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Polish practice in carrying out sensitivity, vulnerability and risk analysis for the identification of hotspots on transport infrastructure due to climatic factors

Submitted by the Government of Poland

I. Introduction

1. This document provides Polish case study on carrying out sensitivity, vulnerability and risk analysis for the identification of hotspots on transport infrastructure due to climatic factors. The Group of Experts requested at the sixteenth session that this case study is tabled as on official document at future sessions.

II. Responsible authority for climate change adaptation policy in Poland

2. 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). IMGW-PIB gathers climate change data.

III. National adaptation strategy and related acts

3. 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), adopted in 2013, is used as framework guidance to monitor and assess the need for adaptation actions at the national, regional and local levels, including in the transport sector. This document contains a

description of the general characteristics of the climate, climate change from 2007–2011, scenarios and impact on sensitive sectors until 2030. It 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.

4. NAS was developed on the basis of a project on the Development and implementation of a strategic adaptation plan for the sectors and areas vulnerable to climate change ("Klimada"). Klimada, as a platform, maintains general information and data on climate change trends and climate change scenarios. It contains a diagnosis of the vulnerability of 12 sectors (including Health, Tourism, Mining, Construction, Transport etc). The Crisis Management Act, developed by the Government Security Centre and adopted on 26 April 2007 addresses the response, among others, to crises triggered due to climate change. It provides the characteristics of hazards and assessment of their occurrences. It specifies the critical infrastructure (including risk maps and hazard maps) and the duties and responsibilities of relevant stakeholders in crisis management in the form of safety net, a statement of the forces and resources planned for use in crises.

5. The revised 2017 Law on Environmental Impact Assessments requires to consider climate risk analysis in the course of EIA procedure. This applies mainly to projects of type I (in the EIA Report), and some projects of type II, if EIA Report is obligatory. This legal requirement does not cover other projects.

IV. Adaptation plans for 44 cities project

6. The Ministry of Environment, through a project on the Development of Urban Adaptation Plans for cities with more than 100,000 inhabitants supports 44 cities in identifying and analysing potential adaption challenges. More specifically, the Ministry drafts plans for local authorities, indicates sources of funding and raises awareness for the need for adaptation, including adaptation to the climate change of the public urban transport system.

V. Carrying out sensitivity, vulnerability and risk analysis for the identification of infrastructure hotspots due to flooding

7. Identification of infrastructure hotspot is carried out based on data collected and generated in a process of assessing and mapping the hazard and flood risk in Poland. Such include:

- 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 IT System for Protection of the Country Data (ISOK) project;
- ISOK - holds information about water management, natural hazards, threatened areas etc. Its objective is to improve the operation of crisis management systems at all levels, but it can also be used in spatial planning (in the context of flood hazard in river valleys);
- Flood risk management plans - to reduce the potential negative impacts of floods on human life and health, the environment, cultural heritage and business. This should be achieved by implementing measures to minimise the identified risks (diagnostic part).

8. Moreover, the identification is done following the methodology contained in the Guide to Investment Preparation Respecting Climate Change Mitigation and Adaptation as well as Resilience to Natural Disasters (Ministry of Environment, 2015).

9. Following this methodology, sensitivity (S) involves the determination of the size and significance of risks to changes in input parameters, while vulnerability (V) is the result of multiplication of exposure (E) by sensitivity (V=ExS). Vulnerability analysis covers evaluation of the sensitivity and exposure of infrastructure to climate change.

10. In the above sense, the sensitivity is related to the size of the road traffic and the type of road infrastructure. Exposure is determined by the height of the flood wave (flooding depth) and by the likelihood of flooding.

11. 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 contains depth intervals divided into four classes described by attributes:

1: = < 0.5 m (less or equal to 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).

12. These ranges have the following reference to flood risk:

(1) water depth less than or equal to 0.5 m – indicates a low risk for people and building objects, but high risk in terms of transport (moderate risk up to 0,2 m. and low risk up to 0,1 m.),

(2) water depth greater than 0.5 m and less than or equal to 2 m – indicates an average risk to people due to the possible requirement for evacuation to higher floors of buildings, 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 – indicates 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 – indicates a very high risk to people and a very high risk of total material loss, extremely high risk in terms of transport.

13. Applying such an analysis, risk maps are developed that portray levels of flooding risk across a geographical area. Data include the likelihood of flooding at Q=0,2%, Q=1% and Q=10%. These specific maps include information concerning flood water depth, water flow velocity and directions of flood water flow.

14. The maximum elevations of the flood water table are included as points on the "maximum water level". In the table of this layer, there are "Level" or “Ordinate” attributes for particular scenarios of flood occurrence, which have water elevation values in meters above sea level in the Kronstadt 86 altitude system.

15. The above-mentioned probabilities of floods may be related to the forecasted climate changes. The likelihood of flooding is changing in a very precisely defined range according to the adopted climate change scenario.

16. As a next step, a layer portraying specific sensitive infrastructure network – Trans-European Transport Networks (TEN-T) was selected – is added to the risk map on flooding. This data includes the type of roads, their width, the type of their surface and some additional data.[1]

A. Results

17. Following the sensibility and vulnerability analysis, TEN-T network hotspots due to flooding have been identified and included on GIS maps. Also, numerical data in GIS

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

format are provided, which in turn may be subject to further processing using available GIS tools.

B. Conclusions and outlooks

18. It should be stressed that the use of GIS tools is essential for analysis of hotspots. Infrastructure hotspots were identified on flood risk maps in GIS environment. These hotspots are shown in relation to the probability of flooding (road network and nodes layers and layers of water with a specific depth associated with the probability of flooding). This work, done in accordance with the recognized methodology provided in the Guide to Investment Preparation Respecting Climate Change Mitigation and Adaptation as well as Resilience to Natural Disasters, presents a crucial step for identification of sections of infrastructure that may be prioritized for adaption to make them more resilient to climate changes.