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THE CONCEPT OF RESILIENCE: DIMENSIONS, PROPERTIES OF RESILIENT SYSTEMS AND SPATIAL SCALES OF RESILIENCE

Grzegorz Masik

Department of Socio-Economic Geography, Faculty of Social Sciences
University of Gdańsk
Bażyńskiego 4, 80-309 Gdańsk: Poland
e-mail: grzegorz.masik@ug.edu.pl

Abstract

The aim of this paper is to identify the dimensions of resilience undertaken in literature, characteristics describing resilient systems and spatial scales in the context of which resilience research and strategic planning are carried out. The research method was desk research within which the papers that were reviewed were selected based on scientific journal reputation including the high Impact Factor. References to resilience in strategic planning were selected on the basis of information about international organizations dealing with resilience mentioned in scientific articles. Based on broad review, environmental, social, economic and institutional resilience have been identified. Important properties of social-ecological systems identified in the context of resilience include connectivity, modularity, redundancy, interdependence, and diversification, while resilience strategies specifically consider flexibility, resourcefulness, reflectiveness, dispersion, mutuality, inclusion, and integration. Research as well as strategic actions to strengthen resilience consider global spatial scale but also national, regional, local, neighbourhood, household and individual.

Key words

resilience • systems • dimensions • properties • research approaches • spatial scales

Introduction

Research on the resilience of socio-ecological systems as well as strategic planning aimed at strengthening resilience take into account four dimensions (Figueiredo et al., 2018; Irani & Rahnamayiezekavat, 2021). These include: environmental (Weichselgartner & Kelman, 2015; Torabi et al., 2018), social (Adger, 2000; Obrist et al., 2010), economic (Martin & Sunley, 2015; Plummer et al., 2018) and the institutional dimension/agency perspective (Bristow & Healy, 2014; Masik, 2018; Masik & Gajewski, 2021). The environmental dimension assumes prevention from natural disasters, sustainable development, the availability of infrastructure adequate to natural threats and the availability of the population

to natural resources. Social resilience is intended to ensure inclusion and social cohesion and it assumes active networks of civic cooperation. The economic dimension indicates the diversification of the industry, diversified skills of employees and the creation of favorable conditions for innovation. Building institutional resilience requires good leadership, long-term vision, significant public resources, cooperation with government bodies and self-governments and open attitude to participation (OECD, 2014).

In addition to the aforementioned dimensions of resilience, in the debate undertaken by theorists and practitioners, the features of resilient systems are highlighted. These features inform about the so-called Complex Adaptive Systems to withstand negative shocks, absorption, adaptation, adaptability and transformation and result from the theoretical assumptions of the concept of resilience. The features of resilient systems include, among others, a high level of human, social and institutional capital, innovation, modern infrastructure, redundancy of infrastructure and resources, diversification of e.g. economic sectors, economic efficiency, connectivity, interdependence and modularity of systems. From the point of view of implementing strategic actions, additional features of resilient systems and resilience strategies are indicated, such as robustness, flexibility, resourcefulness, reflectivity, dispersion, mutuality, and process-oriented actions such as inclusion and integration (Bristow, 2010; Drobniak, 2015; Figueiredo et al., 2018; Masik & Grabkowska, 2020; Irani & Rahnamayiezekavat, 2021)

Characteristic for the geographical sciences is the study of the properties of system elements as well as taking into account various spatial scales. These scales are related to different research approaches focusing on different elements of the systems. Thus, there is a global, national, regional, local (urban) scale, local communities (city districts), households and individuals. The context of the research and the objects taken to strengthen resilience, taking into account various spatial scales, are described later in the article. Referring to the above issues regarding the dimensions, features and spatial scales of resilience, it should be emphasized that the novelty of the presented research is to combine them together in the context of scientific research as well as strategic planning.

Dimensions of resilience

Social resilience

Social resilience is defined as "the ability of groups or communities to cope with external stress and disruptions resulting from social, political and environmental changes" (Adger, 2000: 347). Social resilience can also be defined as "the ability of various actors to access capitals [...] in order not only to overcome or adapt to unfavorable conditions (reactive capacity) but also the ability to seek and create opportunities (proactive capacity), and therefore means the ability to develop better competences (positive outcomes) to deal with threats" (Obrist et al., 2010: 289). Social resilience therefore relates to different social groups, but can also be identified with more key actors, which connects it with an agency perspective. When social resilience is explored, the key question becomes "resilience for whom" (Cutter, 2016). As part of social resilience, the importance of livelihood is emphasized, which focus not only on financial resources, but also on various resources and capital held (Speranza et al., 2014). Livelihoods understood in a broad sense are the basic determinant that result from the possessed human capital, participation, i.e. influence on the political and social process and social capital, including social networks (Adger et al., 2002).

In addition to human, social and financial capital, natural and physical capital are also important. The size of these capitals, their diversity and the balance they hold have a positive impact on the undertaken resilience strategies. Moreover, it should be stated that the more capital is at the disposal of individuals or households, the more opportunities they have to protect their livelihoods. Speranza

et al. (2014) indicate that the following three dimensions are important: the ability to accumulate capital (buffer capacity), the ability to self-organize and the ability to learn. The favorable characteristics of these dimensions relating to individuals, households or social groups mean greater social resilience, including greater adaptability.

Social groups with greater adaptive abilities adapt better to changing conditions, cope better with their weaknesses and threats, are less sensitive to external disturbances through networks of connections, and benefit more from opportunities that arise (Kakderi & Tasopoulou, 2017). Strong social ties allow for a better exchange of information, joint activities, overcoming various barriers to cooperation, better support in the event of threats, creating the so-called 'informal insurance'. Better 'connected' communities with higher level of social capital have a greater ability to recover from difficult situations (Iwasaki et al., 2017). In the first phase of a given crisis, bonding social capital, in particular, makes it possible to obtain informal help. In the period of longer disruptions, bridging social capital becomes more important and diversified sectors of a given economy contribute to greater resilience (Antonietti & Boschma, 2018).

It follows from the above considerations that social resilience means greater integration and equality in society's access to public resources and capitals. For this purpose, it is important to create new forms of deliberation, organize platforms for building consensus, shared responsibility, sharing information and, importantly, risk. When building social resilience, it is important to use local resources to a greater extent and to have a greater share of locally rooted institutions or entities in order to partially become independent from external risks (Bristow, 2010). Social resilience also means carrying out various two-way activities between institutions and important local actors and the community in order to mobilize resources and shift risk in time and space in changing social contexts (Estêvão et al., 2017). It means taking into account changes in political priorities. Despite these assumptions, Brown (2014) indicates the neglect of political dynamics when researching [and building] community resilience.

Economic resilience

Economic resilience is defined as the ability of socio-economic systems to withstand shocks, recover from a crisis situation after they have ceased, and adapt continuously (Xiao et al., 2017). Economic resilience refers to the economic structure of the socio-economic system, innovation, the ability to self-organize economy and the ability to adapt to changing external conditions (Peng et al., 2017). In the so-called an engineering interpretation, the resilience of a regional or urban system can be measured as the degree to which an economy is able to tolerate change until its structure and processes are reorganized (economic equilibrium). Therefore, it is related to the "ability to capitalize on opportunities" that may arise in the future (Drobniak, 2013: 206). The ability of systems to constantly adapt to new circumstances corresponds to the interpretation of adaptive resilience and is part of the trend of evolutionary economic geography (Swanstrom, 2008).

Research on economic resilience focuses on the development trajectories of economies (Martin, 2010, 2012; Simmie & Martin, 2010) and the reasons for economies stuck at a certain point of development (so called lock-in; Xiaohui, 2012; Crespo et al., 2013). Economies stuck at a certain point indicates that they are unable to adapt to change and are doomed to a long-term stagnation or recession (Peng et al., 2017). The concept of economic resilience takes into account determinants of economic development, including decisions taken in the past (Martin, 2012; Dabson et al., 2012; Martin & Sunley, 2015; Plummer et al., 2018). Research indicates that socio-economic systems, i.e. cities, regions or countries, should strive to break the economic determinism based on the defined path in the past (path dependence),

and should make development independent of decisions made in the past (path independence), create new path developments (path creation) and support economic diversification (Martin, 2010; Xiaohui, 2012). These activities help to avoid economies entering a critical point and getting stuck in the economic development trap.

The evolutionary approach to economic resilience distinguishes between two types of resilience: the short-term ability to absorb external shocks and the long-term ability to develop new economic branches (Martin, 2012; Boschma, 2015; Martin & Sunley, 2015). Both types refer to the idea that the industrial structure (e.g. of a region), especially its industrial specialization and industrial connections, play a key role in shaping resilience to external crises (Brakman et al., 2015; Capello et al., 2015; Cainelli et al., 2019). Generally speaking, it is important for overcoming and kind of difficulties to constantly adapt the industry to changing external conditions, including political or economic conditions (e.g. Stryjakiewicz, 1999).

Institutional resilience / agency perspective

Institutional resilience / agency perspective means the ability of all kinds of institutions and key actors to constantly adapt to changing conditions, including the ability to properly respond to negative phenomena. It assumes a long-term and clear vision of leaders, adequate resources available to the public sector, close cooperation between the government and local governments, openness of government activities and participation of citizens (Figueiredo et al., 2018). In the institutional perspective, it is assumed that the central government, local government authorities, civil society institutions, business associations and social leaders are the key players in adaptation measures aimed at strengthening resilience (Bristow & Healy, 2014; Masik, 2018). It also points to the significant importance of control and management functions that affect better connectivity of activities, institutions or entities, and thus better preparation for challenges related to e.g. crisis (Raźniak et al., 2020). Building resilience is most effective when it involves the mutual and responsible action of a variety of institutions, networks of civic institutions and individual citizens working together to achieve common goals under a common strategy (Coaffee et al., 2018).

Appropriate anticipatory policies in the face of a potential crisis and an appropriate response to it depends precisely on the proper functioning of the institutions (Vale, 2014). These institutions can be active and react quickly to external shocks, but they can also be passive and inert, indirectly causing greater damage to local, regional or national economies (Sunley et al., 2017). This issue was previously addressed by Matthews and Sydneysmith (2010) when stating that managing authorities are an essential part of local adaptation capacity because institutions can either support or hinder community access to various resources or implement key adaptation strategies. There are three types of significant obstacles resulting from the nature and functioning of institutions that inhibit the building of resilience. They include: insufficient cooperation between various bodies due to institutional logic, bureaucratic procedures, as well as established and not meeting the challenges of institutional practices of employees of these institutions (Therrien & Normandin, 2017). For this reason, cities or regions should strive for a high degree of differentiation in the activities of institutions (Bec et al., 2019).

In research on the significance of institutions for building the resilience of socio-economic systems, attention is also paid to approaches pointing to ways of enhancing adaptation actions. Thus, one can speak of a centralized or decentralized approach (Chelleri et al., 2015). The decentralized approach makes it possible to adapt activities to local or regional specificities and is by its very nature more flexible and therefore also more adaptable. The implementation of local resilience policies requires a thorough

examination of pre-existing management models, with an emphasis on anticipatory approaches (Perelman, 2007). In this context, resilience is seen through proactive rather than reactive policies more characteristic of centralized operations. Traditional methods of risk assessment are being replaced by taking into account unpredictable events with high consequences and hence by new models for predicting an uncertain future. Due to different goals for reactive and anticipatory policies, there are potential tensions between short-term adaptation and long-term adaptability (Pike et al., 2010). Therefore, strengthening resilience requires both short-term and long-term forward-looking policies and strategies.

Properties of resilient systems

In studies of the resilience as properties of systems, structural features are distinguished, which basically are based on two types of properties: those that determine the innate abilities or capabilities of systems, and the adaptive capacities of systems (Norris et al., 2008; Cutter et al., 2008). Innate abilities relate to the existing economic structure, the existing innovation system, the skills of workers, or the degree of competitiveness prior to the emergence of an economic shock. Adaptive capacities, in turn, refers to the combination of actions and decisions necessary to accelerate the return to the development path or a smooth entry into a new development path. Based on research by Rose (2007), it should be stated that the combination of innate (static) and adaptive (dynamic) abilities and their interactions in the system can ensure its resilience to shock. These capabilities are necessary but do not guarantee that the negative effects of the disruption will be avoided. These depend on the depth of the shock, its duration and e.g. the economic sectors which dominate the system and which are subject to crisis phenomena at a given time. These static and dynamic abilities one can also refer to social-ecological systems perspective (natural science focus) and human systems (social science focus). The latter resilience perspective is understood as a normative process or outcome from human action and agency (Wilson, 2018).

Innate abilities can refer to different properties or features of the system. As part of the 100 Resilient Cities initiative implemented in the world by the Rockefeller Foundation, it is indicated that withstanding negative disturbances in the urban system depends on robustness (e.g. infrastructure) and redundancy and refers to the initial conditions (pre-existing conditions) of the systems and the ability to prevent adverse events. Robust means well-recognized and well-managed physical resources, making them resilient to pass successfully unchanged as a result of threats. This feature relates to protective systems, healthcare, infrastructure, activities related to crime prevention and threat monitoring. Redundancy, in turn, means free additional resources or system components that are intentionally created so that, if necessary, they can be used to counter threats. Redundant resources or elements of systems should make it possible to undertake various ways of implementing the desired actions and mainly relate to transport, communication, but also, for example, human resources useful especially in the area of rescue and health protection (The Rockefeller Foundation, 2014; Arup, 2016; Figueiredo et al., 2018).

The responding systems to external threats, which can be identified with dynamic adaptive capacities, include: flexibility, resourcefulness and reflectiveness. These characteristics relate to the response to disturbance and the return to normal functioning of systems and are outcome-oriented. Flexibility means, for example, that cities and the strategies they undertake should be adapted to unforeseen situations. This feature also means that new and practical ideas should be possible to implement quickly in the event of sudden and unexpected events. Flexibility also means the ability of local actors, institutions and residents to react quickly to external threats. When negative phenomena occur, it is important to make decisions

quickly, even at the cost of mistakes. Flexibility is particularly applicable to the management of energy, water, food and emergency services, but also to the activities of the management. Resourcefulness means that the city community and institutions should be able to quickly identify a variety of ways to achieve goals when an emergency occurs. When creating strategies, one should take into account innovative solutions. Resourcefulness presupposes that institutions and residents are able to achieve the desired results quickly through coordinated action and a combination of available human, financial and infrastructural resources. Therefore, an anticipatory policy in this respect is important, forecasting future negative events in order to gather adequate resources at the disposal of local or regional authorities and residents. This feature is largely related to labour, innovation and business policy. Reflectiveness, in turn, involves using past experiences to make future decisions. This feature means that all stakeholders should learn from past mistakes. This learning should be continuous and subject to ongoing critical evaluation. Importantly, conclusions should be drawn not only from good practices, but also to bear in mind unproven solutions. Reflectiveness applies in particular to local communities, planning and risk identification (Arup, 2016; Figueiredo et al., 2018).

Two features can be distinguished within the process-oriented adaptation, i.e. inclusion and integration. The first feature emphasizes the need for broad consultation and community involvement, especially of the most vulnerable groups in decision-making. Inclusion, or inclusiveness, should particularly include those social and economic groups that have the smallest resources and the ability to deal with negative events. Inclusion also presupposes that all activities are fully transparent and that the participants of social and economic life are jointly responsible for the activities undertaken. This feature applies in particular to the issues of housing, transport, planning and the participation of the largest possible group of stakeholders. Integration, in turn, promotes consistency in decision-making and indicates that any decisions or investments should be oriented towards jointly selected goals. It therefore includes both horizontal and vertical mechanisms. The exchange of information should enable the efficient functioning of institutions and society and ensure a quick response. The implementation of this postulate is possible only in systems characterized by a high level of trust and social capital, including a high level of trust in institutions and a strong so-called by Aldrich (2012) linking social capital. Integration in this sense refers both to urban systems as a whole, but also to their elements, i.e. community, economy and leadership (Arup, 2016; Spaans & Waterhout, 2017; Figueiredo et al., 2018). Summarizing the features of resilient systems identified in the 100 Resilient Cities initiative (2021), it should be stated that they constitute the transition from short-term disaster response to a more holistic process of prevention, response to threats, participation and monitoring of natural and socio-economic processes in order to minimize losses and adaptation to changing external conditions.

According to the literature, the economic subsystem of the urban system should have specific properties that strengthen its resilience. The following attributes are indicated: adaptability, connectivity, diversification, efficiency, redundancy and interdependence (Drobniak, 2015). The adaptability of the urban system in the economic dimension indicates a high level of entrepreneurship, significant innovation abilities, significant local knowledge resources (knowledge base, research infrastructure, knowledge transfer) and large economic resources (number of enterprises, value of their assets, revenues). Connectivity refers to active networks of economic actors (cluster links in production and distribution chains) and cross-sectoral knowledge links (innovation and commercialization platforms within different production chains). Diversification means a diversified economic specialization (industrial mix). In turn, efficiency consists of: supra-local competitiveness

of products, high added value of production chains (profitability of individual links in production chains, knowledge-based industries) and the speed of recovery of lost potential (recovery quickness). The features of redundancy can be various, durable and reliable energy sources and additional, secure ICT applications. Interdependence is equated with good practices and standards in the field of economic cooperation and the complementarity of local industries (including the effects of agglomeration) (Briguglio et al., 2009; Cooke, 2008; Lansford et al., 2010; Hess, 2013).

The above properties or features of a resilient city, but also to some extent strategic actions aimed at strengthening resilience, refer in particular to the local socio-economic system. Similar, though partially different, characteristics of the regional system are also considered under the concept of resilience. Although some properties of the resilient region were indicated earlier, additional attributes can be distinguished when referring to the strategic dimension. Bristow (2010) points to such features of the regional strategy as diversity, dispersion, mutuality and modularity. Diversity means striving for a high degree of diversification of energy production, institutions and resources. Diversity or diversification may refer to both economic activity and the qualifications of the population. Greater differentiation is conducive to resilience to asymmetric economic shocks occurring in individual industries. This differentiation may also apply to different directions of exports or different export products. Dispersion, in turn, means a greater share of local ownership and control over business, energy suppliers and strategic resources. It also entails entrepreneurs taking advantage of the region's strengths and a greater number of small-scale companies. Mutuality is understood through strategic actions aimed at a strong emphasis on territorial justice and a development logic focused on the rights to meet human needs. It also implies a kind of cultural emancipation and political and social empowerment, strong family, community and civil society support networks. Moreover, it is indicated that values such as care, cooperation and collaboration should be of greater importance. Modularity, in turn, is understood as the ability to be self-sufficient in the event of economic or environmental shocks. It also assumes that supply chains should mainly depend on local companies. However, it is equated with a significant degree of international and intra-regional networking in order to share information, learn and enhance interactions.

Spatial scales of resilience

Resilience in geographic research has rarely been a consideration prior to the 2009 financial and economic crisis. For this reason, more often in the second decade of this century, attention began to be paid to the spatial differentiation of resilience and the corresponding adaptation measures taking into account various spatial scales (Drobniak et al. 2021). It is of particular interest how static conditions and dynamic processes related to resilience affect places, especially in physical, social, economic and political contexts (Manyena 2014; Cutter 2016). Taking into consideration the 'resilience of place' approach and the issues of risk management, it is indicated that adaptation activities may be incorrectly located in state institutions or agencies (Weichselgartner & Kelman, 2015). There is therefore a global and national scale, a regional and urban scale, as well as the scale of neighbouring communities, households and individuals. Appropriate approaches to research and strategic activities dominate at each spatial scale.

On a global scale, the approach of disaster risk reduction and climate change adaptation are important, on a national scale, especially in Europe, the second-mentioned approach. On a regional scale, an approach aimed at strengthening diversified economic structures within so-called Complex Adaptive Systems dominate. On an urban and neighborhood scale, the socio-ecological approach is used to examine resilience, while

on the scale of households and individuals, the so-called livelihoods approach (Schipper & Langston, 2015; Figueiredo et al., 2018).

As part of the approach to disasters risk reduction, the ability of a given system to resist environmental threats, with particular use of appropriate technical infrastructure and human resources, is taken into account. These threats can be various types of natural disasters due to the greenhouse effect and the resulting social tensions. The global scale includes protection against natural disasters and, for example, the security of food supplies, but also the implementation of policies to counteract climate change (Weichselgartner & Kelman, 2015). Discussions on this topic are conducted at the global level, as exemplified by summits and conferences on global challenges. An example of meeting these challenges is the report prepared in connection with the United Nations climate summit, which took place in New York in September 2019. Namely, it emphasizes the impact of climate change on achieving sustainable development goals and the need for a holistic understanding of the socio-economic consequences of extreme weather conditions (WMO Statement ..., 2019). The report draws attention to the impact of climate change, including on human health, quality of life, job loss or a decline in labour productivity. The reports of the Intergovernmental Panel on Climate Change (2021) also indicate the processes and consequences of a potential climate disaster.

Disaster risk reduction approach assumes that the response to crisis management should be to shape socio-ecological systems in such a way that they are able to proactively adapt to disruptions that go beyond the scope of normal and even expected threats (Boin et al., 2010). The concept of resilience therefore has much in common with the disasters risk reduction approach. Both provide comprehensive assessments of systems and their interactions, emphasize the ability to manage threats, indicate ways to deal with uncertainty and change, and focus on adaptive and anticipatory activities (Mitchell & Harris, 2012). In the scientific debate on resilience, however, attention is paid not only to the reduction of threats or the process of adaptation to climate change, but also to social and economic processes such as globalization, financialization or digitization, which may contribute to social tensions and economic crises. reducing the adaptability of socio-ecological systems.

On a national scale, attention is focused on measures aimed at counteracting climate change through appropriate legal regulations and central investments. At the national level, research on resilience also addresses economic issues, as exemplified by analyses of decline in gross domestic product or employment as a result of the crisis (Strahl et al., 2015). The national scale also applies to critical infrastructure such as energy or water infrastructure, as well as economic sectors and the threats that appear in them, and unexpected shocks on various markets (Weichselgartner & Kelman, 2015).

The regional scale is particularly the subject of research within the framework of regional studies. Main interests focus on economic sector analysis, related variety, innovation in regional economies and employment issues (Simmie & Martin, 2010; Di Caro, 2014). The relationships between the occurrence of crises and employment, as well as an increase or decrease in gross domestic product reduced to regions are investigated. It also points to the relationship between the functions of regional economies and their resilience to the crisis (Masik, 2019). The role of institutions and other important entities or actors plays an important role in regional research. This is due to the fact that they know the socio-economic environment, territorial specificity, potentials, and are able to assess the vulnerability of regions to threats, including properly assessing the existing risks and opportunities (Bristow and Healy, 2014).

In studies of urban resilience, particular attention is paid to individual elements of urban systems and their functions. In particular, three basic stages in the process

of system response to disturbances are indicated, i.e. persistence, transition (adaptation) and transformation (Meerow et al., 2016; Torabi et al., 2018). Resilience studies on an urban or local scale are most often located in the socio-ecological approach. It allows for a systemic and holistic approach to the city, taking into account the dynamics of changes and the relations between its elements (Davoudi, 2013). As part of urban resilience, particular attention is paid to the ability to withstand technical infrastructure against natural disasters, the resilience and adaptability of local economies, as well as the inclusion and integration of local communities (Drobniak et al. 2021). The importance of social cohesion, social interactions, networks and local institutions is emphasized as well (Irani & Rahnamayiezekavat, 2021). The activity of the city community and leaders, who by definition should cooperate in order to minimize threats, are taken into account. More recent research also takes into consideration the climate change adaptation approach (Masik & Gajewski, 2021).

The sub-urban approach relates to community resilience (Cutter et al., 2014) and focuses on specific areas or neighbourhoods of the city. On this scale, spatial segregation and social inequalities are examined more often than in the previous ones, the result of which is greater vulnerability to external threats. This is especially true of the less privileged, weaker and excluded groups (Hillier & Castillo, 2013). This approach looks at the different levels of resilience of different demographic, social and economic groups. Important in research and strategies on this scale is also the perception of resilience, e.g. the level of security, possible neighbourhood help, etc. (Figueiredo et al., 2018).

The scale of households and individuals relates to wealth, disposable income, and livelihoods. The well-being and welfare of families and individuals is believed to be the basis for building resilience in the event of threats. Research at the level of households in underdeveloped countries is of particular importance, where social differences are significant and a large group are poor people who do not have sufficient resources and capital. In such cases, the key is the individual wealth of individuals or families (Jennings & Manlutac, 2015). Significant is therefore to improve living conditions in order to reduce their vulnerability to negative natural and economic factors. In this regard, it is important to involve care institutions and to increase the awareness of individuals of potential threats (Figueiredo et al., 2018).

Summarizing various scales of resilience research, it should be emphasized that at the highest level, global processes influencing the shape of actions taken in the field of limiting the reduction of disasters and adaptation to climate change are of particular importance. Similarly, at the national level, the importance of climate change is emphasized, but also macroeconomic factors, including economic growth, the labour market, the level of competitiveness of economies, the quality of institutions or the appropriate forward-looking policy of a given country, are also of great importance. At the regional level, research relates in particular to the economic structure, economic interdependencies or the level of innovation. At the regional scale, economic resilience characteristics appear to be similar to the national level, but reduced to regions. At the urban scale, the importance of social capital, including cooperation networks, participation in the social and economic life of a given community, the degree of participation in decision-making processes, etc. is more often emphasized. At the urban level, the research also relates to the economic dimension, which connects it with the regional level. In turn, adaptation to climate change at the urban level connects it with the national and global scale. The sub-urban or neighbourhood level focuses on segregation issues, but also on social cohesion and networks which makes it similar to the urban scale. At the households and individual level, the importance of human capital is more often indicated, including appropriate qualifications

as well as physical and mental health, which determine better adaptation to threats (Kimhi, 2014).

Discussion

The identification of the dimensions of resilience, the characteristics of resilient systems, and the spatial scales allows for debatable issues. Strengthening social and institutional resilience is done by the community and agents and serves, among others strengthening vulnerable groups and increasing institutional efficiency. Irani and Rahnamayiezekavat (2021: 317) emphesize the importance of "building capacity for social agents" and "strengthening institutions that prevent system fragility and increase agents' capacities". In some studies, these two dimensions are taken together. Increasing the resilience of the local community, however, basically consists in activating and mobilizing residents to act against external threats, while increasing institutional resilience consists in strengthening the capacity of the authorities and readiness to anticipate and respond to crises (Chmutina et al., 2016). In general, however, the response of socio-economic systems to crises in resilience studies is most often related to the economic dimension, where sudden or evolutionary changes of countries or regions in the context of economic threats are indicated.

Researchers of economic resilience point out the lack of a generally accepted definition of shock. It is most often identified on the basis of declining economic growth, as well as increasing unemployment or falling employment. It should be said that a shock in a given economy may be the result of a crisis in a specific industry in the global economy, or it may be of political or natural origin. Simmie and Martin (2010) mention as the causes of the crises: unexpected increase in companies' competition from outside the region, sudden bankruptcies of companies employing a large number of employees and sudden challenges related to technological changes. Resilience to one economic shock does not indicate a long-term strong position of a given system or resilience to another shock. Therefore, in order to talk about the permanent resilience of the system, its adaptability should be examined in the period of at least a few shocks (Zakrzewska-Półtorak, 2015). This approach to explaining resilience is called the long view (Pendall et al., 2010).

For the above reasons, warning systems that most often inform about natural hazards, such as taking the 100 Resilient Cities initiative or similar activities, are of particular importance (Bilska, 2016). Alert systems should also indicate risks of a social and economic nature. These warnings are issued by various civic institutions, but it seems that they are often not systemic in the context of strengthening resilience. Warning systems can also relate to institutions, highlighting their ability to continuously adapt. Moreover, it should be emphasized that research on local resilience as well as strategic activities focus mainly on cities, while they are not carried out basically for rural areas as separate territorial units. This direction may constitute a new research field within the concept of resilience.

The conceptualization of resilience can be carried out on various spatial scales, which human geographers are aware of. Wilson (2018: 95) states, that "resilience-building processes are spatially heterogeneous" and human geographers understand them most at individual and local level. He also found that it is more difficult to examine resilience at the regional level and almost impossible at the global level as too many factors are influencing on such complex system. It should also be emphasized that if a system is considered resilient (or tends to be more resilient) on one level, it may be considered non-resilient on a different spatial scale due to other key factors or processes affecting it.

On the basis of conducted above literature review different components of resilience can be distingushed (Fig. 1). They can refer to dimensions, properties of resilient systems, strategic planning, spatial scales and stages of resilience which can be understood

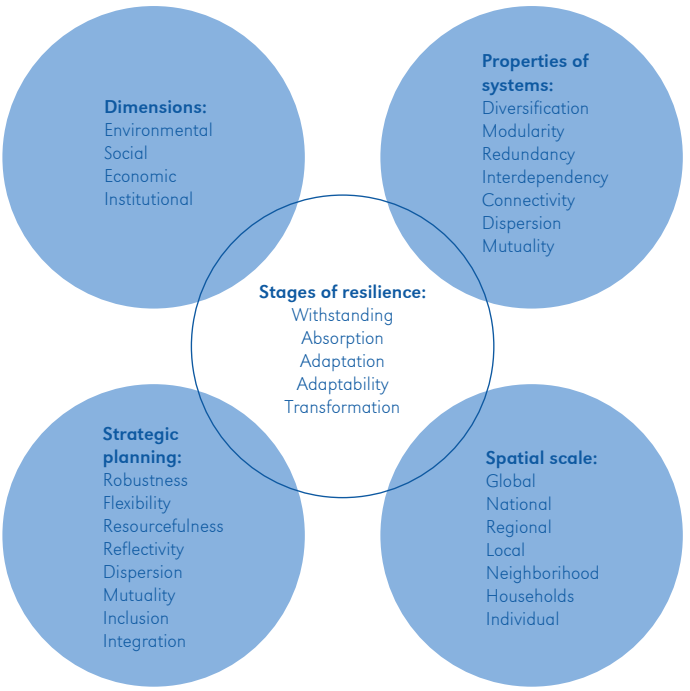

Figure 1. Components and features of resilience

Source: own elaboration

as a process as well. Each component influences itself and all features of resilience can be considered for further research and for preparation of the strategy for a given place. These components and features of resilience (and other components and features?) for designing resilient systems demand deeper consideration and discussion.

Summary

The concept of resilience takes into account four basic dimensions relating to research and strategic activities (Figueiredo et al., 2018; Masik & Grabkowska, 2020; Masik, 2021; Masik & Gajewski, 2021). Namely, there are environmental, social, economic and institutional/agency dimensions. Within these dimensions, resilience refers to the ability of systems to withstand external as well as internal disturbances, absorption, adaptation, adaptability and system transformation. It should be emphasized that adaptation, often equated with resilience, is only one of the stages of resilience of systems or strategic actions undertaken in order to minimize the risks caused by various types of threats of natural or non-natural origin.

Resilient systems have appropriate features that are supposed to make them better able to adapt to changing external conditions. Such properties include modern infrastructure, redundancy of infrastructure, redundancy of resources, possession by systems and individuals of a high level of various types of capital, including human, social and institutional capital. Advantageous features that enhance resilience include innovation, diversification, efficiency, connectivity, interdependence and modularity of systems or subsystems. In addition, resilient systems and resilience strategies are characterized by robustness, flexibility, resourcefulness, reflectiveness, dispersion, mutuality,

and processoriented activities such as inclusion and integration.

The concept of resilience as well as strategic actions to strengthen the resilience of socio-ecological systems relates to different spatial scales. Thus, there is a global, national, regional, local, neighbourhood, household and individual scale. Resilience studies are carried out at different spatial scales and actions appropriate to a given area are undertaken within the approach of disaster risk reduction, adaptation to climate change, socio-ecological and livelihoods. Further work in the research and planning of resilient systems requires the identification of those spatial scales that are appropriate and inappropriate for specific strategic activities. At adequate levels, taking into account the environmental, social, economic and institutional dimension, selected activities should be designed so that the relevant systems (subsystems) strengthen their resilience referring to the key (for a given spatial scale) properties of resilient systems.

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Unless otherwise stated, the sources of tables and figures are the authors', on the basis of their own research.

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