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SOME CONSIDERATIONS ABOUT RESILIENT FOOD SYSTEMS AS A PILLAR FOR FOOD SECURITY AND SUSTAINABILITY

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Abstract:

Food production, processing and distribution – as components of food systems – represent critical sectors playing a key role in maintaining socio-economic functions and activities at all levels. Worldwide, the three classic sides of the food security concept - availability; access and stability – are intrinsically related to arising crises in different contexts, and their fulfilling appears as a result of adequate national and international policies and sustainability practices. Food systems' capabilities in front of crises rely on various ways and alternatives to strengthen their resilience, mostly locally, by balancing the response to urgent situations with long-term strategies which allow a sustainable growth.

The purpose of this paper is to provide an image of food systems resilience concept and its current relevance, exploring linkages between resilience, food security and sustainability. As flexibility and adaptability in the context of various crises (such as Covid-19 pandemic, military conflicts, food prices crisis) is imperative, food systems transformation is prerequisite towards a superior level of resilience. Thus, the paper underlines the importance of building resilient food systems with the participation of all important stakeholders, which need a common approach and understanding on the most appropriate ways to sustainably respond to actual challenges, even if their interests, authority and capabilities may differ.

Key words: food system; food system resilience; food security; sustainability; resilience.

JEL classification: Q18; P46.

1. RESILIENT FOOD SYSTEMS – GENERAL HIGHLIGHTS

Today, food systems worldwide are being challenged by various threats and risks which increase their vulnerability to the extent that in order to ensure continuous access to sufficient and safe food for the population, there is a strong need to develop new approaches that allow for adequate withstanding and recovering from crises. In this context, the concept of "resilience" was adapted and associated with food systems' strength to endure and overcome interacting shocks and stressors with both short- and long-term consequences which jeopardize their functioning and efficacy.

General economic literature associates *sustainability* with the capability of current generations to meet their needs without compromising the same ability for future generations (Tendall et al., 2015), within a context of maintaining ecological balance and preserving natural resources.

Obviously, *resilience* – regarded as the capacity to prepare for threats and quickly recover from and adapt to various difficulties – is a very suitable term to apply to food systems in order to suggest their aptitude to deal with toughness of specific events.

If we consider the two complementary concepts - resilience and sustainability – they cannot be strictly delimited from one another (Grubinger, 2012) as they involve different time horizons (short-terms response to negative events versus long term holistic solutions). To better understand both concepts - which are increasingly used in the past years - they should be linked and analysed, – both conceptually and in a practical manner - in the context of their relationship, which could deliver better results in terms of *food security* through optimal interventions design and implementation.

A continuously rising of food demand and shifting diets add to various types of stress which are hindering the goal of ensuring acceptable, safe and nutritious diet for all in a sustainable manner

(Kougioumoutzi, 2017; FAO *et al*., 2018; Elechi et al. (2022). On the other hand, different diet types have a different nutritional and environmental impact (Cambeses-Franco et al., 2022).

Global food systems tend to become increasingly unstable in face of multiple crisis – therefore lose their resilience in the context of growing global population, climate change, rising pressure on limited resources, socio-economic, environmental and market fluctuations and emerging diseases (Suweis et al., 2015; Kougioumoutzi, 2017) – all of that jeopardizing food security at all levels.

2. APPROACHES ON FOOD SYSTEMS RESILIENCE CONCEPT

Building on different ideas as to how to define specific terms, resilience – initially used in ecology and engineering - is, from a general perspective, related to the coping ability in case of exposure to shocks/stressors/adverse states/severe events and to the recovery capacity under given conditions. Applied to food systems (Hoddinott, 2023), the resulting notion reflects the food system capacity to provide food in a sustainable manner, under problematic circumstances.

According to FAO (2023), resilience was defined as "the ability to prevent disasters and crises as well as to anticipate, absorb, accommodate or recover from them in a timely, efficient and sustainable manner. This includes protecting, restoring and improving livelihoods systems in the face of threats that impact agriculture, nutrition, food security and food safety."

Similarly, *food system's resilience* (also known as food supply chain resilience) was described as its ability to respond and adapt to disruptions, while maintaining its structure and function (Pingali et al. 2005, Schipanski et al. 2016; Stone and Rahimifard (2018), but also as its "ability to maintain a desired state of food security when exposed to stresses and shocks" (GFS, 2018).

Resilience of food system should be regarded as a multi-dimensional concept which needs to be specifically framed by raising four questions (Zurek et al., 2022): "Resilience of what? Resilience to what? Resilience from whose perspective? Resilience for how long?"

A special characteristic of resilient food systems is their "buffering" capacity, which allows them to withstand disturbances by adapting and recovering in the face of change (Schipanski et al., 2016).

In the attempt of developing a procedure to quantify resilience of food supply chains towards food safety shocks, Mu et al. (2021) showed that building resilience is a more comprehensive approach than conventional food risk management (focused on enhancing robustness); three dimensions of resilience factors (time, degree of food safety shocks impacts and degree of recovery) were identified, which are useful for making better decisions on which resilience strategy is more appropriate to apply in order to both improve resilience and food safety.
In 2020, during the Food Forum of National Academies of Sciences, Engineering, and Medicine in the United States (US) it was also underlined that resilience, together with robustness and efficiency is an important element of a food system and that a sustainable but equitable food system should solve inherent trade-offs between different interests and scopes.

The holistic approach of resilience has been proposed by many researchers due to the complexity of all food system dimensions and resulting interdependencies at multiple scales (Tendall et al., 2015). When put in connection to sustainability, resilience obvious forms a vital component for enabling food systems functioning despite disturbances, with emphasis on the time dimension.

Aiming to provide a context for generalizations regarding the global food system resilience, Seekell et al. (2017) developed an indicator-based framework taking into account three dimensions of resilience: socio-economic access to food; biophysical capacity to increase food production, and the magnitude/diversity of current domestic food production. Their study revealed that the global food system complexity leads to heterogeneity between nations in different dimensions' quantification.

In the last years, assessing food systems in terms of resilience thinking with focus on persistence and adaptive capacity has been considered an adequate approach (Hedberg, 2021; Coble, 2019), given the diversity of agri-food system challenges.

3. DRIVERS AND CHALLENGES FOR FOOD SYSTEMS RESILIENCE

Stone and Rahimifard (2018) studied multiple definitions for agri-food supply chains resilience and noticed that, in the literature on the subject, readiness, response and recovery are the main key resilience enablers, to which adaptive definitions added *a fourth* – the dynamic capacity to "adapt" after disruptions.

Emphasizing the same idea, d'Errico et al. (2021) consider that, in terms of household resilience, adaptive capacity is an essential factor, while access to assets (agricultural tools, land, and livestock) is a critical driver of resilience and, as a consequence, adequate strategies should not only mitigate resilience capacity, but offer solutions (based on context specificity) to long-term consequences of shocks.

Piters et al. (2022) identified *four key properties* of building resilient food systems: ensuring agency, creating buffers, increasing connectivity, and enhancing diversity in the food system – from which solutions and intervention can be derived, paying special attention to trade-offs.

According to Hoddinott (2023), several factors contributing to food system resilience, which are insufficiently measured or taken into account, include market structure in the processing sector, market integration, market diversification, openness to trade.

Zurek et al. (2022) suggest that enhancing food systems resilience requires stakeholders to adapt their activities based on relevant drivers by *three approaches* (the three "Rs"), also established as such by the Global Food Security (GFS, 2018):

Robustness: food systems actors ability to resist disruptions by activities adaptation;

Recovery - food systems actors ability to return to normality after disruptions;

Reorientation – changing expectations by accepting alternative outcomes, before and after disruption (which implies trade-offs and negotiations among food system actors).

Similarly, according to Tendall et al. (2015), there are four components which participate to a food system's resilience: robustness (how well is the system able to face arising disturbances); redundancy (the degree of avoiding food insecurity by shock absorption using alternatives); flexibility and rapidity of recovery; resourcefulness and adaptability (the extent of recovery). From their linkage, the necessary action cycle for the food system resilience is resulting (Fig. 1).

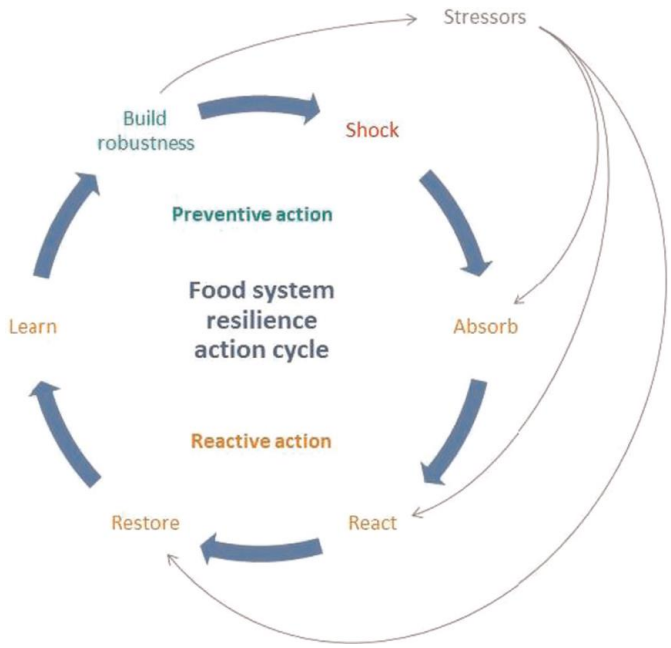

Figure no. 1. The food system resilience action cycle

Source: Tendall et al. (2015).

Another relevant process that should be linked to resilience is *food waste*, given its impact on ecosystems, while the two may come into tensions and conflicts as extra food supply aggravates the food wastage issue even if it provides resilience through redundancy (Bajželj et al., 2020; Stancu, 2022).

Besides Covid-19 pandemic, *climate change* is another relevant challenge affecting food security in many ways - in terms of food production quantity, water scarcity, nutrient content, food borne disease (Nordhagen, 2022) – all of them having a negative impact upon quality and safety of food and diets, firstly putting at risk vulnerable consumers. After analysing environmental variability in relation to food supply chain resilience, Davis et al. (2021) showed that fluctuations and adverse events affecting all stages of food systems can take various forms and therefore there is a need to protect stability of all steps – from local producers to global scale, since integration and globalization increases the probability of novel risks propagation

Consumer eating patterns are another key factor of food security and consequently of resilience, and studies show that current patterns worldwide have a negative impact on multiple levels of the food supply chain, therefore there is a need of adjusting food consumption behaviours, besides actions on the supply side (Stancu, 2016; Guyomard et al., 2012).

Indeed, consumers worldwide acknowledge more and more the impact of their food consumption on the environment and especially young consumers (both the Millennial and Generation Z) are likely to adjust their consumption and waste patterns and choices in order to support 'environmentally friendly' foods and sustainability in general (Chr. Hansen Holding A/S, 2023).

According to Kumar et al. (2018), changes in food consumption patterns (including introducing new crop types in the system) can be used as a key-indicator of subsequent outcomes and as a starting point in designing necessary strategies.

4. INITIATIVES ON FOOD SYSTEMS RESILIENCE

4.1. EMERGENCY RESPONSE OR LONG-TERM STRATEGIES?

In the globalization context, food systems resilience should involve multiple dimensions and reference scales and interactions: local, global, and cross-scale and consider both short-term and longer-term responses and contributing factors (Seekell et al. 2017). While local challenges require rapid disaster response, focus at global scale is moving away from food security dimensions towards economic consequences and their propagation.

Pingali et al. (2005) underlined that addressing acute and recurrent crises is a complex process whereas each crisis should be analysed in the dynamic context of resilience based on principles such as enhancing diversity; developing support networks; local knowledge, adaptation and reorganisation.

For managing crises and rebuilding resilience, FAO has proposed a framework based on a Twin Track Approach, almost two decades ago, aiming to combine short-term interventions and long term strategies for sustainable growth. The necessity of combining both short- and long-term interventions is found in numerous studies, reinforcing the idea that strategies for building resilient food systems should be based on tracking and measuring resilience.

A study on resilience policies in their connection to food security highlighted that long-term resilience building through anticipatory, sustainable interventions and development assistance is generally surpassed by measures for addressing immediate, short –term needs and humanitarian aid (Parera and Hugh, 2023). Thus, emergency response to specific situations cannot replace flexible and robust resilience strategies based on adaptation.

Moreover, as food insecurity is accompanied by malnutrition, Spiker et al. (2020) show that sustainable food systems can be designed only by the intersection of multiple domains including nutrition and health, and professionals in the field of diet and nutrition should actively and directly

participate with their skills in solving nutritional manifestations of current unsustainable food systems.

4.2. COVID-19 AND RESILIENCE

Besides other consequences on humanity, COVID-19 pandemic directly affected food security as an essential aspect of food systems, leading to food shortages, price increase and panic buying (Boyacı-Gündüz et al., 2021) – showing that current food systems are vulnerable. COVID-19 pandemic ripple effect revealed that extreme global events can lead to events propagating towards multiple points, impacting different dimensions of food security (food availability, logistics, access and intake) (Davi et al., 2021; Mu et al., 2021; Sperling et al., 2022). Furthermore, disruptions throughout the food supply chain have the potential to generate increased food waste, which demonstrates that low resilience can result in food wastage (Bajželj et al., 2020).

Clearly, Covid-19 global epidemic affected the stability of food production and exposed the vulnerabilities of the supply chain (Fan et al., 2021), but may be regarded as a trigger for necessary fundamental shifts of the global food and agriculture system. The long-term implications of the pandemic were identified as follows (Table 1):

Table no. 1. Mapping the long-term impact of Covid-19 pandemic on food security: a conceptual overview

Stage	Long term impact (more than 1 year)
Primary production	Build-up on weed seed banks in soils Long-term weakening of agricultural systems Disappearance of low-tech farms
Stability of production	Unreliable, less efficient supply chains Loss of food system livelihoods threatens food system stability and resilience Ongoing uncertainty constraints long-term investment in the food and agriculture sector
Physical access to food	Durable weakening of collective physical infrastructures
Economic access to food	Loss of livelihoods and people's access to food leading to massive increase in hunger Political instability Food riots
Diets	Shifts in diets to less nutritious foods impacts health and livelihood prospects Long-term consequences of poor diets on vulnerable consumers
Global effects on sustainability	Diminished attention to climate and biodiversity threatens food sustainability

Source: author's adaptation from FAO (2020); Savary et al. (2020); Webb et al. (2021).

During COVID-19, FAO has been closely monitoring local food system status and practices and measures adopted worldwide. In order to gather relevant data for improving local food systems resilience and strengthen relevant policies and programmes, in April-May 2020 FAO conducted a global survey eliciting 860 responses from cities (from which 56% came form local government representatives).

The survey – aimed at mapping local responses to the pandemic – revealed a series of relevant aspects regarding the manifestation, impact and consequences of the pandemic in relation to food security and resilience (FAO, 2020):

most of the countries (60 % of total respondents) faced temporary shortages in staple foods;
disruptions to traditional distribution channels resulting from shutdown of public food services seriously affected food supply;

local food accessibility was highly impacted by the restrictions in the use of public transport (66 % of total respondents) and on the selling of food in public spaces (68.3% of total respondents);
country's income level was positively correlated to panic buying and excessive stockpiling (71.3 % for cities of high-income countries vs. 43.1 % for cities in low-income countries);

villages (< 5000 inhabitants) and small towns (5 000–25 000 inhabitants) were less affected by the restriction measures than cities (> 500 000 inhabitants), most probably due to longer food supply chains of the latter;

38 % of the responding cities indicated that facilitation of direct purchases from local producers can be considered as a key measure to minimize the pandemic impact;
restrictive measures on human mobility led to a shortage of labor in local agriculture and food-related activities, negatively affecting local food production (40 % of respondents);

mechanisms for monitoring food markets were established in 50.9 % of the responding cities, in connection to national governments initiatives;

The results of the survey highlight the importance of strengthening urban–rural connections in order to better respond to crises and of shortening food supply chains as a measure to improve long-term food security, and thus resilience and sustainability.

Global interdependencies and integrations created a context of fragility in this crisis, but the situation itself, together with the recovery process may be considered a key-lever and an opportunity for a necessary transformation towards and resilience, equity and sustainability. Exposing pre-existing issues and creating major disruptions in food systems all over the world, the pandemic has also revealed remarkable resilience of certain communities (Ellen Mcarthur Foundation, 2023) and suggested that shifting to circular economy would create resilient systems with multiple benefits for all actors and good impact in terms of sustainability.

As a consequence, building resilience so as to better respond to similar extreme events requires transformation of food sector through sustainable plans and strategies.

4.3. ARE LOCAL APPROACHES THE KEY TO BETTER RESILIENCE? THE ROLE OF SMALL FARMERS AND ORGANIC FOOD PRODUCTION

From the resilience thinking perspective, conventional food system lacks stability as food production is not connected to the local environment and to consumers; therefore, an alternative approach is needed to link people to the ecosystem and consequently to food as a fundamental principle of resilience.

In the same regard, there are numerous studies showing that locally producing food helps building community resilience (Coble, 2019; Fan et al., 2021) since it relies on uniform sharing of community resources and on rightful use of the ecological environment.

As stated by the United Nations Industrial Development Organization (UNIDO, 2020), encouraging local markets is the solution for reconnecting farmers to consumers, better market access for smallholders, local development, higher food diversification and quality – therefore rebalancing long and short food chains is part of the solution to increased food systems resilience.
Considering that short food supply chains involve economic, environmental and social aspects at the same time, there is a mutual influence between their resilience and sustainability practices (Michel-Villarreal, 2023).

Brunori et al. (2020) argued that necessary policies should recognize farmers (as particularly small farmers) as active drivers of change and should include mission-oriented innovations based on a dynamic context.

On the same idea, a farmer-centric food system based on regenerative agriculture could enhance soil conservation, reduce harmful emissions, pesticide use and nutrient loss – thus increasing resilience (National Academies of Sciences, Engineering, and Medicine, 2021).
Rural practices are considered to increase sustainability and resilience to shocks through agricultural innovation, while organic farming brings numerous social, economic and environmental advantages including enhancing food security (Marcu et al., 2022). A study

exploring the potential of organic farming techniques for increasing resilience (Borron, 2006) showed that creating sustainable systems requires strengthening of all specific areas (soil, water, biodiversity, community knowledge and support), so that ecological principles be successfully put into practice, mostly in developing countries.

4.4.REGIONAL APPROACHES

As a global leader, the United States (US) constantly evaluate disruptions across the globe and acknowledge their impact on food security, stability and prosperity in general, both on domestic and international level. Thus, the US play a relevant role in developing policies and programs based on science, innovation and research helping to mitigate and adapt to global and local food systems challenges (Parera and Hugh, 2023)

Aiming to reduce the environmental impact of its food system, European Union (EU) is oriented towards competitive sustainability (Anghel et al., 2017; EIT Think Tank, 2023), which means both ensuring food security and enhancing resilience in the face of current and potential challenges.

At the EU level, agriculture and food system are supported by the Common Agricultural Policy, which aims to become global standard for sustainability (besides other dimensions: safety, security of supply, nutrition and quality) (European Commission, 2023). Moreover, the sustainable growth strategy has at its core the 2020 European Green Deal which implies a set of integrated initiatives aiming to making the EU climate neutral by 2050, recognising the importance of healthy food systems. In July 2023 the Commission adopted a package of measures for a sustainable use of key natural resources (focusing on soil, plants and reducing waste), intended to strengthen the resilience of European food and farming systems. The European Union set ambitious goals involving the food system, aiming to acquire competitive sustainability all along the food supply chain and to reduce environmental impact while ensuring food security despite risks and challenges. Research on transforming energy systems to meet the objectives of the Paris Agreement and the Green Deal (Neacsa et at., 2020) show that attaining the goals established by the EU should involve all economies sectors, including those associated with the food supply chains.

European Institute of Innovation and Technology (EIT) supports EIT Food, an EU-funded organisation leading a dynamic food innovation community (Elpick, 2020) focused on reducing food waste along the food supply chain. EIT Food advocates the importance of technical innovation (including big data, the Internet of Things, Artificial Intelligence and blockchain) in improving food systems and pleads for various measures which support sustainable food consumption (EIT Food, 2020; EIT Think Tank, 2023):

Integrating biology advancements and diversifying protein sources (such as using insect-based proteins in feed);

Developing algorithms and nutrition apps helping consumers to better tailor their choices;

Involving consumers in the process of building resilience.

In the United Kingdom (UK), the Global Food Security programme creates the framework and support for the strategic approach to attaining sustainable food security (Kougioumoutzi, 2017), while the Climate Change Committee (2023) is an advisory body regarding emissions adaptation in the context of climate change.

5. BUILDING RESILIENCE FOR FOOD SYSTEMS – DIRECTIONS AND SOLUTIONS

Feeding 9 billion people by 2050 is certainly a difficult challenge in the context of multiple pressures on the food systems worldwide, for the resolution of which building resilient supply chains is a task that put organizations, researchers and consumers together to cooperate in finding innovative and sustainable solutions (Sela, 2023).

Grubinger (2012) proposes *three combined action levels* to achieve the transition from resilience to sustainability:

Adaptation – dealing with short-term issues;

Mitigation – anticipating future problems and finding mid-term solutions;

Transformation – identifying solutions and solving the causes of long term adverse phenomena.

Schipanski et al. (2016) underline that usual approaches to deal with challenges do not address their underlying causes and thus identify *integrated strategies* for reducing vulnerabilities and enhancing food systems resilience:

Food security research and initiatives should integrate gender equity and social justice;

In crop production, ecological processes should be used instead of external inputs;

Regionalized food distribution networks and waste reduction should be encouraged;

Agricultural production policies should be linked to human nutrition requirements.

For instance, regarding the Near East and North Africa, FAO regional initiatives are focused towards *four main directions* in order to address food insecurity (Borron, 2006; FAO Regional Office for Near East and North Africa, 2023) by addressing the causes of food and nutrition insecurity:

Governance: FAO supports policies, regulations and programmes for food and nutrition security;

Food security information system: FAO helps accurate decision by managing food security related data;

Prevention and risk reduction: FAO assists countries to better deal with shocks by identifying necessary measures;

Preparedness and response: FAO helps communities and governments to prevent and recover from crisis.

Besides quantitative aspects of food security, the connection between food and health circumscribes various areas including unhealthy food choices and food pollution/contamination which requires specific health policy design (Pisacane et al., 2021) that contribute to food systems transformation towards resilience by reuniting all dimensions of sustainability (economic, environmental and social).

Addressing environmental variability challenges needs multiple strategies across the food system – including sourcing and production diversification and strengthening internal feedbacks - but the ability of identifying necessary specific interventions remains limited (Davis et al., 2021).

On the other hand, resolving challenges arising from long-term and sort-term linkages between resilience and food waste require a combination of synergetic interventions as a result of joined-up policy and food system thinking to overcome trade-offs; several *targeted interventions* would imply (Bajželj et al., 2020):

Replacing food surplus (over-production) with food reserves (improving food storage);

Harmonizing complementary interventions to solve trade-offs (acknowledging that waste reduction can actually improve resilience);

Identifying resilience measures that indirectly diminish food waste (increasing diversity, using irrigation systems, alternating income opportunities);

Systemically approach food policies (choosing appropriate alternative under specific circumstances).

Science and innovation should play a central role in dealing with emerging risks from the agri-food sector so that appropriate pathways be considered across entire food systems in order to identify and manage synergies and trade-offs (Sperling et al., 2022). Little et al. (2023) proposed the term sustainability-oriented innovation to underline the importance of science in achieving food security based on a holistic mind-set which reunites co-creation, quality, diversity and shared values.

A vast majority of literature on the subject underlines the relevance of creating and extending safety nets, social protections measures, financing instruments real time conditions monitoring, early warning systems in order to diminish risk exposure and vulnerability of certain social groups, both in national and international context (Sperling et al., 2020).

Solutions for building resilient food systems at different levels can only be based on a joined-up interdisciplinary approach with the involvement of all actors of the food supply chain (Zurek et al., 2022). Also, Menconi et al. (2022) highlight that achieving resilience is a complex goal, requiring community-oriented solutions based on an integrated approach of food planning and on specific measures involving technical, social and agricultural improvement.

Improving resilience of food systems requires correct understanding of interconnected key processes and actors' exposure to shocks and their propagation in order to find the most suitable response to situations of environmental variability. In this regard, addressing all types of climate change consequences based on reduction of greenhouse gas emissions, with emphasis on food systems (responsible for about one third of it) is of major importance the more so as it would build on supply chain resilience and efficacy.

Food systems shifting toward resilience and equity can be empowered firstly by acknowledging the need for a systemic transformation so that the focus on efficiency can be counterbalanced by the emphasis on equity and resilience – thus sustainability. This shift requires a dynamic approach (Sperling et al., 2020) which recognizes the importance of governance agendas, assistance, research and practices oriented towards rural areas, farms system and smallholders.

6. CONCLUSIONS

In the context of agri-food systems, resilience of national and global food systems is an increasingly important and multidimensional topic which refers to the capability of addressing social, ecological and economic challenges and disruptions at all levels, by combining efficiency with equity and transparency for all actors involved.

The importance of building resilient food systems was strongly emphasised by crises in recent years. Food system transformation towards higher levels of resilience needs direct implication of reliable institutions as policy makers and inclusive governance based on a joint conception on food system resilience (Piters et al., 2022).

Current food systems must transform to become more resilient and inclusive in order to address the demands of the future and successfully face potential risks and crises. This complex and multifaceted transformation depends on the sustainability of necessary transitions which should be based on scientific approach, trust, communication and harmonization of stakeholders' interests and values.

Transition towards sustainability is obviously impacting all food security dimensions as well as the stability and resilience of food systems (Borsellino et al., 2020).

Solutions for ensuring food systems resilience need to be tailored to specific local needs and to be transposed at all involved scales to effective cope with disruptive events. Synergies and potential trade-offs between different objectives and dimensions should be carefully addressed by applying innovative technologies and adaptation strategies – all integrated in a combination of research, policies and education.

To adequately address challenges, increase food supply capacity and food systems' ability to manage disruptions, resilience must be better understood and measured as a prerequisite for ensuring food security and ultimately, as a key to a sustainable future.

Future research directions regarding food systems resilience will have to consider the incorporation of multiple aspects and insights of resilience, especially at local and household level, with emphasis on the role of small farmers and innovative agricultural approaches, both at rural and urban scale.

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8. BIBLIOGRAPHY

1. Anghel, M. G., Anghelache, C., & Panait, M. (2017). *Evolution of agricultural activity in the European Union*. Romanian Statistical Review Supplement, 65(6), 63-74.
2. Bajželj,B., Quested, T.E., Röös, E., & Swannell, R.P.J. (2020). The role of reducing food waste for resilient food systems, Ecosystem Services, Volume 45, https://doi.org/10.1016/j.ecoser.2020.101140.
3. Borron, S. (2006). *Building resilience for an unpredictable future*, FAO. Available at: https://www.fao.org/family-farming/detail/en/c/287668/
4. Borsellino, V., Schimmenti, E., & El Bilali, H. (2020). *Agri-Food Markets towards Sustainable Patterns*. Sustainability 12(6):2193. DOI:10.3390/su12062193
5. Boyacı-Gündüz, C.P., Ibrahim, S.A., Wei. O.C., & Galanakis, C.M. (2021). *Transformation of the Food Sector: Security and Resilience during the COVID-19 Pandemic*, 10(3):497. https://doi.org/10.3390/foods10030497
6. Brunori, G., Proost, J., & Rand, S. (2020). *Innovation Policies for Sustainable, Resilient, Food-secure Systems*, in Brunori, G. and Grando, S. (Eds.) *Innovation for Sustainability* (Research in Rural Sociology and Development, Vol. 25), Emerald Publishing Limited, Bingley, pp. 193-201.
7. Cambeses-Franco, C., González-García, S., Feijoo, G., & Moreira, M.T. (2022). *Driving commitment to sustainable food policies within the framework of American and European dietary guidelines*. Sci Total Environ. 2022 Feb 10;807(Pt 2):150894. doi: 10.1016/j.scitotenv.2021.150894.
8. Chr. Hansen Holding A/S (2023). *Growing demand for sustainable consumption can help to build a more resilient future*. Available at https://www.chr-hansen.com/en/food-cultures-and-enzymes/bioprotection/cards/growing-demand-for-sustainable-consumption
9. Climate Change Committee (2023). *Resilient Food Supply Chains*. Available at: Outcomes-Supply-chain-case-study.pdf (theccc.org.uk)
10. Coble, E. (2019). *Developing resilience through local food*. College of Liberal Arts & Social Sciences Theses and Dissertations. 269. Available at: https://via.library.depaul.edu/etd/269
11. d'Errico, M., Pinay, J., Luu, A., & Jumbe, E. (2021). *Drivers and stressors of resilience to food insecurity – Evidence from 35 countries. Background paper for The State of Food and Agriculture 2021*. FAO Agricultural Development Economics Working Paper 21-09. Rome, FAO. https://doi.org/10.4060/cb7411en
12. Davis, K.F., Downs, S. & Gephart, J.A. (2021). *Towards food supply chain resilience to environmental shocks*. Nat Food 2, 54–65. https://doi.org/10.1038/s43016-020-00196-3
13. EIT Food (2020). *How can we improve food system resilience for good?* Available at: https://www.eitfood.eu/blog/how-can-we-improve-food-system-resilience-for-good
14. EIT Think Tank (2023). *Accelerating Protein Diversification for Europe*. Available at: https://www.eitfood.eu/files/EIT-Food-PDTT-Policy-Brief-Accelerating-Protein-Diversification-for-Europe.pdf

15. Elechi, J.O.G., Nwiyi, I.U. & Adamu, C.S. (2022). *Global Food System Transformation for Resilience*, DOI: 10.5772/intechopen.102749 in Ana I. Ribeiro-Barros, Daniel S. Tevera, Luís F. Goulao and Lucas D. Tivana (Eds.), *Food Systems Resilience*, 10.5772/intechopen.95206
16. Ellen Mcarthur Foundation (2023). *Building a healthy and resilient food system*. Available at: https://www.ellenmacarthurfoundation.org/articles/building-a-healthy-and-resilient-food-system
17. Elpick, L. (2020). *Championing innovation for a resilient food system*, Food Science and Technology, Volume 34, Issue2, Pages 36-39, https://doi.org/10.1002/fsat.3402_10.x
18. European Commission (2023) Agriculture and the Green Deal. Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/agriculture-and-green-deal_en
19. Fan, S., Teng, P., Chew, P., Smith, G., & Copeland, L. (2021). Food system resilience and COVID-19 – Lessons from the Asian experience, Global Food Security, Volume 28, https://doi.org/10.1016/j.gfs.2021.100501.
20. FAO Regional Office for Near East and North Africa (2023). *Building Resilience for Food Security and Nutrition*. Available at: https://www.fao.org/neareast/perspectives/building-resilience2/en/
21. FAO, IFAD, UNICEF, WFP, & WHO (2018). *The State of Food Security and Nutrition in the World 2018. Building Climate Resilience for Food Security and Nutrition*; FAO: Rome, Italy, 2018.
22. FAO (2020). *COVID-19 and the role of local food production in building more resilient local food systems*. Available at: https://www.fao.org/3/cb1020en/CB1020EN.pdf
23. Global Food Security (2018). *Exploring the resilience of the UK food system in a global context*. Policy Brief.
24. Grubinger, V. (2012). *Resilience and Sustainability in the Food System*. Available at: https://learn.uvm.edu/foodsystemsblog/2012/10/22/resilience-and-sustainability-in-the-food-system/
25. Guyomard, H., Darcy-Vrillon, B., Esnouf, C. et al. (2012). *Eating patterns and food systems: critical knowledge requirements for policy design and implementation*. Agric & Food Secur 1, 13. https://doi.org/10.1186/2048-7010-1-13
26. Hedberg, R. C. (2021). *An instrumental-reflexive approach to assessing and building food system resilience*. Geography Compass, 15(7), e12581. https://doi.org/10.1111/gec3.12581
27. Hoddinott, J. (2023). *Food Systems, Resilience, and Their Implications for Public Action*. In: Béné, C., Devereux, S. (Eds.) *Resilience and Food Security in a Food Systems Context*. Palgrave Studies in Agricultural Economics and Food Policy. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-031-23535-1_6
28. Kougioumoutzi, E. (2017) The challenge of building a resilient food system. Available at: https://www.openaccessgovernment.org/challenge-building-resilient-food-system/32609/
29. Kumar, K., Ravi, N., & Suresh Chandra, B. (2018). *Increasing food system resilience for nutrition sensitivity and sustainability: A decentralized analysis for India*. IFPRI Discussion Paper 1742. Washington, DC.: International Food Policy Research Institute (IFPRI). http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/132760
30. Little, V.J., Holmlund, M., Polsa, Pia, Naidu, M. (2023). *Towards more resilient food production systems: Implanting sustainability-oriented innovation*, Journal of Cleaner Production, Volume 385, https://doi.org/10.1016/j.jclepro.2022.135708.

31. Marcu, N., Lădaru, G.R., Gostin, I.N. (Eds.) (2022). *Entrepreneurial innovation in agri-food science*, "Alexandru Ioan Cuza" University Press, Institute of Agricultural Economics – Belgrade
32. Menconi, M.E., Stella, G., & Grohmann, D. (2022). *Revisiting global food production and consumption patterns by developing resilient food systems for local communities*, Land Use Policy, Volume 119, https://doi.org/10.1016/j.landusepol.2022.106210.
33. Michel-Villarreal, R. (2023). *Towards sustainable and resilient short food supply chains: a focus on sustainability practices and resilience capabilities using case study*, British Food Journal, Vol. 125 No. 5, pp. 1914-1935. https://1a10yal95-y-https-doi-org.z.e-nformation.ro/10.1108/BFJ-09-2021-1060
34. Mu, W., van Asselt, E.D., & van der Fels-Klerx, H.J. (2021) *Towards a resilient food supply chain in the context of food safety*, Food Control, Volume 125, https://doi.org/10.1016/j.foodcont.2021.107953.
35. National Academies of Sciences, Engineering, and Medicine (2021). *Building a More Sustainable, Resilient, Equitable, and Nourishing Food System: Proceedings of a Workshop.* Chapter: 4 Resilience of the Food System. Washington, DC: The National Academies Press. https://doi.org/10.17226/25832.
36. Neacsa, A., Panait, M., Muresan, J. D., & Voica, M. C. (2020). *Energy poverty in European Union: Assessment difficulties, effects on the quality of life, mitigation measures*. some evidences from Romania. *Sustainability*, 12(10), 4036.
37. Nordhagen, S. (2022). *The Importance of Increasing the Resilience of Food and Nutrition Security to Climate Change*, Food Tank
38. Parera, P., & Hugh, B. (2023). *Feeding Resilience: A Review of Policies at the Intersection of Climate Change, Food Security and National Security Policy*. Edited by Tom Ellison and Francesco Femia. The Center for Climate and Security, an institute of The Council on Strategic Risks. Washington, DC. https://councilonstrategicrisks.org/wp-content/uploads/2023/08/Feeding-Resilience-Report.pdf
39. Pingali, P., Alinovi, L., & Sutton, J. (2005). *Food security in complex emergencies: enhancing food system resilience*. Disasters 29 S5–S24
40. Pisacane, L., Tagliacozzo, S. Corrado, A., & Conti, M. (2021). *Mainstreaming food systems resilience into health resilience*, Technical Report, STG Resilience Papers. Available at: https://hdl.handle.net/1814/71698
41. Piters, B.S., Termeer, E., Bakker, D., Fonteijn, H, & Brouwer H. (2022). *Perspective Chapter: Food System Resilience – Towards a Joint Understanding and Implications for Policy*. DOI: 10.5772/intechopen.99899, in Ana I. Ribeiro-Barros, Daniel S. Tevera, Luís F. Goulao and Lucas D. Tivana (Eds.), *Food Systems Resilience*, 10.5772/intechopen.95206
42. Savary, S., Akter, S., Almekinders, C. *et al*. (2020). *Mapping disruption and resilience mechanisms in food systems*. Food Sec. 12, 695–717 (2020). https://doi.org/10.1007/s12571-020-01093-0
43. Schipanski, M.E., MacDonald, G.K., Rosenzweig, S., Chappell, J. *et al*, (2016). *Realizing Resilient Food Systems*, BioScience, Volume 66, Issue 7, 01 July 2016, Pages 600–610, https://doi.org/10.1093/biosci/biw052
44. Seekell, D., Carr, J., Dell'Angelo, J. *et al* (2017) *Resilience in the global food system*, Environmental Research Letters, Volume 12, Number 2, DOI 10.1088/1748-9326/aa5730
45. Sela, G. (2023). *Building Resilience in the Food Supply Chain*. Available at: https://cropaia.com/blog/resilience-in-the-food-supply-chain/
46. Sperling, F., Havlik, P., Denis, M., Valin, H., Palazzo, A., Gaupp, F., & Visconti, P. (2020). *Resilient Food Systems*, The International Institute for Applied Systems

Analysis and the International Science Council, https://council.science/wp-content/uploads/2020/06/IIASA-ISC-Reports-Resilient-Food-Systems.pdf

47. Sperling, F., Havlik, P., Denis, M., Valin, H., Palazzo, A., Gaupp, F., & Visconti, P. (2022). *Toward resilient food systems after COVID-19*, Current Research in Environmental Sustainability, Volume 4, 2022, https://doi.org/10.1016/j.crsust.2021.100110.
48. Spiker, M.L,. Knoblock-Hahn, A., Brown, K., Giddens, J., Hege, A.S., Sauer, K., Enos, D.M., & Steiber, A. (2020). *Cultivating Sustainable, Resilient, and Healthy Food and Water Systems: A* Nutrition-*Focused Framework for Action*. Journal of the Academy of Nutrition and Dietetics, Volume 120, Issue 6, https://doi.org/10.1016/j.jand.2020.02.018.
49. Stancu, A. (2016). *Correlations and Patterns of Food and Health Consumer Expenditure*, pp. 44-101 in Andrei Jean-Vasile (Editor) Food Science, Production, and Engineering in Contemporary Economies, Hershey, PA: IGI Global. https://doi.org/10.4018/978-1-5225-0341-5.ch003
50. Stancu, A. (2022). *Analysis of Food Loss and Waste for the European Countries in the Context of Sustainable Development*, pp.119-148 in Carolina Machado, J. Paulo Davim (Editors), Sustainability and Intelligent Management. Management and Industrial Engineering, Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-030-98036-8_6
51. Stone, J., & Rahimifard, S. (2018). *Resilience in agri-food supply chains: a critical analysis of the literature and synthesis of a novel framework*. Supply Chain Management: An International Journal 23/3 (2018) 207–238, Emerald Publishing Limited, DOI 10.1108/SCM-06-2017-0201
52. Suweis, S., Carr, J.A., Maritan, A., Rinaldo, A, & D'Odorico, P. (2015)., *Resilience and reactivity of global food security*, 112 (22) 6902-6907, https://doi.org/10.1073/pnas.1507366112
53. Tendall, D.M., Joerin, J., Kopainsky, B. et al. (2015), Food system resilience: Defining the concept, Global Food Security, Volume 6, Pages 17-23, https://doi.org/10.1016/j.gfs.2015.08.001.
54. United Nations Industrial Development Organization (UNIDO) (2020). *Short Food Supply Chains for Promoting Local Food on Local Markets*. Available at: https://hub.unido.org/sites/default/files/publications/SHORT%20FOOD%20SUPPLY%20CHAINS.pdf
55. Zurek, M., Ingram, J., Sanderson Bellamy, A., Goold, C. *et al*. (2022). *Food system resilience: concepts, issues, and challenges*. Annual Review of Environment and Resources 47, 511-34. https://doi.org/10.1146/annurev-environ-112320-050744
56. Webb, P., Flynn, D.J., Kelly, N.M., Thomas, S.M., & Benton, T.G. (2021). COVID-19 and Food Systems: Rebuilding for Resilience, Global Panel on Agriculture and Food Systems for Nutrition, Europeam Commision. Available at: https://knowledge4policy.ec.europa.eu/publication/covid-19-food-systems-rebuilding-resilience_en