ADAPTATION OF BULGARIAN WATER SECTOR TO CLIMATE CHANGE EXTREMES

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INTRODUCTION
The aim of this research is to present implementation of DPSIR methodology approach for climate change vulnerability assessment of the water sector and to propose a Climate Change Vulnerability Index for water sector. It is estimated based on a set of indicators of the impact of water resources, water use and management on the water sector: adaptation, risk, impact and the adaptive capacity.

The suggested index offers a comprehensive expert-assessment of the level of vulnerability of the water sector to climate change. It also proposes a framework that can incorporate more accurate data from regional models for change in climate and hydrology and vary the precision of the included indicators to meet a desired level of detail.

METHODOLOGY
DPSIR Model for Climate Change Risk Analysis

Adaptation to climate change is a social process that takes place in degrees of significant uncertainty. This process is designed to reduce the risk from water for water sector. For this reason, the implementation of risk management mechanisms for adaptation to climate change scores an adequate approach.

A description of DPSIR model in context is given by Helman et al. (2005)

- Drivers: focusing on the level of observed and analyzed trends with respect to climate change, socio-economic systems and the national and European policy.
- Pressures: is also estimated on national level, analyzing variables that quantify the force of temperature, rainfall, concentrations of carbon dioxide, extreme phenomena, GWP, regional development, etc.
- State: is characterized by indicators for the variables, which relate to the sensitivity of the systems or the socio-economic processes.
- Impact: depending on what values are reached the system status indicators and how they are approaching critical levels.
- Response: expressed in the planned adaptation, mitigation, and innovation measures that aim to reduce the negative and enhance positive impacts of climate change. The results of these models are evaluated as a possible future adaptation policies. They must also be supported by business and non-governmental sector.

Climate Change Risk Assessment

The basis of climate change stems from the uncertainty of the realization of one or another scenario of climate change and is defined as the likelihood that a particular outcome and impact against sensitive systems.

Water sector in Bulgaria operates in three main business areas:

• Technical equipment and operation.
• Technical equipment and operation.
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RESULTS
To assess the CCVI for Bulgarian water sector we use an indicator based on a framework that can incorporate more accurate data from regional models for change in climate and hydrology and vary the precision of the included indicators to meet a desired level of detail.

- Climate Change Vulnerability Index (CCVI): 

\[ \text{CCVI} = \frac{S}{A_r} \]

Where: 

- S: Sensitivity 
- A_r: Adaptive capacity

Assessment of climate change and vulnerability of Bulgarian water sector

The analysis is based on information for the current state of precipitation, air temperature, quality and quantity of water resources in the country and related hydro-climatic risks, climate models and climate scenarios according to the IPCC AR4 (2007) and AR5 (2013) and their regional projections for the territory of Bulgaria from KMNI (2013). Additional data were obtained from the National Strategy for the management and development of the water sector in Bulgaria (MWI 2012), the National Statistical Institute (NSI), the National Electric Company (NESCO) and the Ministry of Regional Development and Public Administration and from the Ministry of Environment and Waters (MOEW) on the state of environment and water management, water supply, sanitation and water purification, water resources and water use over the period 2007-2013, publications for the state of the environment from MEW, River Basin Directories (RBH), National Institute of Meteorology and Hydrology, and other sources of information.

DATA
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RESULTS
Identification of main actors in Bulgarian water sector

The analysis is based on data on water resources, water use and management and water-related extreme events in the period just after the accession of the country to the EU in 2007. The long-term strategic objectives for the water sector in Bulgaria is to ensure sustainable use of water resources and to secure the future needs for water of the population, economy and aquatic ecosystems. The summarized results show that the Water sector in Bulgaria is exposed to multi-factor stresses: droughting/severity, flooding/survey, drying and seawards, irrigation, regulation, drainage and promotion from the hydrothermal effects of water and hydrophysical system and equipment (dams and hydrophysical facilities). The operation of each one of these systems depends on the availability, quality and quantity of water.

Assessment of climate change sensitivity and vulnerability of Bulgarian water sector

The analysis is based on data on water resources, water use and management and water-related extreme events in the period after the accession of the country to the EU in 2007. The long-term strategic objectives for the water sector in Bulgaria is to ensure sustainable use of water resources and to secure the future needs for water of the population, economy and aquatic ecosystems. The summarized results show that the Water sector in Bulgaria is exposed to multi-factor stresses: droughting/severity, flooding/survey, drying and seawards, irrigation, regulation, drainage and promotion from the hydrothermal effects of water and hydrophysical system and equipment (dams and hydrophysical facilities). The operation of each one of these systems depends on the availability, quality and quantity of water.

The assessment matrix shows that the change in precipitation will have negative impact on water quality. The negative impact from changes in water-related extremes relates to water quality, drought and flood risk and sea level change. The water sector is most sensitive to the projected changes in related extreme events and drought and flood impacts.

- The index of the water sector’s sensitivity to climate change in the time horizon 2016–2035, is estimated at 0.88 for change in temperature, 0.8 for changes in precipitation and 0.87 for extreme events (drought and flood) under RCP 2.6 scenario.
- Adaptive capacity of the main actors in Bulgarian water sector is assessed as "insufficient" and is scored with 3 points.

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Assessment of climate change sensitivity and vulnerability of Bulgarian water sector

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