities, consumers
Geographic Scope: Multiple cities across Slovakia including Bratislava, Senec, Piešťany, and other regional centers

URL: http://www.farmarsketrhy.sk/

Summary: A network of regularly scheduled farmers' markets operating across Slovak cities, creating direct sales channels between local producers and consumers. The initiative implements standardized market operations with strict vendor selection criteria, focusing on authentic Slovak agricultural and artisanal products. Markets operate on different weekdays in various locations to enable vendor participation across multiple sites.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**1**	Indirect support through promoting local agriculture, but no direct habitat improvement actions documented
Water Management	**0**	No specific water management practices or initiatives mentioned
Soil Quality	**1**	Indirect support through promoting traditional farming methods, but no specific soil improvement programs

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**2**	Direct evidence of knowledge transfer through vendor-consumer interactions and detailed vendor guidelines sharing traditional production methods
Stakeholder Engagement	**3**	Strong multi-stakeholder structure including detailed vendor participation framework, municipal cooperation, and consumer engagement across multiple cities

Food Security	**2**	Direct evidence of improving local food access and supporting regional producers, though scale remains limited to market days and locations

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**1**	Indirect support through local production diversity, but no specific drought-resistance initiatives
Flood Tolerance	**0**	No specific flood management or tolerance measures documented
Severe Weather Recovery	**1**	Basic weather adaptation through flexible market scheduling, but limited formal recovery mechanisms

Scaling Assessment

The initiative has demonstrated successful scaling across multiple Slovak cities with a standardized operational model. Geographic expansion potential exists within Slovakia, particularly in currently unserved regions. The detailed regulatory framework and operational guidelines enable replication, though success depends heavily on local government cooperation and sufficient vendor participation. The multi-city rotation model allows efficient resource use by enabling vendors to participate in multiple markets.

Overall Assessment

The Farmárske trhy initiative shows strong social resilience through its structured approach to connecting producers and consumers while maintaining high quality standards and authenticity requirements. Its primary strength lies in creating sustainable local food distribution networks and fostering direct producer-consumer relationships. While the initiative effectively addresses social and economic aspects of food system resilience, ecological impacts remain largely indirect. The standardized operational model and successful multi-city implementation demonstrate good scaling potential, though deeper integration of environmental resilience measures could enhance long-term sustainability impact.

Food Bank Slovakia (Potravinová banka Slovenska)

Type: Practical implementation/governance
Primary Objective: Combat food waste while addressing food insecurity and hunger through food redistribution
Key Stakeholders: Food retailers, food industry, small producers, charitable organizations, volunteers, European Food Banks Federation (FEBA)
Geographic Scope: National (Slovakia)

URL: https://foodbank.sk/

Summary: Founded in 2005, Food Bank Slovakia operates as a non-profit organization collecting surplus food from retail chains, food industry production, and small producers for redistribution to people in material need through a network of charitable organizations. The initiative combines food waste prevention with addressing food insecurity while promoting sustainable food systems through community engagement and policy advocacy.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**1**	Indirect impact through food waste reduction, but no direct habitat improvement activities documented
Water Management	**0**	No specific water management initiatives documented
Soil Quality	**1**	Indirect impact through partnership with small producers, but no direct soil improvement programs

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Active participation in FEBA networks, international workshops, seminars, and conferences; extensive public awareness campaigns on food waste
Stakeholder Engagement	**3**	Network of 149 charitable organizations, 150+ volunteers, partnerships with food retailers and producers; structured engagement through formal agreements
Food Security	**3**	Distributed 4,850 tons of food in 2020, reaching 136,000 people; comprehensive distribution network through social dining facilities and food packages

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**1**	Indirect contribution through food waste reduction, but no specific drought resistance programs
Flood Tolerance	**0**	No specific flood tolerance initiatives documented
Severe Weather Recovery	**2**	Emergency food distribution network can support disaster response, demonstrated capacity to handle crisis situations

Scaling Assessment

The initiative demonstrates strong scaling potential through its established network of 149 partner organizations and integration with the European Food Banks Federation. The model has proven successful at both local and national levels, with regional managers covering different parts of Slovakia. The standardized operating procedures and charter principles provide a robust framework for replication, while the volunteer-based operational model keeps costs manageable.

Overall Assessment

Food Bank Slovakia represents a mature and well-structured initiative that effectively combines food waste prevention with food security enhancement. The organization has demonstrated significant impact through its distribution of 4,850 tons of food to 136,000 people in 2020, supported by a robust network of partners and volunteers. While strong in social resilience aspects, particularly in stakeholder engagement and knowledge sharing, the initiative shows limited direct engagement with ecological and climate resilience factors. The recognition through the 2019 SDG Award validates its contribution to sustainable development goals, while its membership in FEBA provides access to international best practices and support networks that strengthen its operational capacity and impact potential.

Sustainable Food Systems in Košice

Type: Policy and practical implementation
Primary Objective: Develop a sustainable and comprehensive local food chain in Košice region through stakeholder mapping and mobilization
Key Stakeholders: Technical University of Košice, Spolka organization, Carpathian Development Institute, local farmers, community gardens, school canteens, elderly care centers, City of Košice Authority, Košice Region Authority
Geographic Scope: Košice city and region (6,753 km², >782,000 inhabitants)

URL: https://sharedgreendeal.eu/hubs/sustainable-food-systems-kosice

Summary: This initiative aims to create alternative supply chains connecting local producers with institutional consumers like school canteens while addressing systemic barriers in Eastern Slovakia. The project combines stakeholder mapping, knowledge transfer, and policy advocacy to develop sustainable food systems in a region where agricultural land occupies almost 50% of the area but faces challenges in transitioning to sustainable practices.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**1**	Regional adaptation strategy identifies need for landscape structure diversification, but no direct implementation evidence yet
Water Management	**0**	No specific water management actions mentioned in source material
Soil Quality	**1**	Acknowledges need for regenerative agriculture, but no specific implementation described

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**2**	Structured knowledge transfer through assembly meetings, stakeholder interviews (10 planned), and individual consultations with clear timeline
Stakeholder Engagement	**3**	Comprehensive engagement plan including transition committee, multiple stakeholder groups, and four planned assembly meetings with clear structure

Food Security	**2**	Direct focus on connecting local producers with institutional consumers, developing alternative supply chains for quality, sustainable, and affordable food

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance measures detailed	**1**	Mentioned in context of climate adaptation but no specific
Flood Tolerance	**0**	No specific flood management actions mentioned
Severe Weather Recovery	**1**	General climate adaptation mentioned but no specific recovery measures detailed

Scaling Assessment

The initiative has strong scaling potential within the Košice region due to its significant agricultural land base (50% of area) and established institutional framework. The systematic approach to stakeholder engagement and policy integration creates a replicable model for other regions, though historical context (Soviet-era collectivization) and bureaucratic complexity of EU support may present scaling challenges in similar post-Soviet regions.

Overall Assessment

The Košice initiative demonstrates strong social resilience elements through its comprehensive stakeholder engagement and knowledge-sharing approach, but shows limited direct ecological and climate resilience actions at this stage. Its strength lies in building institutional capacity and alternative supply chains rather than immediate environmental impact. The initiative's focus on policy advocacy and systemic change suggests potential for long-term transformation, though success will depend on overcoming identified barriers including bureaucratic complexity and farmer wariness of new practices. The structured timeline and diverse partner involvement provide a solid foundation for implementation, but concrete environmental outcomes will require translation of stakeholder engagement into specific actions.

Karva Earth Market

Type: Practical implementation
Primary Objective: Create a sustainable monthly marketplace that preserves local food cultures and supports small-scale producers
Key Stakeholders: Slow Food Slovakia, Municipality of Kravany nad Dunajom, local farmers, artisanal producers, cross-border communities
Geographic Scope: Kravany nad Dunajom region with cross-border reach into Hungary

URL: https://www.slowfood.com/press-releases/slow-food-in-slovakia-celebrates-food-biodiversity-with-the-opening-of-the-karva-earth-market/

Summary: The Karva Earth Market is a monthly marketplace initiative in Kravany nad Dunajom, Slovakia, operating on Saturdays from 9:00 to 13:00. The market aims to preserve local food biodiversity, support sustainable agriculture, and strengthen community food systems through direct producer-consumer connections. It is integrated with plans for a Slowdown Cultural Center that will provide educational activities and workshops focused on organic farming and traditional food culture.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**2**	Market specifically promotes local biodiversity and organic farming practices; selection criteria for vendors includes environmental considerations
Water Management	**1**	Located in historically agricultural region along Danube, but no specific water management initiatives documented
Soil Quality	**2**	Prioritizes organic farming methods through vendor selection and educational components of planned cultural center

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Structured program of educational activities and workshops led by local farmers and artisans; planned cultural center for ongoing education

Stakeholder Engagement	**3**	Multi-modal accessibility (car, bicycle, boat, bus), cross-border community involvement, partnership with municipality and Slow Food network
Food Security	**2**	Regular monthly market creates reliable local food access point; supports diverse local production including fruits, vegetables, and prepared foods

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**1**	Support for organic farming implies some drought resistance practices, but no specific initiatives documented
Flood Tolerance	**1**	Strategic location considers historical agricultural practices along Danube, but no specific flood management detailed
Severe Weather Recovery	**1**	Regular market schedule and permanent structure provide some stability, but no specific weather resilience measures noted

Scaling Assessment

The Karva Earth Market demonstrates strong scaling potential through its integration with the broader Slow Food Earth Markets network and collaboration with another Earth Market in Bátovce. Its visibility is enhanced by association with the Degustorium Festival, which brings international attention and networking opportunities. The initiative's cross-border reach and multi-modal accessibility model could be replicated in other border regions, while its cultural center component provides a framework for deep community engagement.

Overall Assessment

The Karva Earth Market effectively builds local food system resilience through its regular marketplace operations and planned educational initiatives. Its strongest impact is in social resilience, where it creates robust networks between producers and consumers while facilitating knowledge transfer across communities and borders. The market's integration with local government and international networks provides institutional stability, while its planned cultural center component suggests potential for deeper community impact. While ecological benefits are present through the promotion of organic farming and biodiversity, the initiative could strengthen its direct impact on climate resilience through more specific programs targeting weather-related challenges common to the Danube region.

Living Lab Regenerative Agriculture and Agroforestry

Type: Research/practical implementation
Primary Objective: To establish and demonstrate regenerative agriculture and agroforestry practices in Slovakia through a living laboratory approach
Key Stakeholders: Ekopolis Foundation, Slovak Academy of Sciences (Mlyňany Arboretum), Slovak University of Agriculture in Nitra, farmers, researchers, students, Deutsche Bundesstiftung Umwelt (DBU)
Geographic Scope: Slovakia, centered at Mlyňany Arboretum (minimum 5,000m² demonstration area)

URL: www.prepodu.sk

Summary: A comprehensive initiative establishing Slovakia's first integrated demonstration center for regenerative agriculture and agroforestry practices. The project combines practical demonstration, research, education, and knowledge sharing through a physical living laboratory and virtual platform, while providing specialized equipment access to farmers for implementing regenerative practices.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**2**	Direct implementation of diverse cropping systems and agroforestry integration at demonstration site; establishment of woody plants in arable crops
Water Management	**3**	Explicit focus on water retention through agroforestry systems and soil management practices; documented implementation in living lab
Soil Quality	**3**	Comprehensive soil improvement through minimal tillage, cover crops, organic matter formation, and direct seeding practices with specialized equipment

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Extensive knowledge transfer through digital platform, educational materials, 8 planned excursions, 10 educational videos, and direct integration with university curriculum

Stakeholder Engagement	**3**	Active engagement of multiple stakeholder groups including farmers, researchers, students, and public; establishment of demonstration farm network
Food Security	**2**	Implementation of resilient agricultural practices and improved soil management, though specific food security outcomes not yet documented

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**2**	Implementation of soil moisture retention practices and improved organic matter content, though long-term impact data pending
Flood Tolerance	**2**	Enhanced water management through agroforestry and soil improvement practices, specific flood resilience measures in place
Severe Weather Recovery	**2**	System design incorporates multiple resilience factors including soil health and biodiversity, though specific recovery metrics not yet available

Scaling Assessment

The initiative demonstrates strong scaling potential through its multi-faceted approach combining physical demonstration, education, and equipment sharing. The project addresses a key barrier to adoption by providing access to specialized equipment (direct seeding machine, crimping roller) for smaller farmers. The integration with academic institutions and establishment of a farmer network creates sustainable pathways for knowledge transfer and practice adoption.

Overall Assessment

The Living Lab initiative represents a strategically designed intervention that addresses multiple aspects of agricultural system transformation in Slovakia. The combination of physical demonstration, research infrastructure, education, and practical farmer support through equipment sharing creates a comprehensive approach to promoting regenerative agriculture. While some impacts are still emerging, the initiative shows strong evidence of effective design and implementation, particularly in ecological and social resilience dimensions. The project's integration with established institutions and focus on practical barriers to adoption suggests strong potential for long-term impact and replication across Slovakia's agricultural sector.

EATingCRAFT (Education Towards the Creation of Alternative Food Networks)

Type: Research and practical implementation
Primary Objective: To increase food system sustainability through training programs that build alternative food networks using Participatory Guarantee Systems (PGS) and Community Supported Agriculture (CSA)
Key Stakeholders: IFOAM - Organics International, European partner organizations, farmers, consumers, local food communities
Geographic Scope: Czech Republic, Hungary, Greece with broader European impact

URL: https://urgenci.net/eatingcraft/

Summary: EATingCRAFT was a two-year Erasmus+ funded project (2017-2019) that developed and implemented training programs to build sustainable local food systems. The initiative focused on integrating PGS with CSA approaches to create transparent, participatory food networks while enhancing relationships between producers and consumers through shared responsibility and decision-making processes.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**1**	Indirect impact through promotion of organic farming principles, but no direct habitat improvement actions documented
Water Management	**1**	Organic farming practices promoted but no specific water management interventions detailed
Soil Quality	**2**	Direct connection to organic farming practices and standards through PGS implementation, evidenced by farm visit assessments

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Strong evidence through four training modules, peer review processes, and documented knowledge exchange during farm visits

Stakeholder Engagement	**3**	Extensive engagement demonstrated through CSA networks, participatory guarantee systems, and diverse stakeholder participation in training events
Food Security	**2**	Direct impact through establishment of short supply chains and local food networks, though scale remains limited

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**1**	Implicit in organic farming practices but no specific drought resistance measures detailed
Flood Tolerance	**0**	No specific flood tolerance measures mentioned
Severe Weather Recovery	**1**	Community support structure may aid recovery, but no specific mechanisms detailed

Scaling Assessment

The initiative demonstrated strong replication potential through its standardized training modules and toolkit, which were successfully tested across three countries. The project's integration with existing CSA networks and organic farming associations provides established channels for scaling. However, European regulatory constraints regarding PGS certification present a barrier to broader adoption.

Overall Assessment

EATingCRAFT successfully established a framework for building resilient local food systems through the innovative combination of PGS and CSA approaches. The initiative's primary strength lies in its social resilience components, particularly in knowledge sharing and stakeholder engagement, evidenced by the robust training program and diverse participation. While ecological impacts are positive through the promotion of organic practices, they remain largely indirect. The initiative's lasting impact is demonstrated through the creation of tools and capacity for pilot PGS initiatives, though regulatory challenges in the European context may limit full realization of its potential.

MetroFarm Network Prague

Type: Practical implementation
Primary Objective: To develop a network of urban farms and community gardens promoting local food production and sustainable consumption
Key Stakeholders: Municipal government (Prague City Hall, district councils), MetroFarm coordinators, community members, local residents
Geographic Scope: Multiple locations across Prague (Letňany, Císařský ostrov, Jinonice)

URL: https://www.metrofarm.cz/

Summary: MetroFarm is a city-supported network of urban farming initiatives operating across multiple locations in Prague. The project combines community fields, individual garden patches, animal husbandry, and composting facilities. It aims to increase local food production while building community engagement and environmental awareness through hands-on farming activities.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**2**	Multiple locations provide diverse growing environments; includes animal integration and composting. Limited by urban setting and scale.
Water Management	**1**	Basic gardening practices implied but no specific evidence of advanced water management systems
Soil Quality	**2**	Composting facilities at multiple locations indicate active soil management; limited by urban context

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Strong educational component with structured learning opportunities, community engagement, and hands-on training programs
Stakeholder Engagement	**3**	Multiple stakeholder involvement including city government, local districts, community members, and project coordinators; clear coordination structure

Food Security	**2**	Provides direct food production capacity through community fields and individual patches; scale still limited relative to city needs

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance practices	**1**	No specific evidence of drought-resistant systems or
Flood Tolerance	**1**	No specific mention of flood management strategies
Severe Weather Recovery	**2**	Multiple locations provide some redundancy; community structure enables collective recovery efforts

Scaling Assessment

The MetroFarm network demonstrates strong scaling potential through its multi-location model and municipal support structure. The project has already expanded to four distinct locations across Prague, showing practical replication capabilities. The standardized yet flexible approach to site development (including community fields, individual patches, and composting facilities) provides a clear template for further expansion, though urban land availability may constrain growth.

Overall Assessment

MetroFarm represents a well-structured approach to urban agriculture that effectively combines municipal support with community engagement. The initiative's greatest strengths lie in its social resilience aspects, particularly in knowledge sharing and stakeholder engagement. While its direct impact on food security remains modest due to scale limitations, the project creates valuable infrastructure for building local food system resilience. The primary areas for improvement include developing more robust climate resilience measures and expanding water management capabilities. The strong institutional support and clear organizational structure provide a solid foundation for future development and potential replication in other urban areas.

Carbon Farming CE Project

Type: Research and practical implementation
Primary Objective: To accelerate carbon farming adoption across Central Europe through testing and standardization of techniques and business models
Key Stakeholders: Agricultural Institute of Slovenia (lead), 11 project partners across 9 Central European countries, farmers, policymakers
Geographic Scope: Central Europe (9 countries)

URL: https://no-gravity.sk/carbon-farming-project/

Summary: The Carbon Farming CE project, launched in April 2023 with €1.8M ERDF funding, aims to mainstream carbon farming practices in Central Europe. The initiative combines technical research, practical field testing, and policy development to create standardized approaches for carbon sequestration in agricultural soils. It emphasizes knowledge transfer through training materials and business model development for widespread adoption.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**2**	Direct evidence through soil organic matter improvement and biodiversity enhancement mentioned in project goals
Water Management	**1**	Indirect impacts through improved soil structure, but no specific water management actions detailed
Soil Quality	**3**	Central focus with direct implementation of multiple techniques (biochar, organic fertilizers, crop residues) and monitoring systems

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Comprehensive training materials, winter school, transnational seminars, and direct farmer engagement
Stakeholder Engagement	**3**	Multi-stakeholder approach involving farmers, researchers, policymakers; participatory dialogue structures

Food Security	**2**	Direct link to enhanced food production through improved soil health, though secondary to carbon sequestration goals

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**2**	Improved soil organic matter content enhances water retention, supported by testing data
Flood Tolerance	**1**	Potential indirect benefits through improved soil structure, but not explicitly addressed
Severe Weather Recovery	**2**	Enhanced soil resilience through organic matter increase, documented in field trials

Scaling Assessment

The project demonstrates strong scaling potential through its transnational structure and standardized approach to technique testing and business model development. The involvement of nine countries provides diverse testing environments and built-in replication pathways. The creation of a Central European Carbon Farming Cluster and integration with CAP 2023-2027 provides institutional support for widespread adoption.

Overall Assessment

The Carbon Farming CE project represents a comprehensive approach to advancing carbon farming in Central Europe, combining scientific rigor with practical implementation. Its strength lies in the systematic development of standardized techniques and business models, supported by robust monitoring systems and knowledge transfer mechanisms. The project's integration with policy frameworks and focus on stakeholder engagement suggests high potential for lasting impact, though success will depend on the practical adoption of techniques by farmers and sustained policy support beyond the project timeline.

Krakovany-Stráže Agricultural Cooperative

Type: Practical implementation
Primary Objective: Restore and maintain soil health and productivity through regenerative agriculture practices
Key Stakeholders: Agricultural cooperative (54 shareholders), management team, local farmers
Geographic Scope: 640 hectares of farmland in Slovakia

URL: https://pdkrakovany.sk

Summary: Krakovany-Stráže is an agricultural cooperative that transformed its conventional farming practices to regenerative agriculture starting in 2010. The initiative implemented a gradual transition including reduced tillage, cover crops, no-till practices, and elimination of chemical inputs, resulting in improved soil health, increased biodiversity, and sustained economic viability.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**3**	Direct evidence of increased biodiversity, establishment of flower strips supporting bee populations, and diverse crop rotation with 14+ species
Water Management	**3**	Measured improvement of 100L/m² per year higher water retention compared to surrounding agricultural land
Soil Quality	**3**	Documented increase in soil organic carbon from 1.7% to 2.6% (2013-2021), zero soil erosion for 12 years

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Regular hosting of school visits, information days, and active participation in EU PREPSOIL project as Community of Practice
Stakeholder Engagement	**2**	Strong internal engagement of 54 shareholders and management, limited evidence of broader community engagement
Food Security	**2**	Maintained yields matching local averages while reducing input costs, diverse crop production including food crops

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**3**	Significant improvement in water retention capacity, year-round soil coverage practices
Flood Tolerance	**2**	Improved soil structure and water retention capacity, though specific flood resilience data not provided
Severe Weather Recovery	**2**	Enhanced soil organic matter and reduced tillage improve general resilience, but specific recovery metrics not documented

Scaling Assessment

The initiative demonstrates high replication potential due to its gradual, systematic approach to transition and documented economic viability. The 640-hectare scale proves feasibility for medium-sized operations, while participation in EU networks and knowledge-sharing activities facilitates broader adoption. The model particularly suits regions with similar agricultural conditions in Central and Eastern Europe.

Overall Assessment

Krakovany-Stráže represents a comprehensive and successful implementation of regenerative agriculture principles, with strong quantitative evidence of ecological improvements. The initiative excels in soil health restoration, biodiversity enhancement, and water management while maintaining economic viability. The cooperative's commitment to knowledge sharing and participation in broader EU agricultural networks strengthens its contribution to agricultural resilience. The documented success in combining environmental benefits with economic sustainability makes this a valuable model for agricultural transformation in the region.

Carboneg Regenerative Agriculture Program

Type: practical implementation/policy
Primary Objective: Transform agricultural practices to increase soil carbon sequestration while providing carbon credits to companies
Key Stakeholders: Farmers, agricultural businesses, corporate carbon credit buyers, Carboneg Group s.r.o.
Geographic Scope: Central and Eastern Europe (Czech Republic, Slovakia confirmed)

URL: https://carboneg.com

Summary: Carboneg is a five-year program that connects farmers practicing regenerative agriculture with companies seeking carbon offsets. The initiative provides financial incentives to farmers based on measured increases in soil organic carbon, while offering companies verified carbon credits. The program includes comprehensive soil monitoring, technical support, and knowledge transfer components.

Resilience Assessment

Ecological Resilience

Criteria	Score	Evidence/Justification
Habitat Quality	**2**	Direct evidence of biodiversity support through cover crop diversity (14-component mixes) and biopás (buffer strips) implementation at DVP Agro case study
Water Management	**3**	Multiple documented practices for water retention including permanent soil cover, reduced tillage, and deep-rooting cover crops improving soil structure
Soil Quality	**3**	Comprehensive soil organic matter monitoring program with annual sampling, laboratory analysis, and financial incentives tied directly to measured improvements

Social Resilience

Criteria	Score	Evidence/Justification
Knowledge Sharing	**3**	Regular field days, collaboration with Mendel University, detailed FAQ section, farmer case studies, and structured knowledge transfer program
Stakeholder Engagement	**3**	Multi-stakeholder approach connecting farmers, companies, and researchers; established community of practitioners with regular interaction

Food Security	**2**	Evidence of improved yield stability in drought conditions and reduced input costs at DVP Agro, though limited broader data

Climate Resilience

Criteria	Score	Evidence/Justification
Drought Resistance	**3**	Documented improvements in water retention and drought resilience through increased organic matter and cover cropping
Flood Tolerance	**2**	Improved soil structure and water infiltration capacity mentioned, with specific practices identified
Severe Weather Recovery	**2**	Enhanced system resilience through improved soil health, though limited direct evidence of severe weather recovery

Scaling Assessment

The initiative demonstrates strong scaling potential through its structured program design and clear financial mechanisms. Current implementation across multiple farms in at least two countries (Czech Republic and Slovakia) shows practical scalability. The combination of technical support, financial incentives, and corporate funding creates a sustainable model for expansion, though the requirement for precise carbon measurement and verification may limit rapid scaling.

Overall Assessment

The Carboneg program represents a comprehensive approach to building agricultural resilience through verified carbon farming practices. The initiative's strength lies in its combination of rigorous measurement protocols, financial incentives, and knowledge transfer mechanisms. Evidence from implementing farms shows meaningful improvements in soil health, water retention, and economic stability, particularly during drought conditions. The program's integration of corporate carbon credit buyers creates a sustainable funding mechanism, though long-term success will depend on maintaining measurement accuracy and ensuring consistent carbon price levels to support farmer transition costs.

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