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Group of Experts on Climate Change Impacts and Adaptation for Transport Networks and Nodes

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Discussions on the final report of the Group of Experts

Case study: Polish practice in carrying sensitivity and vulnerability analysis for the identification of hotspots on transport infrastructure due to climatic factors

Submitted by the Government of Poland

This document briefly introduces Polish approach for transport infrastructure sensitivity and vulnerability analysis due to climate change. The Group of Experts should consider this document and discuss its inclusion in chapter 3 of the final report.

Contribution to the work of the UNECE Expert group concerning description of the Polish practice in carrying out sensitivity and vulnerability analysis for the identification of hotspots on transport infrastructure due to climatic factors.

DRAFT VERSION

INTRODUCTORY

The Polish National Strategy for Adaptation to Climate Change for sectors and areas sensitive to climate change by 2020 with a vision to 2030 (NAS) was adopted in 2013. The project "Development and implementation of a strategic adaptation plan for the sectors and areas vulnerable to climate change" with the acronym KLIMADA, has been the basis for the preparation of a strategic plan for adapting the country to climate change.

The responsible authority on matters of climate change adaptation is the Ministry of Environment (Department for Sustainable Development and International Cooperation). Supportive services are provided by the Institute of Meteorology and Water Management (IMGW-PIB), the Institute of Environmental Protection (IOŚ-PIB), and the Institute for Ecology of Industrial Areas (IETU). Climate change data are gathered by IMGW-PIB. The datasets are available upon request, but not all are currently accessible on a website. KLIMADA holds general information, data on climate change trends and climate change scenarios.

NATIONAL ADAPTATION STRATEGY (NAS)

In the field of adaptation the relevant document is the "National Strategy for Adaptation to Climate Change by 2020 with the perspective by 2030" (NAS) - part of the wider research project "KLIMADA" which covers the period until 2070 and is the basis for the conclusions presented in the NAS. The NAS is used as a framework guidance to help support monitoring indicators and assessment of the implementing actions at the national, regional and local levels, including transport sector.

This document includes a description of the general characteristics of the climate, climate change from 2007-2011, scenarios and impact on sensitive sectors until 2030. Furthermore, the document includes an analysis of climate change trends and impacts on biodiversity, water management, forestry, power engineering, coastal zones, mountain areas, agriculture, transport, spatial economy and urbanised areas, construction and health.

CRISIS MAMAGEMENT ACT (DISASTER RISK MANAGEMENT)

Another applicable document which is concentrated mostly on crisis situations (also related to climate change) is the ACT of 26 April 2007 on Crisis Management. The document has been developed by the Government Security Centre. It includes the characteristics of hazards and risk assessment of their occurrence, the critical infrastructure (including risk maps and hazard maps), the duties and responsibilities of participants in crisis management in the form of safety net, a statement of the forces and resources planned for use in crisis situations.

EIA DIRECTIVE AND POLISH EIA ACT

According to the revised law on Environmental Impact Assessments, it is necessary to take into account climate risk analysis. This applies mainly to projects of type I (in the EIA Report), but it is not obligatory for type II projects. Other projects are not covered by this legal requirement.

ADAPTATION PLANS FOR 44 CITIES PROJECT (MPA)

At the national level, the project Development of Urban Adaptation Plans for cities with more than 100,000 inhabitants in Poland (MPA) coordinated by the Ministry of Environment aims to provide support to 44 cities. The overarching goal is to identify and analyse adaptation challenges each city may face, draft plans for local authorities, indicate sources of funding and raise awareness for the need of adaptation.

KLIMADA

Klimada is a platform developed during the project - "Klimada" (Development and implementation of a strategic adaptation plan for the sectors and areas vulnerable to climate change). The results of this project were the basis for the preparation of the NAS. Klimada holds general information, data on climate change trends and climate change scenarios. It also presents a diagnosis on the vulnerability of 12 sectors (including Health, Tourism, Mining, Construction, Transport etc. The portal holds information regarding climate aspects affecting each sector in Poland, and how they can be addressed in project preparation. Klimada is also collecting data about case studies in some regions in Poland.

FLOOD RISK AND HAZARD

For the water sector, Polish Waters (the national water management body, Wody Polskie) together with the Regional Water Management Boards (11 institutions) has developed several documents and projects that relate to climate change adaptation, including:

- Preliminary assessment of flood risk - the objective is to designate areas endangered by flooding, i.e. areas at significant risk of flooding or where the occurrence of high risks is likely;
- Flood hazard maps and flood risk maps - developed within ISOK project;
- Flood risk management plans - to reduce the potential negative impacts of floods on human life and health, the environment, cultural heritage and business. This will be achieved by implementing measures to minimise the identified risks; and
- Development of counteraction plans of drought effects in river basin districts - the objective is to propose reduction and preventive measures to reduce the negative impact of drought on society, the environment and the economy.
- ISOK - IT System for Protection of the Country Data holds information about water management, natural hazards, threatened areas etc. Its objective is to improve operation of crisis management systems at all levels, but it can be also used in spatial planning (in the context of flood hazard in river valleys).

GUIDE TO INVESTMENT PREPARATION RESPECTING CLIMATE CHANGE MITIGATION AND ADAPTATION AS WELL AS RESILIENCE TO NATURAL DISASTERS (Ministry of Environment, 2015)

Methodologies for integrating climate change adaptation into the development of infrastructure projects rely on the basic rules of risk assessment.

In Poland, projects which are co-financed from EU funds are obliged to use the methodologies indicated in the Guide to investment preparation respecting climate change mitigation and adaptation as well as resilience to natural disasters (2015). Recommendations were prepared by the Department of Sustainable Development at the Ministry of Environment in cooperation with the Pilot Group, including representatives of the Ministry of Infrastructure and Development which indicate the methods that should help investors (including beneficiaries of EU funds in the period 2014-2020) in preparation of investment projects and / or in the application of EU funds on issues related to climate change adaptation and mitigation and resilience to natural disasters.

TRANSPORT

Investments in the transport sector are very diverse, covering roads (including bridges and tunnels), inland waterways, rail, ports / airports, and public transport infrastructure. Any disruption caused in this sector can affect many other sectors (economic and societal) directly.

Rail and road transport

The transport sector is particularly vulnerable to several elements of the climate, especially to strong winds, downpours, flooding and landslides, snowfall and ice phenomena, storms, low and high temperature and lack of visibility (fog, smog). The vulnerability and the impact of climate change on transport may be analysed in relation to individual types of transport.

Road transport, due to its spatial nature, is particularly vulnerable to changing climatic events. Strong winds resulting in, inter alia, blocked roads and damaged road infrastructure and vehicles may grow stronger in the future. Similar changes may be observed in case of rapid rainfall and snowfall, whose occurrence disturbs the transport smoothness. Floods are very dangerous, they can disturb and slow down traffic or even may lead to traffic stop. In addition, floods can be dangerous to human health or life and cause damage to road infrastructure and vehicles. Flooding water up to a height of 0.5 meters is connected with very high risk and can completely paralyze traffic on roads (or a railway system). Problems related to the increasing occurrence of high temperatures also affect negatively both vehicles and road infrastructure elements.

Particularly troublesome for road transport are long-lasting heat periods. More frequent occurrence of temperatures close to zero in winter will result in an escalated occurrence of fog, which, by reducing the visibility, will have a negative impact on road transport while multiple passage through the point of 0°C in the absence of snow cover results in the rapid degradation of the surface.

Rail transport is also vulnerable, especially to incidental climate phenomena. Strong winds and hurricanes as well as heavy rains, that cause flooding and landslides, whose frequency will increase, may damage rail infrastructure elements. Together with the progressive warming process, cases of track deformation and fires of rail facilities may increase and, also, work conditions and comfort of travel will deteriorate.

CASE STUDY DESCRIPTION

For the case study, methodology from the Guide to investment preparation respecting climate change mitigation and adaptation as well as resilience to natural disasters (Ministry of Environment, 2015) was applied. The methodology described/provided in the Guide covers the full assessment of the climate risk, however, in this study, the analysis was limited to climate vulnerability stage, which contains sensitivity and exposure analyses. For this purpose, transport nodes and road sections belonging to the TEN-T network have been selected, for which the traffic intensity/flow is the highest ("hot spots"). Then, risk and flood hazard maps were used (in GIS terms they were added as a layer) to obtain such hot spots where there is a risk of flooding, including in the case of breakage of flood embankments. The next step in the analysis would be to find adaptation options that aim to reduce the climate risk (climate vulnerability) and to choose from these options specific adaptive measures. The use of GIS tools is very important in the case study. Hot spots were added to the risk and flood risk maps in GIS, in the result we obtained maps showing hot spots in the context of probability of flooding (road network layer, layers of water with a specific depth associated with the probability of flooding). This is an example of using GIS tools to conduct a climate vulnerability analysis. In a number of UNECE countries, the use of GIS tools in the climate risk and vulnerability analyses is not sufficient. Below the relevant definitions and technical details are presented (in the meaning of the above Guide).

Sensitivity analysis - involves the determination of the size and significance of the magnitude of risks to changes in individual input parameters.

Vulnerability: The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. In probabilistic/quantitative risk assessments the term vulnerability expresses the part or percentage of Exposure that is likely to be lost due to a certain hazard. Formally, vulnerability (V) is the result of multiplication of exposure (E) by sensitivity (S) (V=ExS).

Vulnerability analysis - evaluating the sensitivity and exposure of infrastructure to climate change.

Risk analysis - estimating the likelihood and impact of relevant climate hazards.

Exposure: People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.

Risk map is a map that portrays levels of risk across a geographical area. Such maps can focus on one risk only or include different types of risks.

The scope of the data analysed in the study was the following:

- flood risk and flood hazard maps - the flood risk and hazard maps connected with flood risk management plans referred to in Articles 4, 6 and 7 of Water Framework Directive. Data consisted of shape files and KML files. Data included the likelihood of flooding at Q=0,2%, Q=1% and Q=10%. The data also contained the information concerning flood water depth, water flow velocity and directions of flood water flow, reference layers contain: surface water, canals, rivers, lakes etc, roads, rails, buildings, borders of voivodships, municipalities, villages, number of inhabitants endangered by the flood etc. Information about roads and rails included type of roads, width, material of surface and some additional data.

This data was confronted with selected transport hot spots (critical infrastructure) to finally chose the proper ones with regard to highest flood risk and climate risk.

The description of the structure of the MZP database containing the description of individual layers and fields (in Polish) can be found here: http://www.kzgw.gov.pl/files/mzp-mrp/zal4.pdf

The depth of water is included on the depth layers for individual flood scenarios. In the depth layers there is a "GŁĘBOKOŚĆ" (depth) field, which contained depth intervals divided into 4 classes described by attributes:

1: < 0.5 m (less than 0.5 m),

2: 0.5-2 m (from 0.5 m to 2 m)

3: 2-4 m (from 2 m to 4 m)

4:> 4 m (above 4 m)

These ranges have the following reference to flood risk:

1) water depth less than or equal to 0.5 m - indicating low risk for people and building objects, but high risk in terms of transport;

2) water depth greater than 0.5 m and less than or equal to 2 m - indicating an average risk to people due to the possibility of evacuation to higher floors of buildings, but high due to material losses, and very high risk in terms of transport;

3) water depth greater than 2 m, and less than or equal to 4 m - indicating a high risk to people and very high due to material losses; not only the ground floors but also the first floors of buildings may be flooded; extremely high risk in terms of transport,

4) water depth greater than 4 m - indicating a very high risk to people and a very high risk of total material loss, extremely high risk in terms of transport.

The maximum elevations of the flood water table were included as points on the "max_rzedna_zw_wody". In the table of this layer, there are "RZĘDNA" attributes for particular scenarios of flood occurrence, which have water elevation values in m n.p.m in the Kronsztadt 86 altitude system.