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DIRECTIONS IN CLIMATE CHANGE ADAPTATION: CASE OF DELTA CITIES NETWORK

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ABSTRACT: Contemporary social and economic development of cities is often challenged by the intensification of extreme weather events caused by climate change. Their occurrence leads to damage in social, economic, environmental, and spatial sphere at multiple layers. Cities that make up the Delta Cities network are areas, which due to their location are exposed to similar climate events. As a result, it is necessary to improve their resilience and prepare society, economy, and the environment to the effects of negative events. In order to achieve it, urban space should be designed and developed in a way that would ensure the continuity of operations of enterprises and critical technical, social, and transport infrastructure. The goal of the paper is to identify threats and directions of adaptation actions undertaken by cities within the Delta Cities network to potentially develop waterfronts as areas especially exposed to sea-borne risks. The paper also draws attention to the fact that in adaptation strategies climate change is treated not only as a threat but also as opportunity for economic development, enhanced innovation, attractiveness, and competitiveness of the city.

KEY WORDS: adaptation to climate change; urban development; waterfronts; Delta Cities

Introduction

Social and economic development of cities and regions is often accompanied by a variety of disturbances that negatively affect social, economic, and environmental spheres. Among them we may identify issues concerning labour market, demography, innovation, enterprise, investment attractiveness, etc. Increasingly more often extreme weather events are mentioned as the root-cause of such disturbances. Natural disasters have always accompanied the mankind, however, the risk intensifies because of the progressing climate change. If no necessary adaptation effort is made, more social, economic, and environmental damage is anticipated. Cities, which make up Delta Cities network are areas, which, due to their location, are exposed to similar weather events. In the face of challenges they seek to identify the most effective ways to adapt, exchange knowledge, good practices, and cooperate within the network. The paper is intended to discuss threats, directions of adaptation efforts, and examples of executed investment projects, as well as the development of specific areas, such as *waterfronts* on the example of cities within the Delta Cities network. Attention is drawn to the fact that adaptation strategies increasingly often perceive climate changes not so much as a threat but as opportunity for economic growth, enhanced innovation, attractiveness, and competitiveness of the city.

Climate change and threats to Delta Cities

Contemporary development of cities, regions, and states is more and more often determined by progressing climate change understood as a "change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC). In the face of climate change broadly understood mitigation and adaptation activities are gaining in importance. According to the IPCC, the first group includes aspects, such as the reduction of greenhouse gas emissions from anthropogenic activities while the second one concerns the adaptation of natural and human systems that will allow risk minimisation and create possibilities to take advantage of opportunities resulting from climate change.

Although development policy measures often have as their premise the reduction of greenhouse gas emissions, forecasts highlight the inevitable intensification of the occurrence of extreme natural disasters, such as heavy rains, rising global sea levels, floods, storms, protracting droughts or high

temperatures. Consequences of these events will be reflected in water management, biodiversity, forestry, energy, coastal zones, mountains, urban areas, transport and construction sectors. There will be new challenges in health care or crisis management. As a result, we will need better resilience and prepare society, economy, and the environment for negative effects of weather events. To achieve it, urban space should be designed and developed in away that will ensure the continuity of operations of enterprises, technical, critical, social and transport infrastructure in the face of existing risks. Solution can be found in collecting and storing rainwater, developing green areas, taking account of strong winds, high temperatures and flooding when designing transport infrastructure and buildings, effective operations of public services and crisis management, diversification of energy supplies, organisation of warning and information systems, developing urban adaptation plans, etc. It is assumed that a well prepared urban system may operate correctly when an event occurs and it can easily regain its optimum capacity immediately after the occurrence. Hence, the aim is to reduce the susceptibility, increase resilience and adaptation capabilities of cities and endangered areas.

World Bank forecasts indicate that in the future more people will be living in coastal areas. It is predicted that social and economic losses in these areas will reach as much as USD 52 trillion in 2050 while in 2005 they amounted to USD 6 trillion. The challenge is to design and develop coastal areas to minimise as much as possible social, economic, and environmental losses (Hallegatte S., Green C., Nicholls R. J, Corfee-Morlot J., 2013, p. 802-806). Delta Cities network based in Rotterdam is an example of broad cooperation of coastal cities in the field of challenges connected with climate change. The network brings together the following cities: Copenhagen, Ho Chi Minh City, Hong Kong, Jakarta, London, Melbourne, New Orleans, New York, Rotterdam, and Tokyo. Despite differences in social and economic problems they cope with, all these cities face the same challenge, i.e., to reduce the susceptibility to current and future consequences of climate change, among which we can find sea-borne threats (location in a delta, increased water level), intense rainfalls (not necessarily frequency), rivers, lowered groundwater levels (weakened construction of levees, buildings, difficulties in inland navigation), as well as droughts, land subsidence, high temperatures, and intensified effects of urban heat island. Consequences of threats can be observed in social, cultural (losses in cultural heritage), economic, environmental, and spatial (e.g. new shape of space) spheres. Resilient cities – that global metropolises are supposed to become – should represent low level of risk and the ability to quickly recover from any event.

Adaptation directions and actions in Delta Cities

Instruments applied in climate change adaptation of cities may be financial, organisational, legal, infrastructural or educational. Depending on the moment of execution, these actions may be undertaken to reduce the risk of a concrete event or as follow-up efforts (linked with the reconstruction). In urban areas we may identify three scopes of adaptation measures connected with shaping resilient urban space: actions undertaken throughout the city that make up a coherent and logic plan; neighbourhood or local activities that cover a district or a part thereof but also buildings and space in between them, as well as actions oriented directly at buildings and their immediate neighbourhood (Shaw R., 2007, p. 17). We may distinguish two types of adaptation. The first builds up adaptation capabilities, including data collection (studies, forecasts, event monitoring, increasing the awareness of threat), social (cooperation, social development), and government support (regulations, legislation). The second type is based on the implementation of adaptation activities, which would effectively minimise sensitivity to climate change or take advantage of opportunities that they create. In case of both types we may speak of the following adaptation options (UK Climate Impact Programme, p. 15-17):

- *No-regrets* – measures that irrespective of climate change are worthwhile under current circumstances, e.g., avoiding construction in areas threatened by floods, reducing leakage from water utility infrastructure as a result of major repair or network modernisation; building from waterproof materials.
- *Low-regrets* – low cost policy based on relatively low cost measures that may be highly effective in the future, e.g., for infrastructural investment ensuring higher capacity of ventilation, channelling expected climate changes; protection of green areas to maintain biodiversity.
- *Win-win* – measures, which besides adaptation benefits produce measurable social, economic, and environmental effects and often mitigate climate change by, e.g., improving cooling properties of buildings and, by the same token, minimising demand for energy; green roofs and walls slow down rainfall drainage, cool the building, expand green areas in the city, and improve residents' standard of living.
- *Flexible (adaptive) management options* – options based on incremental measures, which may constantly be adjusted to outcomes of the latest analyses and climate change studies. Current assessment of actions minimises errors and the number of misguided investments, by, e.g., delaying introducing a specific option by building standards and legal regulations,

gradual withdrawal from investments in flooding areas considering threat and risk maps.

Adaptation instruments used in Delta Cities network include: pumping stations, surface and underground water tanks, levee, water walls, dunes and dykes, development of blue and green infrastructure, water squares, floating buildings, improved flow capacity of rainwater drainage system, buildings resilience to the threat of flood, i.e., wet (free flow of water in buildings, use of mould resistant materials) or dry (elevating buildings above the level of anticipated flood elevation) measures, enhanced awareness of residents, enterprises, monitoring, adequate climate risk planning and management (Connecting Delta Cities, 2013).

Members of the Delta Cities network have developed documents relating to the climate change. In its strategy London stresses that the need to build up resilience in cities translates into the image of the place, its attractiveness, safety of housing and pursuing business activities. We need to bear in mind that it is impossible to achieve 100% resilience, like it is not possible to ensure 100% security. Adaptation measures are necessary although they will not eliminate the risk, however, they will surely mitigate it. For instance, it is estimated that the building up of resilience in New York coastal areas will in the future reduce projected climate change related losses by 25% (Foreword from the Mayor, 2013).

Information included in strategic documents of Delta Cities members helps us draw some major conclusions.

Firstly, local actors reflect enhanced and continuously increasing awareness as to the occurrence of negative events and the need to undertake adaptive measures in Delta Cities network, which is confirmed by numerous analyses and studies conducted to provide foundations of adaptation strategies.

Cities, such as Jakarta, Hong Kong, Ho Chi Minh exhibit dynamic social and economic development reflected in the growing density of residents, infrastructure, as well as shrinking green areas. For example, the size of green areas in Jakarta dropped from 28.8% in 1984 to 10% in 2012. In New York, new flood risk maps for coastal areas have shown the increase of exposed population, buildings, and infrastructure by 90% and the increase in endangered areas by 42% compared to 1983. Also the building up of Kanda River Basin in Tokyo intensified from 60% in 1945 to 95% in 2005 (Connecting Delta Cities, 2013, p. 69, 125). More intense development and sealing of the area with simultaneous shrinking of green areas increase risks. As a result, cities on the one hand face dynamic growth but, on the other hand, they must practice sustainable spatial planning and realise deficits in public and private space that may be used for adaptation measures. Nowadays, Jakarta copes with the problem of illegal slums in the river basin, which reduce water

retention rate. Inhabitants must be resettled from vulnerable areas, which intensifies local social tensions (Connecting Delta Cities, 2013, p. 185).

Some cities, e.g., Copenhagen or Rotterdam have for many years been pursuing social and economic development that takes account of a variety of adaptation measures. Many infrastructural investments as well as soft measures have been implemented to improve resilience to extreme natural events. Cities like Jakarta and Ho Chi Minh have only just started to design and implement infrastructural projects and the need to make substantial financial outlays is still ahead of them. To them, international cooperation and exchange of best practices are crucial. Many documents point to Rotterdam as the leader in solutions and best practices in the field of adaptation to climate change, in particular in water management. For generations the city has been delivering investment projects that help contain the problem. In 2011 within the framework of Jakarta Climate Adaptation Tools project, two students were trained in adaptation to climate change and flood management in Rotterdam. Their acquired skills and competences that could be applied in Jakarta. In cooperation with Rotterdam Climate Adaptation Strategy was developed for Ho Chi Minh city (Connecting Delta Cities, 2013, p. 75).

Strategies of individual cities clearly highlight the importance of blue and green infrastructure in adaptation to climate change, including green walls and roofs, water squares, rain gardens, rainfall management and its redirecting to areas where it may produce little damage (e.g. sports fields, parking lots), water tanks. Stress is put on aforestation and protection of green areas. In Melbourne, for instance, Urban Forestry Strategy has been adopted. London plans to expand green areas by 5% until 2025. It is estimated that the city has got sufficient potential to create 300 rain gardens, 200 green walls 100 ha green roofs. The authorities of Copenhagen worked out a special Cloudburst Management Plan in 2012 including 300 projects on water management that consider green infrastructure and water drainage. Development of parks and green areas will, on the one hand, manage excess water in the best way possible and, on the other hand, positively effect the quality of space, reduce UHI, demand for energy and improved air quality in cities. The authorities of Copenhagen expect that higher security in urban space will positively impact real estate market. Expected benefits are calculated at the level of USD 767 m (Sustainia, 2015, p. 47). Many documents stress that blue and green infrastructure acts in adaptive capacity and improves spaces where people work and live exerting positive impact upon residents' quality of life.

Documents also highlight the need to build up resilience in newly built and existing buildings, critical and technical infrastructure (roads, railways, water and sewerage, gas and energy pipelines). For instance in Tokyo when-

ever infrastructure is designed account must be taken of earthquake threat. In Rotterdam it is planned to draft new construction regulations in the face of new challenges. Attention is also drawn to the need to develop the market of insurance against natural disasters (New York), improve evacuation capacity of residents (Jakarta), residents' education about future risks (Hong Kong, Copenhagen), and the need to cooperate with international actors within the network, local communities, public authorities, institutions and organisations. Delta Cities network is the forum for the exchange of experience and cooperation (Connecting Delta Cities, 2013, p. 31, 127; Copenhagen Climate Adaptation Plan, 2011; Rotterdam Climate Change Adaptation Strategy, 2012).

Waterfronts development in the face of climate change adaptation on the example of selected cities of Delta Cities network

The presence of *waterfronts* is a distinctive feature of cities located on water. Adequate development of banks may provide an impulse for sustainable development of cities. As a result, water does not have to be linked with the risk of flood and storm but be perceived as a source of development potential. The project of Public Spaces foundation listed qualities of attractive waterfronts in cities, which help boost growth and improve the standard of living. They include guidelines for building, types of activity, availability, multi-functionality, flexibility and management. One of them points to the need to ensure proper lighting and activities that go on round-the-clock and throughout the year to make the users feel safe (www.pps.org). The above aspects tackle the narrow understanding of public safety perceived mainly through the lens of criminality rates. Bigger safety and security issues involved in climate change adaptation and constructing highly resilient waterfronts have been omitted. Another example of a list of guidelines and proposed solutions can be found in the guidebook proposed by Waterfront Alliance *Introducing Waterfront Edge Design Guidelines (*Waterfront Building Council, 2015*)* which helps shape resilient and accessible waterfronts. These proposals address adaptation-related issues and encourage developing waterfronts that are (Waterfront edge design guidelines, 2016, p. 6):

- accessible – a waterfront must be accessible and useful to local communities (recreation, leisure), maritime sector, and trade; waterfronts integration with harbour function is recommended;
- environmentally-friendly – it is recommended to protect natural habitats, biodiversity, and implement innovative ecology projects;

- resilient – in the face of climate change, rise of sea levels, and risk of flood we need to pursue adaptation measures that build waterfront resilience.

One more example of waterfront shaping and management can be found in the catalogue. *Waterfront Design Catalogue* originating from Copenhagen. The document outlines strategies of coastal areas development and takes account of progressing climate change. Proposals include a classic waterfront with access to water, public space, routes and connections, active, and of temporary designation (The City of Copenhagen's, 2011).

Since development management in locations in the immediate vicinity of water has recently gained in importance, we observe an intensifying tendency to draft the so called local waterfront regeneration plans. These are strategic local documents, which identify directions to be followed when utilising the potential of waterfronts and water for social and economic development. Regeneration efforts stress the relevance of the involvement of local communities, experts, enterprises, NGOs, and all stakeholders in the process as they may work out a coherent, consensus-based document that will be effectively implemented in the future. When identifying the scope of areas of planned regeneration one needs to examine flood and bank erosion risks. All existing documents should be used, e.g., risk maps, hazard maps, flood scenarios, bank erosion as they will help identify areas at risk (New York Department of State, 2009, p. 3-28; Bolton, 2014, p. 3-11; Westchester County Department Of Planning, 2010, p. 1-8). Due to the progressing climate change, when planning and undertaking regeneration effort in *waterfronts* we need to use their potential, act in environmentally-friendly manner, and follow climate change forecasts. Thus all measures addressing transport, water and sewage infrastructure, modernisation of buildings or greening should deploy solutions, which mitigate the risk of flood and damage caused by storms, floods, etc. (City of BualoMayor, 2014, p. 7, Toronto, 2016, p. 3). In such cases it is recommended to leave more open spaces, design parks, recreational areas, which will reduce damage caused by temporary flooding to acceptable levels (Florida Department of Community Affairs, 2007, p. 43).

Cities brought together in Delta Cities network have specific spaces, such as riverfronts and seafronts and in the face of climate change they are threatened with rising sea levels that may lead to floods and storms. Goal 8 of the waterfront development plan for New York (In 2002 New York adopted The New Waterfront Revitalization Program, which goal was to minimise the cost of flood and banks erosion) *Vision 2020, New York City Comprehensive Waterfront Plan*, makes reference to building waterfront resilience in the face of intensifying extreme weather events. Planned activities should take account of the specificity of the shoreline, including the degree of risk involved, type of waterfront, community expectations, and economic development direc-

tions. The plan identifies five functional waterfront categories in the city (New York City, 2011, p. 106-108):

- natural – expected erosion of banks, beaches, dunes, bluffs and partial loss of certain plant and animal species; it is not easy to identify the specific effects of natural events due to progressing transformations resulting from natural and anthropological factors;
- public – most of waterfront is accessible to residents as a place of recreation activities, which positively impacts the quality of human resources, conditions for working and living. We may expect losses caused by storms and flooding in infrastructure of parks and playgrounds, damage to green areas, beaches, piers, and flood protection infrastructure;
- redeveloping – occupied with residential and commercial buildings; built-up infrastructure and climate change are the reasons why new regulations are developed in the area of spatial development, construction, types of insurance suitable for new and existing structures;
- working – filled with critical infrastructure (road and maritime transport, water and sewage infrastructure), whose damage may adversely affect the continuity of business operations, maritime transport, households and the city. We need to prepare for more frequent repairs and maintenance of infrastructure;
- blue network – in the face of new climate-related challenges and loss minimisation, waterfronts should be adequately designed and adapted to anticipated changes.

In the document *Port Melbourne Waterfront Urban Design Framework* Melbourne undertakes the task to develop attractive residential areas, places to work and rest rich in green spaces, representing high level of safety and optimum storm water management (Melbourne, 2013, p. 2, 14).

New Orleans (www.reinventingthecrescent.org) decided to create attractive, green, and accessible riverfront that ensures flood protection without technical barriers, which could prevent access to the river, the development of green areas, creating an attractive location to live, work and spend leisure time, infrastructure development including the creation of permanent (ca. 24 k) and seasonal jobs.

Concluding remarks

In the face of progressing climate change many cities also in Poland are confronted with the increasing waterborne risks, i.e. risks posed by the proximity of seas (Warsaw, 2013, p. 102), rivers, intense rainfall and groundwater. Since risks to Delta Cities are similar, these cities should strive to exchange best practices, conduct joint studies, deliver projects and analyses of climate

change. Because of the existing cooperation, knowledge, and experience Delta Cities make a good example and offer a pool of knowledge for Polish cities. Against the backdrop of climate change and the need to develop urban adaptation strategies adjusted to Polish circumstances, as well as attempts to identify future steps, it seems fundamental to consider experiences of cities, which have already drafted such documents. It is necessary to get acquainted with the applied solutions, barriers and directions of actions, which enable building up the resilience of coastal cities. Attention is drawn to the fact that Delta Cities exhibit positive attitude to water. Copenhagen is seeking growth opportunities in adaptation measures and treats them as part of building up its competitiveness, innovation and investment attractiveness of the city. In New Orleans water is an important resource and development potential rather than a threat, which should only be combated. Such an approach changes the way flood risks are perceived and shifts us towards the strategy *learn to live with flooding* and with other climate-related risks. It is an opportunity to head towards sustainable development, building up attractiveness and competitiveness of coastal cities.

Literature

Bolton (2014), Town of Bolton, *Local Waterfront Revitalization Program* – July 2014

City of BualoMayor (2016), *Local Waterfront Revitalization Plan Public*, 2014

Connecting Delta Cities (2013), *Resilient cities and climate adaptation strategies*

Copenhagen Climate Adaptation Plan, Copenhagen 2011

Florida Department of Community Affairs Guiding (2007), *The Way To Waterfront Revitalization. Best Management Practices*

Hallegatte S., Green C., Nicholls R.J, Corfee-Morlot J. (2013), *Future flood losses in major coastal cities*, "Nature Climate Change" No. 3, p. 802–806

Identifying adaptation options, *UK Climate Impact Programme*, www.ukcip.org.uk [11-10-2016]

Melbourne (2013), Port Melbourne, *Waterfront Urban design framework*, www.port-phillip.vic.gov.au [12-11-2016]

New York City (2011), *Vision 2020, New York City Comprehensive Waterfront Plan*

New York Department of State (2009), *Making the most of your waterfront. Enhancing Waterfronts to Revitalize Communities*

Rotterdam Climate Change Adaptation Strategy 2012

Shaw R., Colley, M., Connell, R. (2007), *Climate change adaptation by design: a guide for sustainable communities. TCPA*, London

SUSTAINIA, (2015) C40, 100 solutions form climate action in cities, 2015

The City of Copenhagen's, (2011) *Waterfront design catalogue source of inspiration for encouraging more waterfront activity*

Toronto (2016), *Waterfront Revitalization Initiative* 2016-2025, Capital Budget, Toronto

UK Climate Impact Programme, *Identifying adaptation options*, www.ukcip.org.uk [20-11-2016]

Warsaw (2013), *The list of cities the most endangered with storm flood includes Gdansk, Szczecin, Swinoujscie, and Kolobrzeg*, in: Opracowanie i wdrożenie Strategicznego Planu Adaptacji dla sektorów i obszarów wrażliwych na zmiany klimatu Etap III 10

Waterfront Building Council, (2015), www.waterfrontalliance.org [20-11-2016]

Waterfront edge design guidelines (2016), www.waterfrontalliance.org [20-11-2016]

Westchester County Department of Planning (2010), *A Guidance Document for Municipal Officials and Planners*, E. Buroughs, AICP, Acting Commissioner

www.pps.org [27-11-2016]

www.reinventingthecrescent.org [20-11-2016]