



Dariusz PIENKOWSKI • Wojciech ZBARASZEWSKI

## THE CONCEPT OF CLIMATE RESILIENT ECONOMY FROM THE PERSPECTIVE OF LOCAL COMMUNITIES

Dariusz **Pieńkowski**, PhD (ORCID 0000-0002-0006-2186) – *Poznan University of Life Sciences*  
Wojciech **Zbaraszewski**, PhD (ORCID 0000-0002-1373-1895) – *West Pomeranian University of Technology in Szczecin*

Correspondence address:

Wojska Polskiego Street 28, Poznań, 60-637, Poland

e-mail: [darpie\\_xl@wp.pl](mailto:darpie_xl@wp.pl)

**ABSTRACT:** The concept of a climate-resilient economy appeared prominently in the 2015 economic considerations in the context of the Paris Agreement. However, the very concept of resiliency emerged in the 1970s in ecological research and was also widely considered from the perspective of socio-economic development. This paper presents the objectives of the European Union policy related to the creation of climate-resilient economies and the rationale behind the concept of resiliency. This analysis seeks to reveal differences between the resilient-oriented strategies of local rural communities in developed countries, based on the example of bioenergy villages, and in less-developed countries, using the example of reintroduced traditional farming. This research reveals the key strategies and benefits generated by the particular local communities.

**KEY WORDS:** resilience, European Union policy, climatic shocks, chinampa, waru-warus, bioenergy villages

## Introduction

Significant signs of long-term climate change have been observed in recent years. The World Meteorological Organization recognized the last three years, i.e. 2015-2017, as the warmest in history, and its data confirms the long-term upward trend in global temperature. The average global temperature in 2017 was higher by 1.1°C than the average temperature in the pre-industrial period (WMO, 2018). The climate changes resulting from this increased temperature affect both human environments and the conditions of socio-economic development. The Paris Agreement, which came out of the 2015 conference of the United Nations Framework Convention on Climate Change, is considered to be crucial for disseminating the concept of a climate-resilient economy (Bahadur et al., 2016; Ninan, Inoue, 2017). However, a widely understood concept of resilient economy was developed in economics much earlier. In the broader meaning, resilience means *“the capacity for a complex system to survive, adapt, evolve and growth in the face of turbulent change”* (van Opstal, 2007, p. 8). With regard to economic systems, it can be defined as the *“ability of the system to withstand either market or environmental shocks without losing the capacity to allocate resources efficiently (the functionality of the market and supporting institutions), or to deliver essential services (the functionality of the production system)”* (Perrings, 2006, p. 418).

The concept of a climate-resilient economy challenges local communities, which are an important link in the process of adaptation to environmental changes, and at the same time constitute far-open requirements based on very specific local conditions for development determined by very specific external (natural) and internal (socio-economic) environments. This is a creative process and, as in the case of most adaptation processes, it *“contains an element of freedom but also a risk of failure”* (Dobzhansky, 1959, p. 76). The key element is therefore to understand the specificity of the goals set in the creation of climate-resilient socio-economic systems. These general postulates should be directly implemented into practice due to specific conditions of particular communities.

This paper aims to present the concept of resiliency for rural areas from the perspective of the best practices identified in the world. It analyses the basic political postulates, the concept of climate-resilient economies and the key principles identified in research. There are two hypotheses stated in this paper: 1) some resilient economic activities were originally successfully developed in ancient times or rural areas and can be reintroduced, particularly in developing countries and 2) industrialized societies will need to develop new socio-economic structures to work out new strategies based on their technological advancements. The latter is mostly due to the different

stages of their economic development and the structural transition of the rural areas that has resulted in their having a high share of non-economic activities. The case studies identified in the literature will be analysed to show the key successful strategies of resilient economies. It will help to understand the determinants of resiliency and their relationship to sustainable development. Two types of economic strategies for rural areas have been pointed out in the context of climate-resilient economies. This research helps to identify the differences and complexity of the strategies, as well as the key features that have determined the success of these economies.

### Stability, resiliency and economy

The origin of the concept of resiliency is strongly related to the natural sciences and the evolutionary view of economic processes. Holling (1973) pointed out that resilience differs from stability in that stability refers to the ability of a system to remain within equilibrium, while resilience has a broader meaning, which is the *“persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist”* (Holling, 1973, p. 17). The key is, in particular from the perspective of modern anthropogenic systems whose ecological balance is difficult to maintain, that the system can be highly resilient, but have low stability. This concept seems important to accept in real situations, where there are highly changed and often unbalanced ecological and socio-economic systems. Both from the perspective of increasingly rapid climate change and economic shocks caused in various parts of the world that lead to crises on a global scale, the resiliency concept becomes more important equilibrium-based approaches typical of the debate of neoclassical economists (Pike, Dawley, Tomaney, 2010).

Perrings (2006) points to four areas of understanding resiliency:

- *latitude* – the ability to tolerate different shocks that do not cause the loss of functionality of an economy,
- *resistance* to changes,
- *precariousness* – understood as not exceeding of the economic stability limits,
- *panarchy* related to adaptive cycles of individual subsystems – the highest risk exists when various economic subsystems are in the same, least shock-resistant point of the adaptive cycle (hypercoherency).

The mechanisms of adaptation to these exogenous shocks are characteristic for individual economic systems. Moreover, at the same time there are many different resilient states for a single system (Perrings, 2006; Pisano, 2012).

A climate-resilient economy is understood as having appropriate political regulations in terms of the place, structure and functioning of the infrastructure, enabling reduction of vulnerability to the physical consequences of climate change. Lowering the sensitivity to threats associated with these changes is related to the use of both “soft” (socio-economic) and “hard” (technological) tools (Vallejo, Mullan, 2017). These postulates are related to the sustainable development policy and, in the context of these assumptions, indicate that it is necessary to reduce the emission of harmful substances through economic growth and reduction of poverty; seek adaptation strategies related to temperature rise and ocean levels; adjust to price changes on international markets (e.g. due to increased transport costs); apply new energy technologies; or create new international financial institutions and regulations for climate change (Mitchell, Maxwell, 2010). However, it is also pointed out that this is a very difficult process, due to the scale and long-term perspective of changes, as well as the potential beneficiaries and losers of these changes (Mitchell, Maxwell, 2010).

### The European Union’s policy in the light of the concept of climate change resiliency

The European Union (EU) monitoring report of 2015 states that “*the normal functioning and prosperity of Europe’s economy and society in general depend on the use of natural resources [...] In this respect, the efficient management and use of materials is essential for resource security and increased ecosystems resilience*” (Eurostat, 2015, p. 86). These issues are primarily related to the size of the resources consumed (including energy resources), waste management (including hazardous waste) and the volume of emissions (Eurostat, 2015). The issue of adaptation to climate change was particularly strongly addressed in the recommendations of the EU White Paper of 2009, which followed the Green Paper of 2007 (Commission of the European Communities, 2007). The White Paper stressed that climate changes will particularly influence certain social groups, such as the elderly or low-income households. Two main areas of action are the reduction of greenhouse gas emissions and adaptation aimed at dealing with unexpected shocks (Commission of the European Communities, 2009).

*A roadmap for moving to a competitive low carbon economy*, published in 2011, ended with the statement of the necessity of cooperation and global actions for “*a resilient low carbon economy*” (European Commission, 2011, p. 16). That is why the EU was a signatory to the above-mentioned Paris Agreement, pursuing a policy aimed at achieving climate resilience of socio-eco-

conomic systems. Article 2 of the Agreement indicated three main objectives (Paris Agreement, 2016):

- limiting the temperature rise (up to a maximum of 1.5°C above the pre-industrial temperature),
- increasing adaptability in the field of negative climate change and development of climate resilience and policy to reduce greenhouse gases emissions without threatening food production,
- adjusting the financial flows policy to the above activities.

The EU project of the LIFE program for 2021-2027 indicates as the main objective *“to contribute to the shift towards a clean, circular, energy-efficient, low-carbon and climate-resilient economy, including through the transition to clean energy, to the protection and improvement of the quality of the environment and to halting and reversing biodiversity loss, thereby contributing to sustainable development”* (European Commission, 2018, p. 16). In light of the main objective, it is necessary to develop and promote legislative mechanisms and policies, including the involvement of public and private actors and citizens (European Commission, 2018). Recommendations of the European Committee of the Regions from 2017 point directly to the role of regions, noting that they should be catalysts that support the efforts of local self-governments *“in strengthening their resilience to climate and disaster risks, building capacities and deploying available financing”* (The European Committee of the Regions, 2017, p. 52). The idea of resistance to climate change has become an inherent element of considerations in the field of socio-economic transformation and is an inseparable element of the sustainable development strategy, in particular in the area of approaches to climate change. However, the strategies usually differ between the different parts of the world.

### Bioenergy villages, chinampas and waru-warus as an example of resilient economic activities

The studies carried out in Nicaragua, Guatemala and Honduras after Hurricane Mitch have shown that farmers who used diversification, such as cover plants, intercrop and agroforestry, suffered less damage than farmers who had monocultures (Holt-Giménez, 2002). Moreover, surveys carried out in Cuba in 2008 after Hurricane Ike showed that farms with diversified crop structure show losses in the amount of 50% compared to 90-100% losses in the case of monocultures (Rosset, 2011). The Tschardt study (2005) similarly suggested that agriculture can contribute to the preservation of large diversity systems that can guarantee resilience, i.e. the ability to reorganize after a disruption. All of these studies have confirmed the great importance

of diversity in farming systems in terms of resilience to extreme climatic shocks.

Examples of climate-resilient economies can be shown in the distant past. For example, economies exposed to temporary flooding included *chinampas* (artificial fertile islets on the shores of lakes that secured themselves from flooding with, among other things, water-absorbing wicker) in the Valley of Mexico, as well as *waru-warus* near Lake Titicaca in Peru and Bolivia (Wilken, 1987; Altieri, 2018). Waru-warus were originally developed in the year 300 BC. The farming system used a network of canals separated by dykes for water storage and plant watering. The dykes were used for crop cultivation. They consisted of a mixture of clay soils and sand to enable the holding of water in the beds, while the soil within such created beds enhanced infiltration and the recycling of nutrients. The canals supplied water during droughts, and during floods they removed the excess. Moreover, the system created specific thermal conditions, as the water in canals absorbs solar energy during the day and radiates it back during nights; it also prevents against frost. The network of canals accumulated nutrients and served as a reservoir of natural fertilizers for the crops. The specific microclimate and organic conditions resulted in very high productivity and resiliency against environmental shocks (floods, drought or frost) (Altieri, 2018; UNEP, 1997).

A similarly successful farming system, called chinampas (the floating gardens), was developed in Mexico. The farming system was registered by UN FAO in 2018 in Globally Important Agricultural Heritage Systems (GIAHS) (UN FAO 2018). Chinampas were developed in 1100 AD from the muck excavated from swamps and the bottoms of shallow water reservoirs. The different layers of the nutrient-rich soil were piled into plots surrounded by water canals or lake water. A group of such gardens was integrated into a complex agricultural system. Willow trees were planted along their edges to control erosion (Sutton, Anderson 2010; Wilken, 1987). This system characterizes high productivity, biodiversity and climate resilience, and therefore, it is an example of sustainable and resilient farming. In 1984, a project was created to reconstruct the farming systems in Peru and Bolivia. It was particularly recommended for regions with extreme climate conditions. The cost of the infrastructure was relatively low and it increased the productivity of crops (usually potatoes) (UNEP, 1997). Moreover, this farming system has also been introduced in other countries such as China, Korea, Japan, Egypt and Spain (UN FAO, 2018).

Finally, in some communities, renewable resources were widely disseminated that were focused on energy self-sufficiency. The concept of bioenergy villages was originally related to the use of biomass as a new source of energy for rural areas. The process of building biomass plants assumed a social com-

mitment and community ownership (at least 50%). Therefore, communities were created around these common investments and new forms of economic activities, which included cooperatives. Zbaraszewski and Pieńkowski (2017) presented the evolution of renewable energy communities and the development of new activities, such as educational centres, or more complex forms of energy usage, including solar or wind energy. The key benefits include climate change mitigation, energy security and energy independence, stable and affordable energy prices, new job creation and social cohesion.

However, the selected cases show different strategies and forms of climate-resilient economies, although all the cases represent climate change strategies. The renewable energy communities mostly focus on climate change mitigation and resistance to economic shocks, while the farming examples represent a strategy of environmentally friendly farming and resistance to climate shocks (table 1).

**Table 1.** Benefits of economic activities on the example of bioenergy villages, waru-warus and chinampas

Dimensions of development	Bioenergy villages	Waru-warus and chinampas
Environmental	<ul style="list-style-type: none"> <li>– lower pollution</li> <li>– climate change mitigation</li> <li>– waste management (biomass energy sources)</li> </ul>	<ul style="list-style-type: none"> <li>– lower pollution</li> <li>– biodiversity</li> <li>– resistance to climate shocks</li> <li>– natural flows of matter and energy</li> </ul>
Economic	<ul style="list-style-type: none"> <li>– new job creation</li> <li>– resistance to energy market shocks</li> <li>– lower prices</li> <li>– energy surplus sales</li> <li>– development of new non-farm activities (i.e. agritourism)</li> </ul>	<ul style="list-style-type: none"> <li>– higher productivity</li> <li>– healthy, organic food</li> <li>– food security</li> </ul>
Social	<ul style="list-style-type: none"> <li>– social cohesion</li> <li>– energy security (self-sufficiency)</li> <li>– young people's attraction to rural areas</li> </ul>	<ul style="list-style-type: none"> <li>– social cohesion (farming provided by communities as a whole)</li> <li>– traditional cultivation</li> </ul>

Source: author's own work.

## Conclusion and recommendations

The effects of climate change, which have intensified in recent decades, have become a main focus of the international community. Events related to climate change, in particular, temperature increase, as well as the intensity and frequency of extreme weather events, affect the functioning of society and the environment and have effects on the economy. Climate change has

caused an increase in activities that can be classified into two groups. One group is mitigation activities, which are aimed at stopping climate change and counteracting the negative effects of these changes. This group of activities consists of contracts and agreements on the reduction of the use of fossil fuels, increase in the share of renewable energy sources in energy production, reduction of greenhouse gas emissions into the atmosphere and improvements in energy efficiency. The second group consists of adaptation activities, in which efforts are undertaken to reorganize and optimally adapt to the ongoing climate change. These strategies are mostly determined by the specific socio-economic conditions of particular local communities. The development of waru-warus or chinampas is an example of adaptation to climate changes – climate-resilient farming – while renewable energy communities are focused on climate change mitigation. The strategies are determined by particular socio-economic and ecological conditions. Local communities have to design and develop strategies based on their own resources and capabilities. The most developed countries, which have a relatively high share of non-farming activities, try to limit their greenhouse gas emissions and create new socio-economic structures that will not compromise the well-being of rural areas, while the highly populated developing countries need to secure food production and develop climate-resilient farming activities, as climate change challenges the relatively higher agricultural sector in those countries. Based on the analysis of the case studies provided, it should be stated that the accepted research hypotheses should not be rejected. It is necessary to comprehensively support the local economy so that it can prepare for the threats and opportunities that climate change can bring in the different parts of the world.

### The contribution of the authors

Dariusz Pieńkowski – 50% (concept and objectives, literature review, analysis and interpretation of data, revising critically the article).

Wojciech Zbaraszewski – 50% (concept and objectives, literature review, data acquisition, drafting the article).

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