

Anna DUBEL

INTEGRATING MITIGATION AND ADAPTATION IN CLIMATE, WATER AND DEVELOPMENT POLICIES IN KRAKOW

Anna **Dubel**, PhD, MA, Eng. – *AGH University of Science and Technology, Krakow*

Correspondence address:
Faculty of Management
ul. Gramatyka 10, 30–067 Krakow, Poland
e-mail: adubel@zarz.agh.edu.pl

ABSTRACT: In view of such a complex phenomena as climate change not sufficient outcomes emerge from concentrating separately on mitigation or adaptation efforts, but rather it is their integration in a coherent policy and the subsequently planned actions that could increase effectiveness and efficiency as well as intensify the desired results. This working hypothesis is elaborated in the paper based on the case study of the city of Krakow in the Southern Poland. The aim of the paper is to identify the synergies and trade-offs from the climate mitigation and adaptation efforts planned within the climate, water and development sectors in Krakow. The scoping study of the policies and strategic documents was performed with that respect and the state-of-the-art literature was studied to capture the latest advancements in the climate mitigation and adaptation integration studies in order to develop the research method. The applied method was validated as relevant for integration of these aspects with the focus on the cities. The results show the landscape of the planned strategic actions towards mitigation and adaptation to climate change as well as synergies and trade-offs between the two. In the discussion the results are analysed in view of the identified performed studies of this type.

KEY WORDS: climate, mitigation, adaptation, synergies, trade-offs

Introduction

The emerging effects of climate change are spread worldwide and they are resulting in multi-sectorial impacts. While scenarios and prognoses of future behaviour of the key climate change variables and driving forces are elaborated, the scope and magnitude of these effects in different parts of the world in the future are yet to be researched. Although there could be some positive impacts, such as lower energy demand during warmer winters or cooler summers, most of the foreseen climate change impacts are likely to be negative (Edenhofer et al, 2014), as more weather and climate related extreme conditions are forecasted. Therefore, mitigation of climate change is gaining more attention at the political agenda and more social understanding. Mitigation is defined as an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases (Edenhofer et al, 2014).

At the same time, the even more frequently emerging discomforts and losses related to climate change are driving the implementation of a number of locally-well suited adaptation measures. Adaptation is a process of adjusting to actual or expected climate change and its effects and its purpose are to mitigate or avoid negative impacts, as well as benefit from certain opportunities arising from climate change (Field et al. (eds.), 2014). There are various kinds of adaptation defined, such as: anticipatory or reactive, spontaneous (autonomous) or planned, private or public. The integration is mostly possible and would be the most effective in case of public, planned, anticipatory adaptation.

Mitigation and adaptation do not always complement each other, but can be counterproductive (Field et al. (eds.), 2014). One can imagine that even their integration could lead to adverse results. On the other hand beneficial synergy effects might emerge from the integration. Therefore, in order to increase effectiveness and efficiency of the single actions the integration possibilities of the adaptation and mitigation domains should be explored.

Research method

The aim of the paper is to identify the synergies and trade-offs related to the climate mitigation and adaptation efforts planned within the climate, water and development sectors in Krakow by performing a systematic content analysis of the major city relevant policy and strategic documents. It is to determine whether in view of such a complex phenomena as climate change sufficient outcomes emerge from concentrating separately on mitigation or

adaptation efforts or it is rather their integration in a coherent policy and the subsequently planned actions that could increase their effectiveness and efficiency as well as intensify the desired results.

In order to achieve this the scoping study was performed to identify strategies, sectorial programmes and other policy documents related to climate, water and development sectors in the city.

In the paper, the integration concept was defined. The state-of-the-art literature was studied to capture the latest advancements in the climate mitigation and adaptation integration studies that were used to frame the building blocks of the integration framework. Identification of positive and negative interactions between the climate change mitigation and adaptation efforts as well as identification of the possible synergies between them were based on the state-of-the-art research as well as on a study of the policy and strategic documents related to climate, water and development policies. The identified and analysed documents are presented in Table 2. "Snow ball" technique was adopted to identify the relevant documents – it means that the analysed documents pointed out to other studies, which were further explored.

Integration concept

The mentioned integration can be understood and defined in various ways. Climate policy integration or climate mainstreaming (Brouwer, Rayner, Huitema, 2013) indicates that effective policy implementation requires integrating climate change objectives into sectorial policies. In the water sector Water Framework Directive (2000/60/EC) and Flood Directive (2007/60/EC) as well as other daughter directives of Water Framework Directive transposed to the Polish legal system, mostly to the Water Law (Dz.U. 2015, poz. 469), stress that the contemporary water management should be implemented as an integrated water resources management taking into consideration surface and ground water quantity and quality as well as technical, social and ecological aspects, spatial and land use planning as well as landscape. Similarly flood (and adequately draught) management (Dubel, Preisner, 2015) is perceived as an integrated process, linking preparedness, protection, reaction and recovery in a holistic and operational concept. Integrated management takes into account interests of many stakeholders, such as water managers and users, it is sustainable and it is implemented in the catchment (river basin) as a whole. Based on these concepts integration of climate mitigation and adaptation would require a joint effort of stakeholders and should be perceived as one holistic approach, leading to mutually beneficial outcomes. However, such close integration of climate mitigation

and adaptation might not be possible due to the differences between the approaches that are presented in table 1.

The differences mentioned in the table 1 do not prevent efficient implementation of both types of measures on the same local or regional scale.

Table 1. Differences between climate mitigation and adaptation

Characteristic	Mitigation	Adaptation
Effectiveness in spatial and temporal scales	Global benefits; effects visible with delay (after several decades)	Mostly local or regional benefits (scale of the impacted system); effective immediately
Possibilities of costs and benefits estimation, comparison and aggregation	Universal metrics for comparison can be applied (e.g. CO ₂ -equivalents), thus the cost-effectiveness of measures can be determined and the options relatively easy compared	Different metrics are applied (e.g. damages avoided, human lives saved, losses to natural and cultural values avoided, etc.); it's difficult to precisely assign benefits to a particular adaptation option
Actors (stakeholders) and sectors	Involves primarily the energy and transportation sectors in industrialized countries as well as to an increasing extent the energy and forestry sectors in developing countries, and also agriculture sector; well organised actions at national level	Agriculture, tourism and recreation, human health, water supply, coastal management, urban planning and nature conservation; spread decision making

Source: based on (Klein, Schipper, Lisa, Dessai, 2005).

Studies about the climate policy integration and coherence in land use policies in the developing countries, such as Brazil, Indonesia and Peru, investigate administrative domain (including complex governance and stakeholders analyses) as well as interactions within and across policy domains. The studies show the extent to which positive and negative interactions between mitigation and adaptation are taken into account in policy formulation (Di Gregorio et al., 2016; Pramova, Di Gregorio, Locatelli, 2015). Integrated approach to mitigation and adaptation is understood as implementation of policies or measures where mitigation and adaptation are pursued together as joint objectives and seeking mutual benefits.

Exposure to the climate phenomena and sensitivity of the area to these phenomena constitute the magnitude of climate change impacts on a given area. The vulnerability to climate change depends on the magnitude of the impacts and adaptive capacity of a place (*Podręcznik adaptacji dla miast*, 2015). The increasing adaptive capacity makes the place more resilient. The losses are the result of probability of extreme event and risk, the last one being a multiplication of value of exposed assets and their vulnerability.

Examples of measures to mitigate climate change are the following: energy from renewable energy sources, energy-efficient constructions, and

low-carbon technologies. Examples of integrated solutions include: planting trees, construction of ponds and infiltration basins, green roofs, to name but a few. Many of measures from the catalogue of the natural water retention measures (www.nwrm.eu) as well as indicated in the Adaptation Wizard (www.ukcip.org.uk/wizard) are mutually beneficial. As examples of trade-offs additional open spaces for water retention, green spaces protection or increase of urban densities to reduce car dependency, can be mentioned.

The need for integration is driven by the possibility to acquire additional benefits or synergy effect, eliminate negative impacts and to improve the effectiveness and efficiency of adaptation and mitigation measures.

Case study

Krakow is a place of living for almost 770 thous. inhabitants within the area of 327 km². It's located in the Vistula river valley and floodplain. The hydro-morphological characteristics of its location determine significant weather related and climate induced risks (e.g. floods – especially during the high precipitation in the summer period), together with low air exchange and high infrastructure density that constitute the key challenges regarding the climate adaptation and mitigation. Krakow is an important tourist destination. It's visited by more than 10 Mill. tourists yearly and it's a home of many universities. It is recommended as a place to localise B2B services. The vision of the city is that "Krakow, a city encouraging civic pride, guaranteeing its inhabitants a high standard of living and demonstrating sustainable development, a European metropolis and competitive hub of a modern economy based on scientific and cultural opportunity" (Krakow Development Strategy, 2016).

The main causes for the high damages resulting from floods and water infiltration in Krakow are: placing constructions (buildings) and infrastructure next to the river in the natural floodplain areas.

Results

The legal acts and strategic documents implemented in Poland, at the country wide level, highlighting the need to take active measures for flood risk management, adaptation to climate change and mitigation of its effects were identified and studied as well as the strategic and planning documents of the city of Krakow. Based on the Gregorio et al studies (Di Gregorio et al, 2016) thirteen different types of interactions could be identified: positive (+) or negative (-) effects that a policy or measure aimed at one objective (adap-

tation: A, mitigation: M, or non-climate objective: X) might have on another objective (from A, M or X categories) and integrated approach (pursuing both adaptation and mitigation objectives together in an integrated manner aimed at realizing mutual benefits: I). Relations between the selected mitigation and adaptation actions identified from selected documents and the chosen type of synergies are presented in table 2.

Table 2. Mitigation and Adaptation interactions based on strategic documents relevant for Krakow

Name	Adaptation actions	Mitigation actions	Type of interaction
Poland's Strategy of Development until 2020 (Strategia Rozwoju Kraju do 2020 roku), 2012, Ministry of Regional Development	A1: development of adaptation plans; A2: education campaigns on climate change and adaptation; A3: flood protection measures and preventive spatial planning; A4: investments limiting negative weather related impacts on economy	M1: RES development; M2: implementation of measures increasing energy efficiency; M3: clean technologies development; M4: energy demand integrated management systems development; M5: grid development; M6: GHG emissions management	A1->A+X+ A2->A+M+X+ A3->A+X+ A4->I M1->M+A+/-X+/- M2->M+A M3->M+A+X+ M4->M+ M5->M+X+ M6->M+X-
Polish National Strategy for Adaptation to Climate Change (NAS 2020) with the perspective by 2030. 2013, Ministry of Environment	A5: restoring and maintaining the good state of waters, water ecosystems and water-dependent ecosystems A6: promoting the development of RES; A7: development of alternative energy production capacities at the local level; A8: implementation of sustainable low-carbon energy sources; A9: increasing the forestation rate; A10: implementation of local monitoring systems; A11: taking into account, in urban development plans, of the need to expand green and water areas, ventilation corridors and low-emission ways of heating buildings; A12: inclusion of local communities and self-government administration into actions to prevent the effects of climate change.	Not explicitly identified climate change mitigation measures	A5->A+X+ A6->A+M+X+/- A7->A+M+X+ A8->A+M+X+/- A9->A+M+ A10->A+M+X+ A11->A+M+X+/- A12-> A+M+X+
Poland's Climate Policy until 2020 (Polityka klimatyczna Polski do 2020 roku), 2010, The Ministry of Environment	A13: reducing water losses in industry and the municipal economy; A14: enhancing the capacity to store water, particularly through small retention	M7: protection of the natural environment against the adverse effects of the impact of energy generation processes; M8: use of BAT; M9: promotion of low-emission technologies	A13->A+M+X+ A14->A+M+X+ M7->M+X+ M8->M+X+ M9->M+A+X+
Polish National Water Policy until 2030 (Polityka wodna państwa do 2030 roku), 2010, KZGW	A15: mitigating flood and drought risks and negative results of extreme events; A16: investments in water retention measures; A17: more effective water resources management driven by efficient technologies	Not identified	A15->A+X+ A16->A+M+/-X- A17->A+M+X+

Name	Adaptation actions	Mitigation actions	Type of interaction
Cracow Development Strategy 2030 (Strategia rozwoju Krakowa 2030), 2016, Krakow Local Authorities	A18: development of climate change adaptation plan for the city; A19: green roofs	M10: creating conditions for the knowledge transfer from the technology experts; M11: promotion of passive constructions; M12: development of cycling infrastructure	A18->A+ A19->A+M+ M10->M+X+ M11->M+ M12->M+
Programme of Environmental Protection of the Krakow City (POŚ dla Krakowa), 2016, Krakow Local Authorities	A18: continuation of investments in flood protection measures	M13: continuation of low emission elimination programme with the focus on private coal furnaces M14: protecting the green corridors system and green open spaces in the city	A18->A+X+/- M13->M+X+/- M14->M+X-
Plan of Low Emission Economy for the city of Krakow (Plan gospodarki niskoemisyjne dla Gminy Miejskiej Kraków), 2015 ^{a)}	Not identified	M15: thermo modernization; M16: modernisation of local heating systems; M17: widespread implementation of RES technologies; M18: elimination of solid fuels for heating; M19: development of low emission transport	M15->M+X+ M16-> M+X+ M17->M+X+ M18->M+X+/- M19->M+X+/-
Spatial development study in Krakow, 2015, Krakow Local Authorities ^{b)}	A19: implementation of flood protection measures limiting flood damages; A20: banning environmentally important areas from construction development	M20: reduction of raw materials branches and development of highly processed products; M21: development of beneficial aero-sanitary and micro-climatic conditions	A19->A+ A20->A+X- M20->M+X+/- M21->M+A+X+

a) Similar actions were identified in: „Założenia do planu zaopatrzenia Gminy Miejskiej Kraków w ciepło, energię elektryczną i paliwa gazowe”, Krakow.

b) Studium uwarunkowań i kierunków zagospodarowania przestrzennego Miasta Krakowa.

Both mitigation and adaptation actions are presented within one goal, namely (Goal II.6) “Energy security and environment” in the Poland’s Strategy of Development. They are further pursued in Energy Security and Environment Strategy (Strategia Bezpieczeństwo Energetyczne i Środowisko perspektywa do 2020 r.) where they are presented as separate actions. In many cases, like action M3 identified in table 2 (clean technologies development), the actual positive impacts on adaptation or other sectors will depend on particular conditions of the measure implementation, e.g. water efficiency of these technologies. In the National Strategy of Regional Development 2010–2020 (Krajowa Strategia Rozwoju Regionalnego 2010–2020) “Response to climate change and provision of energy security” are presented as one of the strategic challenges of regional policy. In case of the Polish National Strategy for Adapta-

tion to Climate Change for presentation in the table 2 only a few adaptation measures were selected out of a very rich catalogue presented in the strategy. As indicated in the table 2 many of the actions that are defined as adaptation actions are also serving for the purpose of climate change mitigation, e.g. promotion of the development of RES. In the Polish National Strategy for Adaptation to Climate Change synergies with the climate mitigation and co-benefits with the other sectors are visible. Poland's Climate Policy until 2020 defines the goals for the energy, industry, transport, agriculture and forestry sectors as greenhouse gas emissions reduction, but also gives recommendations concerning measures to adapt Polish economy to climate change. Protection of forests and green areas (indicated in Program Ochrony Środowiska dla Miasta Krakowa), mitigation of urbanization effects (indicated in Cracow's Development Strategy) or ban on constructions in environmentally important areas (indicated in Studium uwarunkowań i kierunków zagospodarowania przestrzennego Miasta Krakowa) are good examples of measures that have co-benefits on both mitigation and adaptation to climate change. In the Cracow's Development Strategy identified measures are presented under the overarching objective: "Cracow – good city to live in".

Discussion of results

Although the Grigorio et al 2016 and Palmova et al 2015 studies were focused on agricultural and forest policies, the interesting recommendations and conclusions drawn from these studies were explored with regard to the climate-water and development nexus in Krakow city ecosystem. The relevance of the chosen findings and observations of these studies were discussed in view of the performed Krakow case study.

- „Policy makers need to address more explicitly potential trade-offs between mitigation and adaptation in both policy formulation and implementation“ (Di Grigorio et al., 2016). This is certainly relevant for Poland with regard to both national and local levels. More attention to integration is given in such documents as Podręcznik Adaptacji dla Miast, where analyses of options based on the Multi Criteria Decision Analysis are proposed and interdisciplinary experts, representing stakeholders' groups, are planned to be engaged in the development of adaptation plans for cities in Poland.
- More attention to integration should emerge from the more resourced and influential policy actors linked to the climate change mitigation policy domain (Di Grigorio et al., 2016). It would be useful also in Poland and in particular in Krakow. Studies presenting mutual benefits are recommended to be developed.

- Integrated approaches that consider mutually supportive mitigation and adaptation actions are called for in key climate change policies, but so far such linkages remain largely unexplored in sectorial policies (Di Grigorio et al., 2016). This statement is also true for Poland. Especially at the local and regional levels there are possibilities for a wide variety of policy responses, such as sustainable urban form, energy production from RES or new approaches to biodiversity conservation (Hamin, Gurran, 2009).
- “Half of the actions identified contain potential conflicts to achieving adaptation and mitigation simultaneously” (Hamin, Gurran, 2009). This was not observed. However, there measures with potential trade-offs identified. Therefore, the more detailed studies supported by the cost-benefit analysis are recommended. The issue of trade-offs can be addressed by implementation of economic analysis as recommended by the WATECO Group. Such approach was presented in Bayer et al 2012 (Bayer, Dubel, Sendzimir, 2012) within the Warta river basin. Also, in order to avoid conflicts, the priorities need to be set in linking climate change adaptation with sustainable development (Laukkonen et al., 2009). Moreover, case studies of successful adaptation and mitigation strategies are suggesting that involvement of local authorities using participatory approaches is an important driver of success (Laukkonen et al., 2009).

Conclusions

The presented study on possibilities for integration of both adaptation and mitigation measures shows the approach towards identification of potentially most effective and efficient climate adaptation and mitigation strategies for the future. The analysed documents indicate in general that mainstreaming mitigation and adaptation is pursued separately in different sectors, but the efforts towards a more holistic and coordinated approach are undertaken. However, the mutual interactions of the policies and measures as well as their integration, the resulting co-benefits or trade-off, have not yet been adequately analysed in the mentioned strategic documents. The planned mitigation strategies for the cities, whenever possible, should involve impact analysis on adaptation options and the planned adaptation strategies should involve impact analysis on climate mitigation.

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