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Resilience in the food sector – environmental, social and economic perspectives in crisis situations

RESEARCH ARTICLE

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Abstract

Environmental, social and economic perspectives, derived from the sustainability approach and present within by the resilience concept, are integral parts of food systems. At the same time they are clearly articulated within the EU farm-to-fork (F2F) strategy referring to building up resilience to possible future crises as diseases and pandemics. The aim of this paper is to investigate resilience in the food sector referring to its selected environmental, social and economic dimensions, which in fact rely on each other and cannot be separated, simply because of the character of food system itself (work with living organisms, soil, within natural environment, etc. done by people for business purposes). The issue of resilience in the food sector must be considered multidimensionally. In this approach, the basic direction of activities should be the one focused on the resilience approach, both in environmental protection and society. For a harmonious combination of these activities, it is also necessary to look at economic perspective of food system and entire rural livelihoods (e.g. income and employment diversification). Considering the last shocks discussed (COVID-19, war in Ukraine, drought, embargo on grain exports from Russia, rising inflation), a difficult situation on the food market can be expected in the nearest future, which makes the concept of resilience in the food sector even more relevant than it has been so far.

Keywords: resilience, food system, biodiversity, finance, labor, inflation
JEL code: G00, J21, O13, Q10

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1. Introduction

The issue of a sustainable approach to production processes in agriculture has been studied for many years. It has already been proven that an intensive economy leads to an imbalance in nature (Foster and Clark, 2018). Many animal species have become extinct, others are threatened with extinction (Ceballos *et al.*, 2010). The growing population and uneven geographical distribution of food demand contribute to the intensification of production processes with increased mortality due to hunger and poverty at the same time (Lappé *et al.*, 1998). In this context it seems reasonable to refer to the holistic perspective of resilience encompassing the complexity of food systems operating at many scales (Tendall *et al.*, 2015). Another argument for the need to re-evaluate the human approach to its activity and directing actions towards it in accordance with the laws of nature is the COVID-19 epidemic problem that caused the epidemic crisis. It proved that one should return to primal processes of nature and disrupting them has much wider effects than we can predict. Environmental changes, social norms and institutions, and, consequently, the linkage of biology, information and society cannot be detached, also from their further financial consequences in all areas of human activity (Peters and Jandrić, 2021).

Environmental, social and economic reasons, derived from the sustainability approach and present within by the resilience concept, are integral parts of food systems. At the same time, they are clearly articulated within the EU farm-to-fork (F2F) strategy referring to building up resilience to possible future crises as diseases and pandemics (European Commission, 2020). That is why, the aim of this paper is to investigate resilience in the food sector referring to its environmental, social and economic dimensions, which in fact rely on each other and cannot be separated, simply because of the character of food system itself (work with living organisms, soil, within natural environment, etc. done by people for business purposes).

This article consists of 5 sections. After the introduction, the second part includes a literature review, investigating the resilience concept taking into account environmental, social and economic perspectives. It is difficult to discuss them separately, but the narration from environmental, through social to economic issues is proposed. However, it should be noted that it is impossible not to refer to some economic issues while discussing environmental dimensions (e.g. monoculture and industrialized agri-food system), as well as to refer to some social aspects without discussing their economic role (e.g. income diversification). The research methodology is presented in the third section. The fourth section contains the research results with the same narration from environmental, through social to economic issues. The fifth section presents conclusions, limitations and recommendations.

2. Analytical framework and methods

2.1 Methodology of the literature review

The methodological two-fold approach intends to form a framework based on the integrative literature review and analysis of time series of selected indicators (secondary data). The literature review was applied to identify resilience in the food sector and its wide background. The term of the resilience is not a completely new one, beginning of 21st century has brought an increasing interest in this topic, resulting for example in rising number of scientific publications. Results for Web of Science Core Collection prove the increase during the last ten years, from 4,930 in 2012 to 21,279 in 2021. This increase was gradual, year by year, but the COVID-19 epidemic put the resilience concept in one of the most important research areas, especially regarding the food sector. With the pandemic background, the paper can be treated as addressing emerging issues, investigated in different scientific fields, which justifies the application of an integrative literature review (Torraco, 2005).

The review started from searching the Web of Science Core Collection with the key word ‘resilience’, then the key word ‘crisis’ was added, and adjectives such as: economic, social and environmental. Afterwards, it was developed with other sources as current publications led to different types of information relevant to

the topic as for example policy briefs. Complexity of the investigations led also to snowballing application, such as using the reference list and key concepts of a paper to identify additional sources appropriate for the study. The number of citations of the items was taken into account (although it does not always determine the weight of the article), hence the expert evaluation of the literature was also used. Detailed qualitative and quantitative notes were prepared without use of special software dedicated to bibliometric analysis. Main stages of the process included identification of the topic, justification literature review as the accepted methodology, searching the literature, its analysis and synthesis. The synthetized knowledge from the state of the art supported by analysis of time series of selected indicators allows to propose a new, more comprehensive, perspective on the topic of resilience in the food sector.

2.2 Statistical data sources

The literature review is supported by the presentation of time series describing issues pointed out within the literature review. Generally, we studied 27 EU countries as joined by the common approach of the EU F2F strategy (e.g. data on harmonized indices of consumer prices and employment in agriculture analyzed within this approach) but selected issues were also analyzed with wider geographical perspective. For example, data of WWF or International Union for Conservation of Nature (IUCN) were used in order to illustrate the problem of hunger and defaunization. It is worth to notice here that harmonized indices of consumer prices (HICPs) (Mazumder, 2018) that are designed for international comparisons of consumer price inflation were also analyzed. HICP is used for example by the European Central Bank for monitoring of inflation in the Economic and Monetary Union and for the assessment of inflation convergence as required under Article 121 of the Treaty of Amsterdam. HICPs statistics were obtained from the Eurostat database in 2010(2012)-2021.[1] HICPs information for the USA in 2021 was derived from the U.S. Bureau of Labor Statistics (2022). In the case of the EU, two data sets were taken into account: (1) describing European Union; (2) Euro area; and (3) Unites States of America. This approach allowed for taking into account a longer time series for uniformly recorded data.

2.3 Methodological framework

The data was presented with figures and described initiating a scientific discussion. Finally, we give insights for possibilities and limitations of a resilient approach implementation across the food sector. Due to the multithreaded nature of the study, the research methodology is presented in Figure 1.

3. Literature review

The term resilience may be found together with sustainability in the state of the art. Marchese (*et al*., 2018) even conclude on three following approaches dominating the literature: (1) resilience as a component of sustainability; (2) sustainability as a component of resilience; and (3) resilience and sustainability as separate objectives. As formulated within the aim, the literature study also refers to resilience according to three basic dimensions of sustainability (environmental, social and economic). Then a short literature review on symptoms of resilience in the food sector towards crises is presented.

3.1 Environmental, social and economic perspectives of resilience

Baum *et al.* (2015) provide a definition stating that, 'a resilient system is able to retain critical functionality in the face of disruptions, even while it may make adaptations of noncritical attributes. In the face of global food supply catastrophes, a resilient global human system will adapt its food procurement practices to keep people alive and keep civilization intact'. In the context of resilience, Baum and Handoh (2014) referred to the risk of catastrophes beyond humanity's capabilities, which resulted in humanity's transition to a different, worse state. The context of the deterioration of the conditions for humanity is interesting, as it refers to disasters

[1] https://ec.europa.eu/eurostat/web/main/data/database

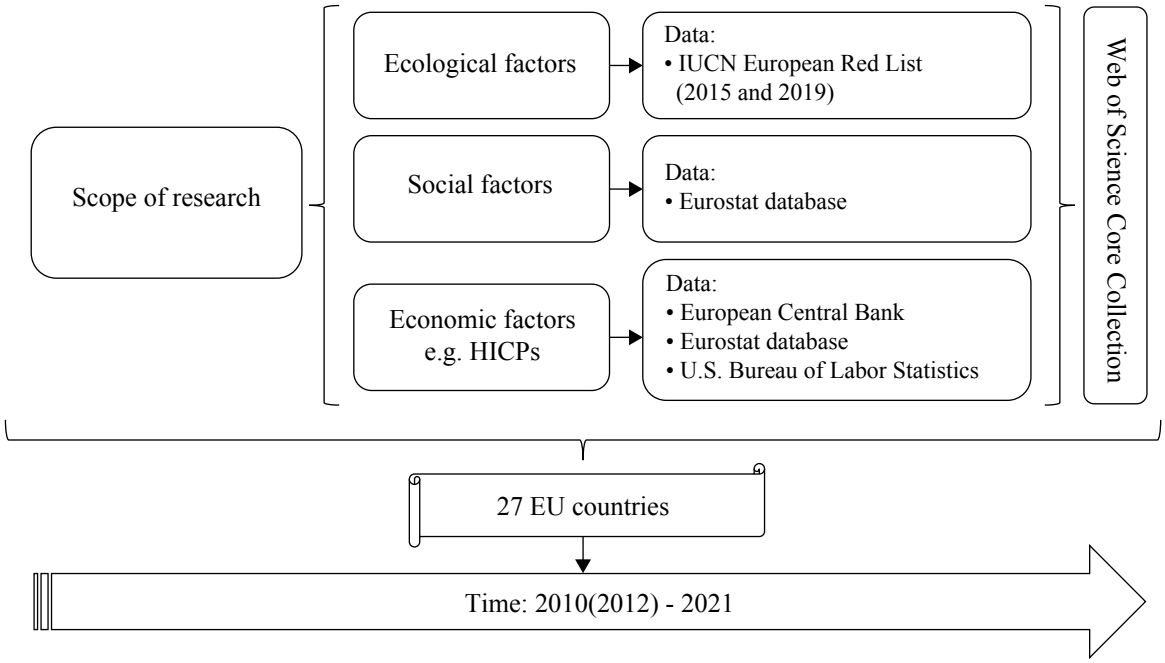

Figure 1. The research methodology.

comparable to ones resulting from volcanic eruptions, collisions with comets or asteroids, nuclear wars, as well as outbreaks of plant and animal diseases. There is no doubt that the effects of such events may not only jeopardize world food supplies, but may also lead to a shortage of food in large areas. Plants and animals mentioned above are undoubtedly connected to bioresources, so it is necessary to consider biodiversity and one of the key problems of the modern world like the widespread and ubiquitous defaunation process. Its effects are far-reaching and limitation of animal overexploitation and land use change are possible mitigation actions (Dirzo *et al.*, 2014). Hendrickson draws attention to the impoverishment of the environment and the monoculture occurring in many areas as a manifestation of the industrial approach to food production in the world. Additionally, conventional agriculture is an integral part of the economy. The paradigm that led to a highly concentrated and industrialized agri-food system has created environmental, social, and economic risks (Hendrickson, 2015).

Adding the social perspective makes it possible to refer to the term 'social-ecological resilience' as the capacity of a system to withstand shocks, still have the same identity and possibly to improve or even advance by learning, adapting, coping with shocks, as well as recovery afterwards (Maleksaeidi and Karami, 2013). It seems necessary to care for cultural continuity, generational diversity, support the family and community, and maintain the roles of older people in the family and society. In many cases, it is difficult to point to cultural continuity (e.g. the disappearance of certain professions, customs), generational diversity (elderly cannot count on childcare and are placed in specialized nursing homes, and the younger generation loses the opportunity to associate with their living ancestors) while families looking for a better existence are scattered around the world (Becker *et al.*, 2003).

The most numerous group in the food system are small agricultural entrepreneurs who can support the resilience of agri-food production, e.g. by providing socio-cultural services, playing a fundamental role in shaping landscapes and increasing the relationship between humans and nature (Manyise and Dentoni, 2021). A resilient food system must support the entire community (social resilience). There are examples of studies on social capital and resilience of food systems (Berno, 2017; McDaniel *et al.*, 2021; Nosratabadi *et al.*, 2020; Smith *et al.*, 2016). It is important to notice that social networks can contribute to resilience of agricultural systems in remote rural areas (Bruce *et al.*, 2021) typical for some forms of farming, e.g. beef

cattle or sheep production. Despite a decreasing role of agriculture in the economy, it is still an important component of the economic, social and cultural environment for specific geographical contexts.

Creating resilience can be understood as 'a process of social learning, using human capacities and knowledge to reduce vulnerability and risk in the face of the unknown and unexpected' (Hudson, 2009). Paganini *et al.* (2020) understand food system resilience as an opportunity to alleviate faults and build capacities. The first are coping capacities for cushioning shocks, then adaptive capacities build on the immediate environment within the family and community (social capital) and provide the flexibility to cope with shocks. Finally, transformative capacities are considered as a solution space that provides the opportunity to create longer-term change to sustainably improve the community and household food system. Hertel *et al.* (2021) indicate that diversification of income sources is critical assuming the prominent role of income in ensuring household well-being. Rural livelihood diversification and social capital are pointed out as enhancing rural resilience and contributing to sustaining sustainable rural communities (Li *et al.*, 2019).

At the same time, McDaniel *et al.* (2021) provide a wide approach to community resilience, including political, economic, social, natural, human capital as well as flexible and networked community resources and community pride & belonging. The social capital is approached as relationships among people that contribute to individuals' capacity to overcome challenges. However, other dimensions listed can be at least partially applicable to wider perspective of social resilience. This refers to human capital, expressed within skills, education, and working experience increasing workforce productivity and wages, as well as community pride & belonging understood as a sense of being a part of a cohesive community with a unique collective identity. Resilience is simply more likely when people identify with places they live (McManus *et al.*, 2012).

Zanotti *et al.* (2020) analyzed issues of comprehensive changes in farming within the concept of resilience. This conceptual approach seems to be comprehensive, but still open to the inclusion of further factors, such as, for example, a broader connection of social changes, as well as taking into account changes in the area of finance. In this context, the problem of a very heavily regulated financial market, which is periodically plagued by crises (revealing the weaknesses of these regulations) is one of the interesting areas, showing the need to return to the rules that prevailed centuries ago. Historically, it is possible to point to a tulip bubble, a bubble in the real estate market, manifested by financial crises. These crises have become more severe with the liquidation of the marketable equivalent of money in gold deposited with banks and the increased rate of information flow due to computerization (Epstein, 2005; Foster, 2008). Direct references to financial crises lead the attention to the concept of economic resilience (Griffith-Jones and Tanner, 2016).

3.2 Crisis situations and resilience

Literature provides examples of situations when crises make farmers diversify their professional activities, mobility (Otsuki *et al.*, 2014), diversification of economic activities towards product innovation and agribusiness expansion (Chin and Pehin Dato Musa, 2021). It is an expression of rational behavior aiming at risk mitigation, which has quite long history in economic research, as for instance Stark and Bloom (1985) point out that the decision to change the employment sector may be driven by a tendency to avoid risk – if one of the household's members changes the employment sector to one in which the salary is inversely correlated, statistically independent or slightly positively correlated with the salary in the previous sector (in which at least one of the other members of the household is still working). This relation explains both the change in the labor sector of one person and the fact that the other member of the household did not make such a change. There is simply a kind of insurance by diversifying the sources of livelihood. However, some research on crises other than current pandemic state prove that anti-resilient operations can also take place in a form of a return of the workforce to the family farm, as the external environment is perceived as unfriendly as the internal one – or even more so (Ragkos *et al.*, 2016).

It is interesting to notice that the mobility mentioned above as a way to react to crises through income diversification, can be also interpreted as a process which can hamper resilience. Camarero *et al.* (2016)

point out a process referring to the role that family strategies and inter-generational solidarity play in the resilience of rural society. Authors of this study describe a course which starts with movements of the mobile generation (30-50 years old) as the answer for a crisis. However, these generations play the crucial role in family strategies (care and assistance, productive and consumption activities), so their mobility can contribute to hampering rural resilience building. These topics have received little attention in the state of the art (Camarero *et al.*, 2016) but they exceed the food system framework and refer more to rural resilience in general. Long-term perspective on food system resilience at the farm level can be connected to intergenerational transfer in family farms, which succession is constrained by perceptions of farming as a relatively low income occupation with long working hours, remote locations, reduced social life and high financial challenges (Huber *et al.*, 2015; Meuwissen *et al.*, 2019).

One of the shocks that have had and are of global scope is the COVID pandemic. The second major shock to society is the ongoing armed conflict in Ukraine, and its social, economic and ecological consequences are currently impossible to estimate.

Some more on the effects of the COVID epidemic on resilience disorders have been described in the literature. The COVID-19 epidemic is one of the extraordinary phenomena affecting the functioning of people in virtually every sphere. The effects on food security are not the result of the virus itself, but a consequence of the loss of income and the purchasing power of money. These, in turn, result from the decisions of the governments of individual countries (Béné, 2020). Cottrell's *et al.* (2019) extensive research shows that of the 134 countries affected by the shocks, 2 experienced shocks across multiple sectors over the same five-year period. The shocks affecting many sectors simultaneously were geopolitical in nature, whereas armed conflicts led to extensive devastation of agricultural land, rapid declines in crops, livestock farming and fishing (Cottrell *et al.*, 2019). The consequences of such events are far-reaching. Not only for the ecosystem, but also for food security, in particular poverty, the reduction of education opportunities and hunger for entire societies.

Lack of resilience leads to crises. In the long run, the crisis may lead to a systemic weakening of agriculture, in particular poorer farmers, which may result in a reduction in their income. It may also lead to a total loss of income and elimination of such entrepreneurs from the market. As a result, the aging process of agriculture will progress (lack of its modernization and development) (Savary *et al.*, 2020). The COVID-19 crisis is affecting not only weaker farms but, in particular, the poorest people. This part of society may face difficulties in meeting basic needs, including nutritional needs. According to WFP data, as many as 768 million people were chronically hungry in 2020 (FAO, IFAD, UNICEF, WFP and WHO, 2021). An additional factor negatively affecting the income situation of the society, including farms, may be inflation, which in 2021 began to grow dangerously in many regions of the world.

The current study of Béné (2020) referring to the context of COVID-19, points out there is still very little formal analysis of the impact of COVID-19 on food systems and their actors and even less of the invasion on Ukraine. In the case of the latter, for example the Food and Agriculture Organization signalized on risks for global agricultural markets associated with the current conflict (FAO, 2022), referring for example to resilience of food systems especially in countries depending on food imports from Ukraine and the Russian Federation. A lot has been already commented about the problem of disturbances in the food value chain, which result also from difficulties or even the inability to obtain grain from Russia (the largest wheat exporter in beginning of the 21st century) (Svanidze and Gotz, 2019). Adding the inflation phenomena to these shocks (COVID-19, war in Ukraine, drought and embargo on grain exports from Russia), it should be emphasized that there are many factors disturbing resilience in the food economy at present.

4. Results

Production processes aimed at continuous increase in the productivity of plants and animals not only allow solving the problem of food waste in rich societies, and their shortage in poor regions of the world. They also lead to the disturbance of the natural processes of growth and development of living organisms (plants and

animals). In many cases, such activities lead to the suffering of animals which, e.g. due to their high efficiency, have unnaturally developed parts of the body (udders in dairy cows or muscles of pigs), or their growth is accelerated (broilers), but also to human suffering (emotionally connected with these animals) (Porcher, 2011). While attention is being paid to filling the information gap among farmers, which has a significant impact on sustainable agriculture and its development (Adamashvili *et al.*, 2019), it seems necessary to take a step further towards resilient agriculture and food production. Resilient food systems require linking to other concepts like circular economy but also specific practices for innovation (Brassesco *et al.*, 2022), just to mention farm digitalization (Fourati-Jamoussi *et al.*, 2018) addressed by the F2F strategy. Additionally, attention should be paid to depopulation of wild animals. Taking into account the WWF data, it should be emphasized that the population of wild animals has decreased by 68% over the last fifty years. It is the result of climate change, water pollution and acidification, natural threats, and harmful human activities (including deforestation, clearing meadows, draining swamps) (WWF, 2020). Balance in every sphere of life must be maintained (biodiversity), otherwise the scale of negative phenomena, including epidemics, will increase. To illustrate the scale of the problem, Figure 2 presents the most endangered species in Europe (expressed in % of risk). Bearing in mind that man is one of the species of mammals, it will not be possible to ensure the well-being without resilience (including the provision of food, hygiene, cultural, psychosocial and other needs).

Figure 2 proves that Europe has a large number of plant and animal species that are at high risk of extinction. The most threatened with extinction are freshwater molluscs (clams and snails), endemic European trees and freshwater fish. Many endangered species are the backbone of ecosystems and also enable people to feed and gain income from within these ecosystems. In this regard, three important areas come together: environment, society and economy, and therefore the areas of ensuring resilience. Following the results of the research by Hobbs (2020), it is worth emphasizing that it is important to distinguish between innate and adaptive immunity, which applies to each of the areas studied.

Food sector and generally the primary industry is important from the perspective of social resilience. The primary industry has long been perceived as being the backbone to successful economies of rural areas. However, a trend of leaving rural areas in favor of moving to urban ones, and a decrease in the number of small farms over a period of more than a century have been observed (Fourcroy and Drejerska, 2019). The share of agriculture in total employment is nowadays at the level of 4% (Figure 3). A decreasing trend in this

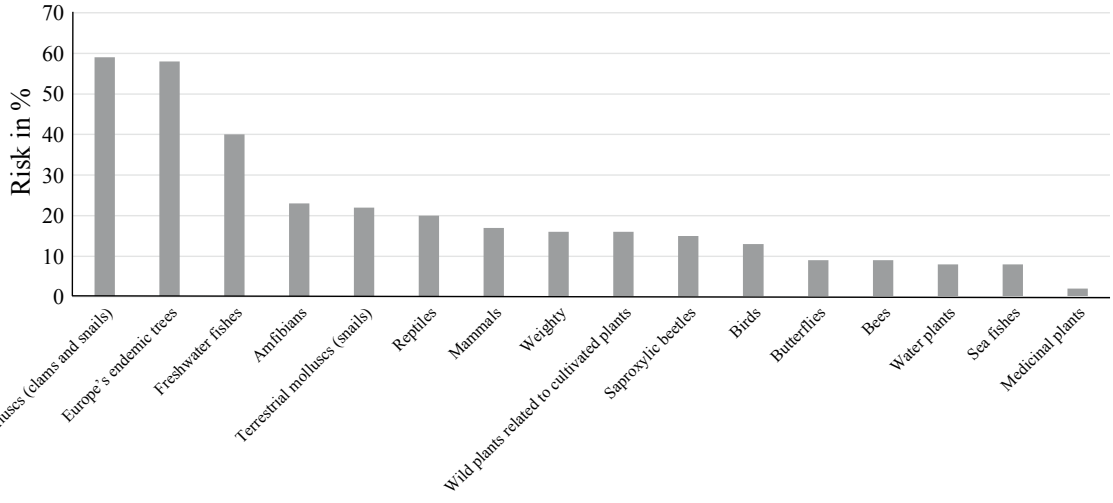

Figure 2. The most endangered species in Europe (expressed in % of risk) (based on IUCN European Red List (EC, nd)).

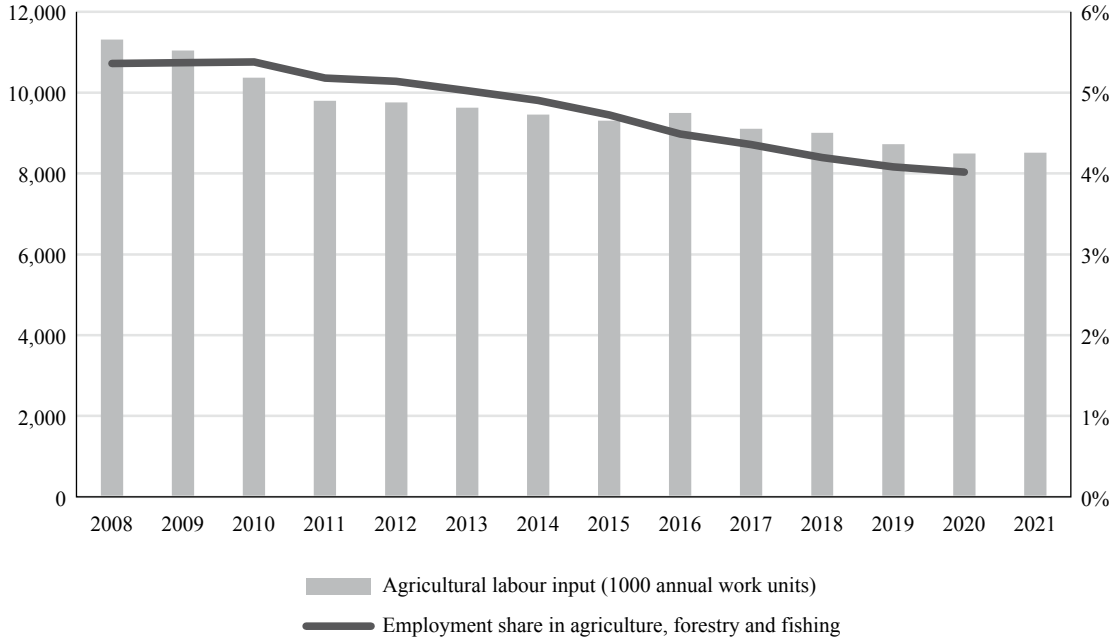

Figure 3. Employment share in agriculture, forestry and fishing (as % of employment in all NACE activities) and agricultural labor input (1000 annual work units) in EU-27 countries (Eurostat, 2022a,b).

sector's employment across EU is expected to slow down at -1% per year, reaching the level of 7.9 million workers in 2030 (European Commission, Directorate General for Agriculture and Rural Development, 2020). Increasing profile diversification of agricultural workers and farm managers is expected (European Commission, Directorate General for Agriculture and Rural Development, 2020) Different strategies can be found in the state of art – from diversification of marketing channels and product categories (Benedek *et al.*, 2021) even to selling livestock, seeking new off-farm income and sometimes selling land (non-European example) (Blazy *et al.*, 2021).

The resilience of the workforce has been tested through the duration of the COVID 19 global pandemic crisis. In case of European food system, it should be noticed that COVID mobility restrictions made seasonal temporary workers unavailable for some agricultural activities. It influences the sector's productivity, as for some regions or branches migrants' inflow is important labor supply channel. Taking into account the fact, that movers into agriculture are mostly migrant men older than 19 living in a rural area and with low qualification as well as recent labor market trends, it can be concluded that native workers can only partially fill potential vacancies in the sector (European Commission, Joint Research Centre, 2020). In should be pointed out that this problem does not only refer to food system resilience but also to resilience of entire economies as agriculture is understood as a sector where presence of migrants is essential to the pandemic response as well as long-term recovery and development (Guadagno, 2020). COVID situation put the light on the labor force quantity available for the food systems, but it is necessary to stress labor force quality required, as this perspective is an important part of the F2F strategy, as a factor enabling the transition through advisory services, data and knowledge sharing, and skills (European Commission, 2020). There is lack of current and reliable data and analysis on the impact of the ongoing armed conflict in Ukraine on the labor force in agriculture. It was a popular sector of employment for Ukrainian immigrants (mainly temporal) to the EU countries (e.g. in Poland, Chmielewska *et al*., 2018). Nowadays, some males came back to Ukraine, while females left their country, which of course will not naturally lead to filling the gaps in employment in agriculture and related activities.

One of the areas that enables a person to provide resilience is income security. The situation in this respect has worsened as a result of the COVID epidemic. Due to the pandemic, public debt in the OECD area increased

by another $5.7 trillion in 2020 – an amount of $3.5 trillion higher than estimated before COVID (Lysandrou and Ranjbaran, 2021). This increase in government bond issuance took place in a context of zero interest rates, which has benefited both indebted governments and investors looking for safe assets amid the global economic recession (Stockhammer *et al.*, 2021).

Following the global finance crisis (GFC), quantitative easing (QE) measures implemented by the United States and some developed countries have created an excess of capital in international markets. A large amount of speculative capital has flowed into international grain futures and other derivative markets, resulting in large fluctuations in the international grain price market. This phenomenon is known as the financialization of grain (Yaojun, 2021). The volatility of grain prices, resulting from speculative activities, does not translate into an increase in the profit of agricultural producers, but into the profits of intermediaries participating in the trade. One may hypothesize that agricultural producers are losing out on speculations due to increased uncertainty and risk. The research by Sifat *et al.* (2021) shows that speculations in the gasoline, crude oil and gold markets are the most visible. Nevertheless, this situation also affects other groups of stakeholders. It is therefore difficult to talk about resilience in these conditions, and speculation on the agricultural commodity or energy markets should be considered a threat to the broadly understood food sector resilience. It is also a threat to the economic balance, and therefore one of the three pillars of resilience under consideration.

Figure 4 shows the time series relating to harmonized indices of consumer prices. In the period 2010-2021, clear increases in HICPs are visible, resulting from the global finance crisis initiated in 2007 with the speculative bubble on the US real estate market. The scale of this phenomenon surprised financial analysts, but most of all it gave rise to problems for many economies (especially developed economies). In addition, the GFC and 2012 Euro area sovereign debt crisis resulted in a reduction in investment in innovation (Peia and Romelli, 2022). In the period 2011-2015, a decreasing direction of changes in HICPs was observed both in the EU and US countries. As Mazumder (2018) states, most observers did not expect a sharp drop in inflation in the EU in 2012 (Mazumder, 2018). It was a time of gradual improvement in the financial situation of economies that experienced post-GFC recession and those that experienced a slowdown. Further increases in HICPs, both in the EU and in the US, occurred in the period 2015-2018, but their amplitude was smaller than during

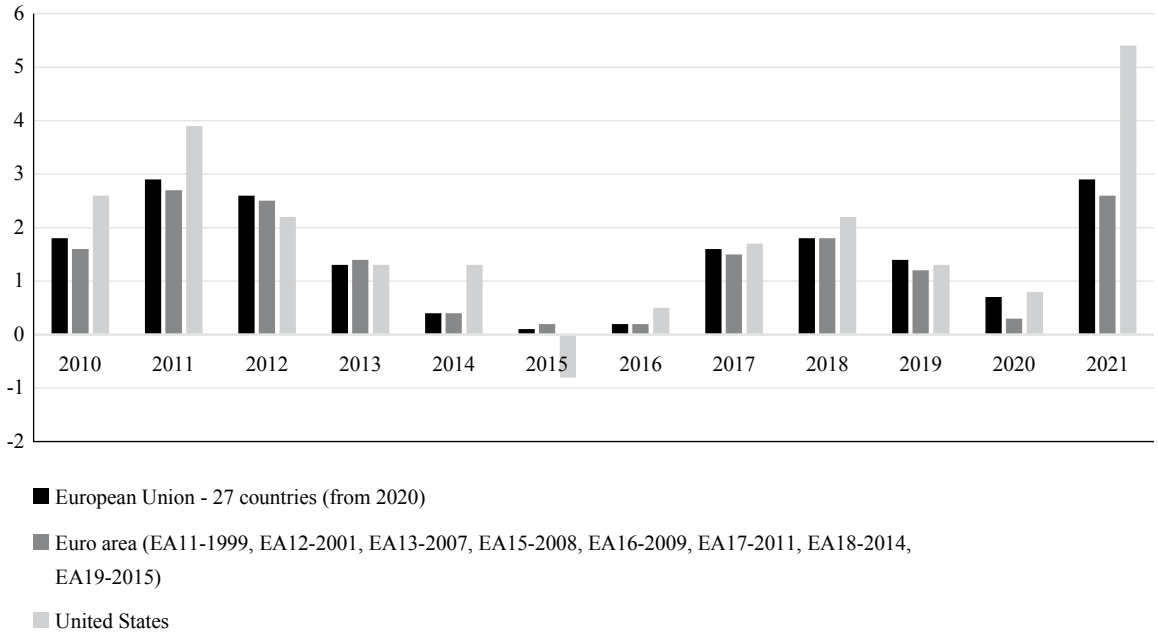

Figure 4. Harmonized indices of consumer prices – inflation rate EU and US 2010-2021 (Eurostat, 2022c).

the GFC. After a short period of about two years of decreasing the level of HICPs, a significant increase was observed. U.S. The Bureau of Labor Statistics recorded an increase in the consumer price index for all urban consumers (CPI-U) in the USA in 2021 on a twelve-month basis (unadjusted percentage change Dec.2020-Dec.2021) by 7.0%. CPI in European Union (Nov. 2020-Nov.2021) was 111.7% (Trading Economics, 2022).

Undoubtedly, such a large increase in the inflation rate should be considered worrying, reducing the purchasing power of money in the food sector and, moreover, may cause a further deterioration in this sector, which started with the lock downs in 2020 and 2021 and war and sanctions in 2022. In our opinion, all the factors discussed across this study are known from the literature, and their combined appearance will threaten resilience in agriculture, especially in the context of drought in the early 2022. Considering the last shocks discussed (COVID-19, war in Ukraine, drought, embargo on grain exports from Russia, rising inflation), we should expect a difficult situation on the food market in the nearest future. Unfortunately, this situation will probably lead to deepening poverty and hunger in the poorest regions of the world.

5. Conclusions

The issue of resilience in the food sector must be considered multidimensionally. In the paper, we proposed environmental, social and economic perspectives, derived from the concept of sustainability. It seems that the sustainability approach is not sufficient, despite its very important role in modern agriculture and the departure in this concept from the abusive economy, manifested, for example, in excessive exploitation of agricultural land or animals (welfare). It is imperative to pursue a holistic approach involving three main interest groups: environment, society and economy (including finance). In this approach, the basic direction of activities should be the one focused on the resilience approach, both in environmental protection (including agricultural production) and society (with an attempt to return to the roots in the culture of the functioning of multi-generational families and local communities). For a harmonious combination of these activities, it is also necessary to look at the economic perspective of food systems and entire rural livelihoods (e.g. income and employment diversification).

The issue of biological balance (or its lack) is an important factor, both an opportunity and a threat to resilience in food sector. Human activity wreaks havoc, on the one hand, occupying new areas where wild species of animals and plants live, and, on the other hand, strives to rebuild the dying fauna and flora. It will not be possible to ensure the well-being of people (including the provision of food, hygiene, work, income or cultural, psychosocial and other needs) without resilience in human life in general.

Another factor negatively affecting food sector is the increase in prices, defined by harmonized indices of consumer prices, especially the one resulting from the GFC, but also those recorded in 2021, resulting from COVID. It has its source in the increase in energy prices, on which the profit of agricultural producers depends, but also in the standard of living of farms (the need to limit expenses for other purposes). The increase in prices caused by the war in Ukraine and the sanctions imposed on Russia is becoming more and more visible.

Speculation on the agricultural commodity or energy markets is one of the factors posing a threat to food sector. It makes it difficult to stabilize the terms of cooperation between different stakeholders. It seems, however, that this area will be difficult (even impossible) to regulate in such a way as to avoid the actions of people looking for profit maximization opportunities, often in isolation from the real economy. This perspective leads to appreciation of common strategic approach to food sector, as F2F strategy for European Union countries, which is extremely problematic for some other markets.

The wide scope of the paper does not facilitate to formulate specific managerial implications as they can refer to different entities operating within the food system aiming at being resilient. It can be farmers, food companies but also public and non-governmental bodies. Undoubtedly, proving that environmental, social and economic perspective are important features of resilience should encourage different stakeholders, not only managers, to realize about factors, which are not included in standard profit and loss accounts but has

impact on long-term development perspectives and can decide on retaining critical functionality in the face of disruptions, which can happen suddenly and unexpectedly. For example, it is reasonable to approach finance in a new way, especially taking into account the risks resulting from the negative effects of financialization.

Finally, while considering resilience in the food sector, attention should be paid to different groups of factors, both stimulating and limiting. The scale of the problem is so vast that it is impossible to put them all in one paper. Therefore, the focus was on current elements (regarding recent ones resulting from COVID pandemic), but with the indication of one of the primary sources of the problem, i.e. the biological imbalance resulting from human activity. Important limitation of the study results from its wide scope as research on environmental, social and economic dimensions are very broad and multi-threaded. It requires further study, but we believe that these three thematic areas cannot be analyzed only separately from the resilience point of view. Attempts to combine them are not easy and require improvement in further research. This is a key problem, as the agri-food sector must develop adaptation processes in response to subsequent shocks (e.g. the COVID epidemic; the war in Ukraine).

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