Towards a strategic vulnerability and resilience analysis framework for sustainable small farmer involvement in short food supply chains (SFSCs).

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Abstract: The economic and social disruption caused by the COVID-19 pandemic again focused the attention on the importance of strategies and practices to secure the sustainability of small farms involved in short food supply chains (SFSCs) following such disruptive activities. The aim of the paper is to examine the role and importance of the vulnerability and resilience predisposition of SFSCs and show the importance of their adaěptive capacities in the face of such catastrophes and disruptions. Some theoretical analysis is offered in analyzing the adaptive capacity of such undertakings. The article interrogates the potential collective protective mechanisms offered by SFSCs to participants in mitigating these risks with the objective to offer perspective on strategies and policies aimed at the management of the sustainability of small farms in SFSCs. Selected methodological approaches suitable not only for identifying the levels of sustainability, resilience, and vulnerability of small farms, but also the importance of their individual determinants, are discussed. This paper identifies this matrix of contributing factors and offers insight into the development of a strategic vulnerability and resilience analysis framework to research and promote sustainable small farmer involvement in SFSCs. Discussions confirm the importance of careful policy considerations and mechanisms when developing vulnerability and resilience analysis frameworks to enhance the adaptive capacities of small farms in navigating toward resilient small farms in inclusive SFSCs.

Keywords: small farms, short food supply chains, sustainability, resilience, vulnerability
JEL Classification: QOI, Q12, Q13

1 Introduction

When the World Health Organisation (WHO) declared the Novel Coronavirus (Covid 19) a global pandemic on March 11, 2020, the scale of disruption caused by this pandemic, was compared by historians to that of the aftermath of the second world war (Kiwanuka, 2021). Not only did the challenges caused by this event leave institutions increasingly vulnerable, but the capability of Government institutions globally to adapt innovatively to new mechanisms with the potential to foster societal resilience were severely tested. Blažková, et.al. (2023) confirms this concern in their findings on the impact of the COVID-19 pandemic on family farms, emphasizing that family farms as businesses are generally characterised as vulnerable because of their autonomous, family-oriented standing and their constrained financial capital and resources. The uncertainty that naturally characterises agricultural systems, was just aggravated, increasing concerns about the ability of agricultural and food systems worldwide to oversome these disruptions and shocks. This created important concerns for governments and policymakers (Blažková, et.al., 2023).

To worsen matters for farming systems, a broad range of environmental, economic, social and institutional challenges were created (Meuwissen, et.al., 2019), not excluding the economic and social challenges resulting from very complex market conditions like volatile prices in liberalized markets and sudden changes in access to markets. Blažková, et.al. (2023) eludes to this problematic dynamic in their discussion on the complexities of family agriculture in the Visegrad countries. The increased emergence of short food supply chains (SFSCs) during this time of restrictions, given their limited exposure to the effect of international restrictions, and being closer to the consumer, strengthened research activities to provide technical solutions aimed to improve short food supply chains and local production (Nemes, et.al., 2021).

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The propagation of shocks through food supply chains and their subsequent effect on consumption and the resulting impact on the sustainable small farmer involvement in SFSCs are not regular topics of research. As global food systems become more integrated, understanding the dynamics of propagation across supply chains through empirical research is critical to inform adequate interventions (Marsden, Zander, Lassa, 2023). This paper aims to offer an analytical perspective on the possibilities and most suitable processes to follow in developing a strategic vulnerability and resilience framework for analysing sustainable small farmer involvement in SFSCs in Poland and the Czech Republic.

2 Methods

An important influence on the eventual selection of the theoretical rationale for this study followed, is reflected in the IPCC (2001) definition of vulnerability: *Vulnerability is a function of the character, magnitude, and rate of environmental variation to which a system is exposed, its sensitivity, and its adaptive capacity.* This definition refers to and highlights the unique, contextual and sensitivity aspects associated with the framework of analysis that will be created. In this light, a significant and innovative (but challenging) aspect of the process is the systematic measurement and evaluation of the vulnerability, sustainability and resilience strategies and adaptive capabilities of small farms in SFSCs. This broad perspective of vulnerability offered by Joseph (2013) in Figure 1 and resilience clearly suggests a complex combination of risks together with the intrinsic ability to handle the negative consequences of disruptive events (adaptive capacity) (see Figure 2). The structure and potential relationships suggested by Jami. Dixon, Stringer, & Challinor, (2014), Béné, *et. al*. (2012) and Engle (2011) were carefully integrated to create this integrated perspective. Štreimikienė, Baležentis, *et. al. (*2021) goes further to show how vulnerability analysis is measured at four different levels:

- Physical vulnerability relates to physical assets and covers the possible losses and waste of food as well as other agriculture infrastructures necessary to livelihood of rural communities.
- Social vulnerability relates to the most vulnerable groups of society in rural areas.
- Economic vulnerability relates to the losses in economic assets and processes of agricultural systems.
- Environmental vulnerability analysis should examine the risk of destruction of soil, losses of fauna and flora.

The integrated rationale reflected in Figure 2 was used as the guide to the conceptualization of this process.

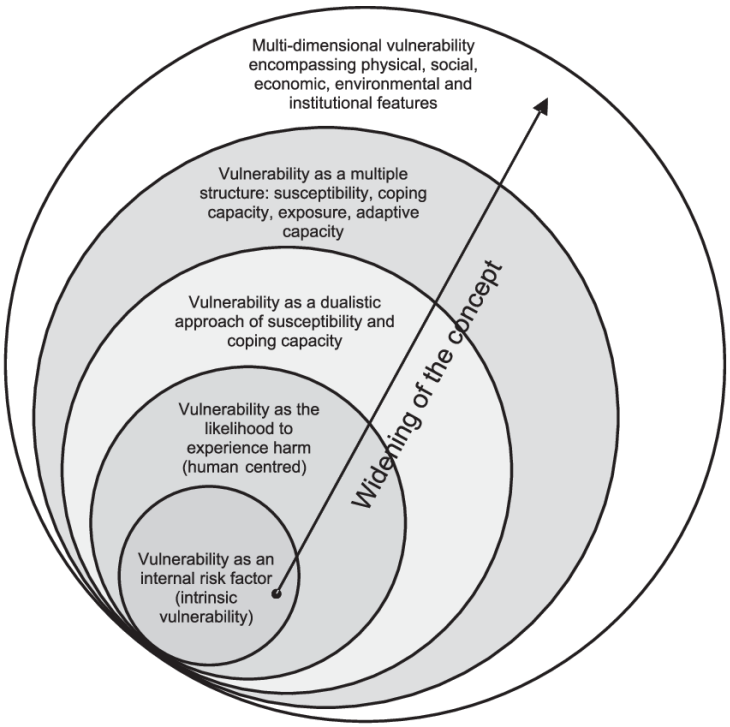
3 Research results

Farming systems are typical examples of agro-ecosystems, and consist of complex, social and ecological systems (SES). Vulnerability is thus an inherently dynamic feature of food systems, with farming systems becoming increasingly risky because of market liberalization and globalization, severely reducing predictability. It is a default position that may and will change over time as the interactions between the potential disruptions (risks, stressors) and the affected socio-economic system change. This is emphasized by Dixon, Stringer and Challinor (2014) in their assertion that "*every natural system is subject to regular disturbance; those that have survived, indeed must have built up some degree of resilience*" – referring to the ability to successfully negotiate and overcome such disruptive events in future.

3.1 Why is vulnerability a factor?

Vulnerability describes the fundamental preposition and susceptibility of any system prior to shocks or disruptive events. This perspective of the vulnerability of food systems is supported by the definition of vulnerability as the degree to which a food system, or its constituent, responds harmfully in the face of a shock or disruptive event is supported by Štreimikienė, Baležentis, *et. al.* (2021, citing Handmer & Dovers, 2009) and Dixon, Stringer and Challinor (2014). Food systems, like farming systems, are complex systems, and are not only economically productive systems; they also have important political, social and cultural dimensions, acting risk sensitive (Dury, Bendjebbar, Hainzelin, Giordano, & Bricas, 2019). These multi-dimensional features of vulnerability as predisposition in a food system are illustrated in Figure 1 (Joseph, 2013) and supported by the findings of Adger (2006).This means that current vulnerability to stressors does not define equal future vulnerability to such risks being realized.

Figure 1 Widening the concept and understanding of the nature of vulnerability (Joseph, 2013)



This understanding clearly reflects in the Inter-Governmental Panel on Climate Change (IPCC 2001) definition of vulnerability: *The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of environmental variation to which a system is exposed, its sensitivity, and its adaptive capacity.*

3.2 The fundamental importance of resilience

Many perspectives exist on what resilience is (Folke, et.al., 2013; Harris and Spiegel, 2019), but it is generally considered to be the ability to deal with disruptive shocks and stresses, including the unknown and previously unimaginable, such as the Covid-19 crisis (Meuwissen, et.al. 2019). Resilience describes the degree to which a response reaction to a specific hazardous event succeeds in completely overcoming the impact of such an event. It is not linked to vulnerability but is determined by the ability of an undertaking to overcome, survive, and even grow post-catastrophic events or shocks. This perspective is valuable to facilitate an understanding of how a system or unit responds to negative change, whether it 'does' return to this preexisting state, or whether it is 'transformed' to another state, be it advantageous or disadvantageous (Martin et al., 2016). Resilience is determined by the adaptive capacity of a food system (or SFSC) and is characterized by it possessing and applying the necessary strategies, policies, processes, and practices deemed essential to allow for such a food system to overcome the disruptions caused by shocks and catastrophes (Dixon, Stringer and Challinor, 2014). From a social-ecological perspective resilience has been defined as the capacity of socio-economic systems (e.g., households) to withstand shocks through actions of absorption, adaptation, and transformation (Ansah, Gardebroek, & Ihle, 2019) and is reflected in the success with which societies sustainably adapt to externally imposed change. The authors integrate the thinking discussed to define resilience of a farming system as *its ability to ensure the provision of the system functions in the face of increasingly complex and accumulating economic, social, environmental and institutional shocks and stresses, through capacities of robustness, adaptability and transformability.* This is in line with Adger (2006) who defines resilience as, "the magnitude of shock that can be absorbed before a system changes to a radically different state, as well as the capacity to self-organize and the capacity for adaptation to emerging circumstances".

3.3 Growing the understanding of adaptive capacity.

The adaptive capacity of social systems depends on the nature of their institutions and the ability to absorb disruptive events and shocks which potentially can actually play a constructive role in resource management, forcing a new consideration of issues of learning, adapting and renewal (Rodriguez, *et.al*., 2018*)*. It is therefore important to understand that the ability to recover from shocks and disruptions depends largely on the capacity of food systems to implement adaptive strategies to overcome such catastrophes or disruptions. Where this capacity fails, a mismatch between demand and supply arises, while there is an escalation in consumer demand for SFSC products. Figure 1 offers some perspective

of the various levels of adaptive capacity demands from food systems to overcome and to remain sustainable and overcome the possible implications for SFSCs. Participation by small farmers in short value chains contributes largely to managing their vulnerability and improve their resilience capacity and policy considerations and frameworks are important to support and sustain the participation of small farms in navigating toward resilient and inclusive short value chains.

Figure 2 Linking vulnerability and resilience frameworks through the concept of adaptive capacity. (Own structuring after: Jami L. Dixon, J.L., Stringer, L.C., & Challinor, A.J. 2014; After: Béné, et. al., 2012; Engle, 2011)

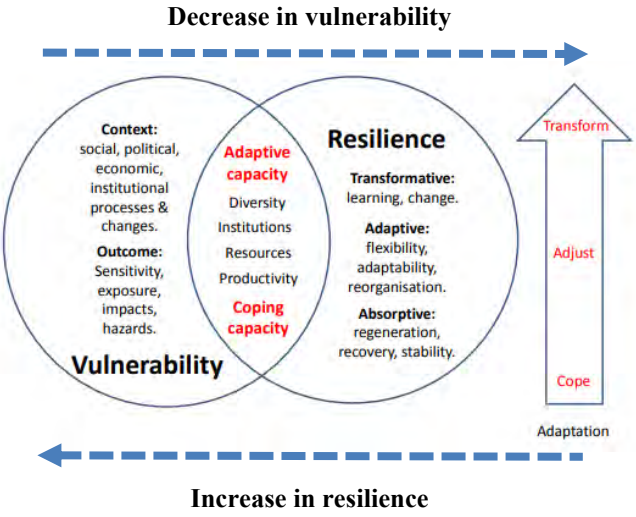


Figure 2 offers an integrated perspective linking vulnerability and resilience frameworks through the concept of adaptive capacity presenting resilience as an inherent capacity of systems. It suggests three key attributes which characterize the set of necessary actions that systems exposed to shocks need to undertake (adaptive capacity):

- *Absorptive capacity* defines the ability of the system to minimize its exposure to shocks, but also having the mechanisms to recover quickly when disruptive events occur, ensuring the persistence of system functions, and mostly constitute coping strategies such as harvesting crops early to avoid floods, taking children out of school or even delaying debt repayments (OECD 2014).
- *Adaptive capacity* measures "the ability to make informed choices about alternative livelihood strategies based on changing conditions" (Béné *et al.* 2012; Heltberg & Lund, 2009).
- An important expansion in resilience thinking is the consideration of *transformative capacity*, which refers to the system level conditions that are necessary for changing the basic configuration of the system to create long-term resilience. Researchers argue that adaptive and transformative capacities are necessary for dealing with the primary sources of vulnerability (Carpenter et al. 2005; Folke et al. 2010; Béné et al. 2012).

Dixon, Stringer and Challinor (2014) comment that, in the language of vulnerability, adaptive capacity can correct sensitivity towards a disruptive situation. In resilience terms it can enhance the robustness of a system. System robustness is defined as a system's ability to remain functioning under disturbances. This implies that information is needed on how the system responds to different degrees of disturbance (Mens, Klijn, De Bruijn & Van Beek, 2011). Practical evidence suggests that adaptive capacity relatively easily translates into practical actions and policy recommendations (see Figure 2).

3.4 The important role of Short Food Supply Chains (SFSCs)

In their discussion on the growing importance of SFSCs during the COVID-19 pandemic, Uliano, Stanco & Nazzaro (2023) stresses how restrictions imposed by health authorities and experts had significant impact on the isolation and food purchasing and consumption behaviour of consumers. This provided evidence of the fragility of food systems and the ease and speed with which they can be disrupted. SFSCs are considered business forms including a limited number of intermediaries, sometimes none in the case of direct sales to the consumer.

Smallholder farmers have become especially vulnerable and are now explicitly recognized by the EU as an area that should be supported within the EU rural development policy. SFSCs are covered by a definition in Article 2 of Regulation (EU) No 1305/2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD), which entered into force with the reformed Common Agricultural Policy for 2014-2020. In these policy documents an SFSC is defined as *"a supply chain involving a limited number of economic operators, committed to cooperation, local economic development, and close geographical and social relations between producers, processors*

and consumers". In a separate comprehensive study on SFSCs in the EU, Kneafsey, *et.al*. (2013) adopts a similar definition of SFSCs but emphasizes the *"identification and traceability of food to the source at a farmer."*

SFSCs therefore provide such contextual survival mechanisms for small farmers from where adaptive strategies can be applied, and small farms can be supported and successfully recover from disruptive and catastrophic events. Joseph (2013) offers some insight in Figure 1 into the differential abilities of farmers in SFSCs to react differently to shocks and disruptive events – offering farmers differential capacities to respond differently and express different adaptive capacities. In a study conducted in Slovakia on the development of SFSCs, Floriš, Schwarcz, Schwarczová, & Munk (2022) quotes important observations by Van der Ploeg (2000) around the developments of SFSCs as a *"commonly recurring phenomenon in several fields of rural development centred around distinctive product qualities including organic farming, high quality production and region-specific products"*. They continue to summarize several important characteristics of such SFSCs:

- SFSCs are based on their capacity to re-socialize or re-spatialize food, allowing the consumer to make value-judgements about the relative desirability of foods.
- The short supply chain has a positive effect on public goods, with overt environmental benefits, when compared to the long supply chain.
- There is a significant emphasis put on minimizing the distance between the food and the consumer's table, saving both time and cost.
- The factor of minimizing the distance allows the consumer to buy higher quality, healthy, and seasonal products, promoting the territory with the marketing of local food products.
- The number of intermediaries benefits the profitability for the producer and the trader, improving the economic benefits from the perspective of the farmer/producer/processor and improving their long-term economic survival.

Data that will be collected with face-to-face surveys among farmers who experienced the crisis caused by COVID-19 pandemic, will be analysed to describe, and explain how shocks impact on the successful functioning of small farms in short value chains. This is particularly important to reflect on their absorptive, adaptive, and restorative capacities. In the current will be conducted. The following set of relevant variables will also be included (amongst others), for individual components:

- Economic – income gap indicator (difference between average income in the national economy and total income of the agricultural holding), the level of agricultural investment and governance, estimated market value of the holding, debt ratio of the respondent.
- Social – household equipment, workload ratio, quality of health, participation in social and cultural life, participation in a lifelong learning system, membership of organizations, clubs, associations, etc.
- Environmental – crop biodiversity, livestock units, share of permanent grassland and forest in the farm area, fertilizer and pesticide use, soil quality.

Information will be analysed to determine the latent ability and preparation of small farms in short value chains to successfully deal with and recover from future shocks after changes in their absorptive capacities, following experiences of previous shocks and the resulting changes in the resilience capacities and attributes of such farms. This pattern of analysis is in line with the research methodologies advanced by Dixon, Stringer and Challinor (2014) and Ansah, Gardebroek & Ihle (2019).

4 Conclusions

Any attempt to design a strategic vulnerability and resilience analysis framework for small farmer involvement in short food supply chains (SFSCs) needs to acknowledge the dynamic and expansive multi-dimensional nature of vulnerability and resilience in food systems, showing the following dimensions:1) Intrinsic vulnerability or risk; 2) Human centered possibility for harm; 3) Susceptibility and capacity to cope; 4) The interrelated structural nature of vulnerability; and 5) the complexity of vulnerability. This paper is an important reflection on the theoretical and conceptual approach followed in the development of data collection instruments to ensure the vulnerability, sustainability and resilience strategies and adaptive capacities of small farms in short food supply chains are sufficiently represented in the analysis.

The objective is to integrate and, where necessary, augment the approaches identified in the literature in order to perform vulnerability analysis at four different levels (following the methodology suggested and implemented by Štreimikienė, Baležentis, et al, 2021), namely: 1) Physical vulnerability relating to physical assets coverings the possible losses and waste of food as well as other agriculture infrastructures necessary for the livelihood of rural communities; 2) Social vulnerability relating to the most vulnerable groups of society in rural areas; 3) Economic vulnerability relating to

the losses in economic assets and processes of agricultural systems; 4) Environmental vulnerability relating to the risk of soil destruction and the loss of fauna and flora.

Based on the foregoing explanations, the ability of SFSCs to recover and continue functioning following reversible and irreversible disruptive events (adaptive cycle), three system capacities will be analyzed to understand the resilience of farming systems, namely, robustness, adaptability, and transformability. To complete the analysis it will be necessary to: 1) Assess the absorptive capacity of small farms in SFSCs to deal with disruptive shocks; 2) Assess the impact of disruptive shocks on the productive functioning of small farms in SFSCs; 3) Assess the ability of small farms in SFSCs to implement their adaptive restorative strategies against future shocks to ensure the recovery of small farms in SFSCs, and; 4) Actions by small farmers to improve / strengthen the absorptive capacity of their farms in SFSCs remain less vulnerable – e.g., through creating new outlets, changing business models, expanding on markets, diversifying of products, using smart technology or smart agricultural production principles, repositioning, or innovative restructuring of the farm to improve its environmental, economic / technological and social position, increased vertical and horizontal integration.

In line with this strategy proposed, the following aspects will be addressed in the analyses (aligned with Meuwissen, et.al. 2019): 1) Characterizing the farming system; 2) Identifying key challenges; 3) Identifying the desired functions of the farming system; 4) Assessing the resilience capacities of the farm; 5) Assessing the resilience-enhancing attributes of the farm. To accomplish this, the following research methodology and analysis process will be followed:

- Develop an initial conceptual framework for the research process based on desktop literature reviews.
- Complete a household analysis, farming system analysis (characteristics, challenges, functions and performance indicators), short value chain structuring and economic performance, risk analysis of farming and short value chain relationships and structures.
- Assess the resilience capacities (robustness, adaptability, and transformability) and resilience attributes (enhancing and constraining attributes) of the farm and map the resilience profiles of small farms in SFSCs.
- Use the Delphi technique to subject the data collection instruments to expert consultations in both Poland and the Czech Republic to identify the critical factors and their weightings for inclusion in the analysis.
- The next important step will be to follow an approach suggested by Volkov, Žičkienė, et.al. (2021) to quantify the resilience profile through the development of a resilience index for small farms in short value chains (following analyses of the dynamic changes in resilience capacities and attributes). This will be an innovative approach implemented to the mapping process to give a better indication of the resilience profiles of farms and regions. It will also provide a powerful basis from where comparative studies of the vulnerability and resilience profiles of small farms in short value chains in the two countries can be undertaken.

Explanatory / clarifying comments and information will be provided to describe and explain how shocks impact on the successful functioning of SFSCs, specifically reflecting on their absorptive, adaptive, and restorative capacities. The latent ability and preparation of SFSCs to successfully overcome current and future disruptive events, following changes in their absorptive capacities and resilience capacities and attributes. The dynamic interaction between vulnerability and resilience, with the definitive internediate impact of adaptive capacity holds very important significance for researchers with the perspective of serving the agricultural industry. The „triple helix“ structure of the interaction identify three important areas of functional importance in the ongoing consistent development and growth of SFSCs that demand knowledge and understanding of:

- The strategic predisposition of SFSCs and small farmers to the possibility of disruptive events.
- The ability of SFSCs and small farmers to negotiate, cope with and design strategies and practices to counter the disruptive impact of such events
- The successful implementation of such strategies and practices to comprehensively adapt to externally imposed change.

To efficiently and effectively address this need for remaining abreast in understanding these important areas of functional importance, it is recommended that ongoing research address the following important questions:

- What support is necessary to optimize the predisposition of farmers and SFSCs to the possibility of disruptive events and shocks?
- What support is necessary farmers and SFSCs to optimize their adaptive capacity to successfully react to and exceedingly overcome disruptive shocks and events?

Participation by small farmers in short value chains contributes largely to managing their vulnerability and improve their adaptive capacity for resilience. Indications are that careful policy considerations and frameworks are essential to support

and sustain the participation of small farms in navigating toward resilient and inclusive short value chains. This study pledges to make a contribution to this process.

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References

Adger, W.N. (2006). Vulnerability. *Global Environmental Change* 16, 268–281.

Anderies, J. M., C. Folke, B. Walker, and E. Ostrom. (2013). Aligning key concepts for global change policy: robustness, resilience, and sustainability. *Ecology and Society* 18(2): 8. DOI 10.5751/ES-05178-180208.

Ansah, I.G.K., Gardebroek, C. & Ihle, R.(2019). Resilience and household food security: a review of concepts, methodological approaches and empirical evidence. *Food Security (2019) 11:1187–1203.* DOI 10.1007/s12571-019-00968-1.

Bayir, B.; Charles, A.; Sekhari, A.; Ouzrout, Y. (2022). Issues and Challenges in Short Food Supply Chains: A Systematic Literature Review. *Sustainability*,14, 3029. DOI 10.3390/su14053029.

Béné, C., Wood, R. G., Newsham, A., & Davies, M. (2012). Resilience: New utopia or new tyranny? Reflection on the potentials and limits of the concept of resilience in relation to vulnerability reduction Programmes. IDS Working Papers, 1–61.

Blažková I., Svatošová V., Chmelíková G., Tamáš V., Svobodová E., Grega L., Miškolci S., Piecuch J., Ujj A., Hupková D., Puchała J., Bazsik I., Jancsovszka P., Nagyné Pércsi K., Dobošová L. (2023): The effects of COVID-19 crisis on small family farms: Empirical evidence from Visegrad countries. Agric. Econ. – Czech, 69: 366–374.

Carpenter, S. R., Westley, F., & Turner, M. G. (2005). Surrogates for resilience of social–ecological systems. *Ecosystems*, 8, 941–944.

Deconinck K., Avery E., Jackson L. A. (2021): Food supply chains and Covid-19: Impacts and policy lessons. *Euro-Choices*, 19: 34–39.

Dixon, J.L., Stringer, L.C., and Challinor, A.J. (2014). Farming System Evolution and Adaptive Capacity. *Resources*, *3*(1), 182-214**;** DOI 10.3390/resources3010182.

Dury, S., Bendjebbar, P., Hainzelin, E., Giordano, T. and Bricas, N., eds. (2019). Food Systems at risk: new trends and challenges. Rome, Montpellier, Brussels, FAO, CIRAD and European Commission. DOI 10.19182/agritrop/00080.

Engle, N.L. (2011) Adaptive capacity and its assessment. *Glob. Environ. Chang. 21*, 647–656. DOI 1.1016/j.gloenvcha.2011.01.019.

Faulkner, J-P., Murphy, E. & Scott, M. (2020) Developing a holistic 'vulnerability-resilience' model for local and regional development, *European Planning Studies*, 28:12, 2330-2347, DOI 1080/09654313.2020.1720612 .

Folke, C., S. R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockström. (2010). Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society* 15(4): 20. [online] URL:http:// www.ecologyandsociety.org/vol15/iss4/art20/

Floriš, N.; Schwarcz, P.; Schwarczová, L.; Munk, M. (2022). Short Food Supply Chains and Small Farms—Evidence from Slovakia. *Sustainability*, 14, 2728. DOI 10.3390/su14052728.

Kiwanuka, M. A. N. (2021). Institutional vulnerabilities, COVID-19, resilience mechanisms and societal relationships in developing countries. *International Journal of Discrimination and the Law*, *21*(3), 288-307. DOI 10.1177/13582291211031381.

Heltberg, R., & Lund, N. (2009). Shocks, coping, and outcomes for Pakistan's poor: Health risks predominate. *The Journal of Development Studies*, 45, 889–910.

Harvey CA, Rakotobe ZL, Rao NS, Dave R, Razafimahatratra H, Rabarijohn RH, Rajaofara H, MacKinnon JL. (2014) Extreme vulnerability of smallholder farmers to agricultural risks and climate change in Madagascar. *Phil. Trans. R. Soc. B* 369: 20130089. DOI 10.1098/rstb.2013.0089.

Harris, J. & Spiegel, E.J. (2019). Food Systems Resilience: Concepts & Policy Approaches. Center for Agriculture and Food Systems. June 2019. https://www.vermontlaw.edu/academics/centers-and-programs/center-for-agriculture-and-food-systems/projects.

IPCC, 2001: Climate Change (2001): The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881.

Joseph, J. (2013). Measuring vulnerability to natural hazards: a macro framework. *Disasters*, 37(2): 185−200.

Kneafsey M, Venn L, Schmutz U, Balasz B, Trenchard L, Eyden-Wood T, Bos E, Sutton G, Blackett M, authors Santini F, Gomez Y Paloma S, editors. Short Food Supply Chains and Local Food Systems in the EU. A State of Play of their

Socio-Economic Characteristics. EUR 25911. Luxembourg (Luxembourg): Publications Office of the European Union; 2013. JRC80420.

Marsden AR, Zander KK, Lassa JA. (2023) Smallholder Farming during COVID-19: A Systematic Review Concerning Impacts, Adaptations, Barriers, Policy, and Planning for Future Pandemics. *Land*, 12(2):404. DOI 10.3390/land12020404.

Martin, R., Sunley, P., Gardiner, B., & Tyler, P. (2016). How regions react to recessions: Resilience and the role of economic structure. *Regional Studies*, 50(4), 561–585. DOI 10.1080/00343404.2015.1136410.

. The meaning of system robustness for flood risk management. *Environmental Science & Policy*, 14(8): 1121-1131. DOI 10.1016/j.envsci.2011.08.003.

Meuwissen, M.P.M., Feindt, P.H., Spiegela, A., Termeer, C.J.A.M., Mathijs, E., De Meya, Y., Finger, R., Balmann, A., Wauters, E., Urquhart, J., Vigani, M., Zawalińska, K., Herrera, H., Phillipa Nicholas-Davies, P., Hansson, H., Paasa, W., Slijpera, T., Coopmanse, I., Vroegef, W., Ciechomskaj, A., Accatinoo, F., Kopainskyk, B., Poortvlietb, P.M., Candeld, J.J.L., Mayei, D., Severinip, S., Sennip, S., Sorianoq, B., Lagerkvistm, C., Penevar, M., Gavrilescus, C., Reidsman, P. (2019). A framework to assess the resilience of farming systems. *Agricultural Systems* 176 (2019) 102656. DOI 10.1016/j.agsy.2019.102656.

Meuwissen., M., Paas, W., Slijper, T., Coopmans, I., Ciechomska, A., Lievens, E., Deckers, J., Vroege, W., Mathijs, E., Kopainsky, B., Herrera, H., Nitzko, S., Finger, R. yann de Mey, Poortvliet, M.P., Nicholas-Davies, P., Midmore, P., Vigani, M., Maye, D., Urquhart, J., Balmann, A., Appel, F., Termeer, K., Feindt, P., Candel, J., Tichit, M., Accatino, F., Severini, S., Senni, S., Wauters, E., Bardaji, I., Soriano, B., Zawalińska, K., Lagerkvist, C., Manevska-Tasevska, G., Hansson, H., Peneva, M., Gavrilescu, C., Reidsma, P., (2018). Report on resilience framework for EU agriculture. Project funded from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 727520. Sustainable Resilient EU Farming Systems.

Nemes, G., Chiffoleau, Y., Zollet, S., Collison, M., Benedek, Z., Colantuono, F., Dulsrud, A., Fiore, M., Holtkamp, C., Kim, T-Y., Korzun, M., Mesa-Manzano, R., Reckinger, R., Ruiz-Martínez, I., Smith, K., Tamura, N., Viteri, M.L., Orbán, E.(2021). The impact of COVID-19 on alternative and local food systems and the potential for the sustainability transition: Insights from 13 countries. DOI 10.1016/j.spc.2021.06.022 .

OECD. (2014). Guidelines for resilience systems analysis. France: OECD Publishing.

REGULATION (EU) No 1305/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005.

Rodríguez LO, Cisneros E, Pequeño T, Fuentes MT, Zinngrebe Y. (2018) Building Adaptive Capacity in Changing Social-Ecological Systems: Integrating Knowledge in Communal Land-Use Planning in the Peruvian Amazon. *Sustainability*. 10(2):511. DOI 10.3390/su10020511.

Štreimikienė, D., Baležentis, T., Volkov, A., Ribašauskienė, E., Morkūnas, M. & Žičkienė, A. (2021). Negative effects of covid-19 pandemic on agriculture: systematic literature review in the frameworks of vulnerability, resilience and risks involved, *Economic Research Ekonomska Istraživanja*, 35(1), DOI 10.1080/1331677X.2021.1919542.

Uliano, A.; Stanco, M.; Nazzaro, C. (2023). Short Food Supply Chain and Resilience: An Analysis during COVID-19 Pandemic in Inner Areas of Campania Region. *Sustainability* 15, 12721. DOI 10.3390/su151712721.