

Adaptation Strategy of the Slovak Republic on Adverse Impacts of Climate Change

Overview: Executive Summary

Climate change has caused a wide range of impacts on natural and human systems all over the world¹. In Slovakia in recent years more frequent physical impacts of climate change such as floods, landslides, long-term droughts and heatwaves were observed, which influenced the economy, social systems, ecosystems and the infrastructure

The National adaptation strategy provides an overview of the impacts on natural systems (geological environment, water, soil, biosphere and biodiversity) as and describes the impacts on human health, urban environment, agriculture, forestry, transportation, energy, industry and tourism. The strategy summarizes a set of adaptation measures for each sector.

The aim of the strategy is ***to draw attention to the fact that climate change is an urgent issue that requires an integrated and comprehensive approach.***

PRINCIPLES

- *Integrated approach* and coherence between mitigation and adaptation measures is important
- Implementation of *win-win and no-regret measures* is a priority;
- *Avoiding maladaptation is crucial*;
- *Knowledge and objective information* for decision-making at all levels should be built.

OBJECTIVES

- To describe *adverse impacts* of climate change in the Slovak Republic;
- To analyse the *expected impacts* of climate change on key areas/sectors of economy;
- To propose a set of *proactive adaptation measures* and mechanism for their implementation;
- To identify *opportunities* associated with the process of adaptation and create space for their practical realisation;
- To create an institutional framework which would enable efficient and cost-effective adaptation to adverse climate change effects by 2020.

CLIMATE CHANGE AND TRENDS IN SLOVAKIA

Following trends were observed from 1881 to 2010:

- increase of mean annual air temperature by about 1.7 °C;
- decrease of annual precipitation totals by about 0.5 % (mainly in the south of Slovakia - up to 10 %, small increase in precipitation totals is only at the northern border of Slovakia - about 3 %);
- decrease of all snow cover characteristics by altitude 1000 m a. s. l.; increase of snow cover days and depths was recorded only in higher mountains;
- increase of potential evapotranspiration and decrease of soil humidity – southern Slovakia gradually dries out which is visible on the characteristics of evapotranspiration, soil humidity and solar radiation;

¹ <http://www.ipcc.ch/report/ar5/>

- the amount of extreme daily precipitation increased within the last 15 years, this caused the growth of the risk of local floods.

Climate change impacts:

Air Temperature

- in comparison to the period between 1951 and 1980 the average air temperature may gradually increase by from 2° C to 4° C – the so-far inter-annual and inter-seasonal weather fluctuation may remain;
- the decrease of the average daily air temperature amplitude is caused by the faster growth of the daily minimum air temperature in comparison with daily maximum air temperature;
- the projections do not assume influential change in the annual air temperature cycle; lower air temperature increase may be measured in autumn in comparison with the air temperature increase measured in spring, summer and winter.

Precipitation amount

- annual precipitation stays the same except the southern parts of Slovakia (10 % increase);
- more significant changes are expected in the annual precipitation cycle:
 - higher incidence of relatively longer droughts and relatively shorter heavy rain episodes;
 - thus the warmer weather, the snow cover under altitude 900 m a. s. l. is expected to be uneven;
 - more winter floods due to the unstable snow conditions;
 - increase of snow cover days and depths was recorded only in higher mountains (altitude above 1 000 m a. s. l. covers only 5.4 % of Slovak territory).

Other climate elements/indicators and characteristics

- considering the tendency to the stronger storms in the warm period of the year, the higher occurrence of high wind, gale and tornado is expected;
- decrease of soil moisture in Slovak lowlands.

In general, Slovakia is not considered to be vulnerable to climate change to a great extent and therefore the topic is not perceived as a priority. Some sectors are considered more vulnerable than others, such as transport, infrastructure and agriculture.

STRATEGIC DOCUMENTS AND POLICIES

The European Commission policy documents (Green paper, White paper, EU Strategy on adaptation to climate change) provided a basis for the formulation of the principles of proactive adaptation. Other documents used for preparation of the national adaptation strategy are:

- Concept of water management policy of the Slovak Republic 2015;
- Water Plan of the Slovak Republic 2009 – 2015;
- National Biodiversity Strategy of Slovakia;
- National Forest Programme (NFP);
- Action Plan of the NFP;
- Strategy on Forestry in Slovakia;
- Strategy of the International Commission on Protection of the Danube River (2013);
- Environment and Health Action Plan;
- Strategy for Transport Infrastructure Development 2020;
- Tourism Development Strategy to 2020.
- Climate change impacts and possible adaptation measures in various sectors in Slovakia report

Scientific and research organisations widely participated in research projects aimed at climate change impacts, economic impact assessment and identification of the adaptation measures, which provided inputs to the strategy.

The Slovak Hydrometeorological Institute report “Climate change impacts and possible adaptation measures in various sectors in Slovakia” provided inputs for identification of the adaptation options. Other agencies, universities, the Slovak Academy of Sciences, and research institutes have included adaptation in their tasks.

The Slovak institutions participate in several international projects, for example Comenius University participates in the CC-TAME Project (Terrestrial Adaptation & Mitigation in Europe) and RESIN project (Climate Resilient Cities and Infrastructures). The Slovak Hydrometeorological Institute participated in the project Joint Disaster Management Risk Assessment and Preparedness in the Danube macro-region (SEE Risk) which was focused on risk assessment and its purpose was to foster awareness and effectiveness of the measures in emergency situations caused by climate change.

CLIMATE CHANGE IMPACTS AND PROPOSED ADAPTATION MEASURES – examples

Field/Sector	Climate Change Impact	Proposed adaptation measure
Geological environment and soil	<ul style="list-style-type: none"> ▪ landslides, soil erosion ▪ changes in the valley shape as a result of floods and heavy rain ▪ desiccation and salinization of soil 	<ul style="list-style-type: none"> ▪ to protect potentially vulnerable area against landslides – adjust water regime and ensure vegetation cover ▪ increase inundation and retention capacity of the area; to create retention areas in order to collect heavy rain and convert to the space of the original inundation while respecting the geological structure and maintaining the conditions of stability zone ▪ to change the water regime of non-irrigated soils, infiltration belts
Hydrology and water management	<ul style="list-style-type: none"> ▪ decrease in water resources in the south and east of Slovakia ▪ increase in the occurrence of drought and floods ▪ change of hydrologic cycle 	<ul style="list-style-type: none"> ▪ to decelerate water runoff from the river basin (ensure suitable land use in areas threatened by increased risk of erosion and flooding, to apply good agricultural practices etc.) ▪ implementation of measures for the effective use of water resources to ensure sustainability ▪ to minimize the pollution of water resources by discharges of untreated or insufficiently treated municipal waste water
Biodiversity	<ul style="list-style-type: none"> ▪ change of the favourable status of forest habitats, fragmentation of forest, fire, increase of damages, of drought and floods ▪ drought and floods, changes of water regime and of water sources quality; increase of air temperature ▪ increased erosion, change of temperature conditions for plant production and of agro-climate production potential, changes of physical and chemical properties of soil ▪ habitat fragmentation ▪ spread of invasive alien species and pathogens 	<ul style="list-style-type: none"> ▪ strengthening of the natural regeneration of natural forests and their sustainable use ▪ diversification of landscape and landscape structures – ensuring the heterogenic ecosystems, increased diversity of vegetation and of morphology, ensuring the dynamic natural processes; sustainable use of grasslands ▪ increase of the landscape connectivity – building of green infrastructure, support or creation of corridors and stepping stones, elimination of barrier effect of roads and railways, elimination of barrier on water streams ▪ systematic, long-term mapping, monitoring of

		occurrence of populations of invasive alien species
Urban environment	<ul style="list-style-type: none"> ■ overheating of buildings ■ higher demands on water consumption ■ deterioration of traffic safety and flow ■ disruption in supplies of energy, damage of equipment 	<ul style="list-style-type: none"> ■ to define an urban structure of the city in order to allow better air circulation ■ to support and ensure the re-use of rainwater and wastewater ■ to ensure and support adaptation of transport and energy technology, materials and infrastructure to climate change
Health	<ul style="list-style-type: none"> ■ the deterioration of general health, older and lonely people aged over 75, children and disabled will be the most affected ■ increased risk of infectious diseases caused by polluted water and food ■ asthma, allergies, respiratory diseases 	<ul style="list-style-type: none"> ■ to extend the network of monitoring stations to monitor the concentration of biological allergenic particles (pollen grains, spores) in ambient air as a basis for the public information and alerting ■ to create and continuously maintain the public reporting and alerting of extreme weather events (heat waves, frost, floods, drought, allergens in the air, an outbreak of the disease, especially epidemic diseases, etc.)
Agriculture	<ul style="list-style-type: none"> ■ occurrence and spread of pests and diseases on plants, trees and animals ■ areal changes of the precipitation and humidity (decrease of the air humidity under altitude 400 m a. s. l.) ■ extension of the growing period (43 more days in the eastern and 84 more days in the southern Slovakia by 2075) 	<ul style="list-style-type: none"> ■ protection of the biotopes ■ protection of the integrated production and ecological stability ■ use of irrigation with emphasis on irrigation efficiency and water saving ■ to ensure the traditional Slovak species breeding, to support the domestic species and help adapt them to the present-day conditions with the purpose of more stable productivity
Forest management	<ul style="list-style-type: none"> ■ elevation of the production optimum altitude of the forest ■ higher risk of forest fire ■ changes in the population dynamics of the pests 	<ul style="list-style-type: none"> ■ measures supporting biodiversity, ecological stability and community service of the forest ■ improvement of the forest management (objectives, framework, principles) regarding to the adaptation to the climate change (according to the latest research)
Transport	<ul style="list-style-type: none"> ■ damage to road infrastructure ■ longer transport time, vulnerability to accidents 	<ul style="list-style-type: none"> ■ optimize the design of roads with regard to climate change ■ maintain the high frequency weather monitoring and on-time warning in the endangered areas (floods, storm, ground-ice)

Energy	<ul style="list-style-type: none"> ▪ affecting power plants by more adverse weather phenomena, tornado, strong thunderstorm ▪ higher demand for energy in summer season 	<ul style="list-style-type: none"> ▪ increase of power plants safety
Tourism	<ul style="list-style-type: none"> ▪ less snow and irregular occurrence of snow cover in lower localities ▪ winter season shortening in lower localities 	<ul style="list-style-type: none"> ▪ transfer of skiing activity to higher altitude centres ▪ reorientation of threatened winter centres to other activities
Disaster risk management		<p>Proposed measures in fields:</p> <ul style="list-style-type: none"> ▪ threats and risks monitoring ▪ critical infrastructure protection ▪ civil protection ▪ crisis management system

FINANCIAL FRAMEWORK

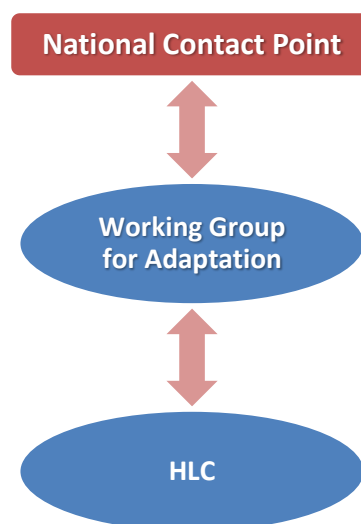
Adaptation measures should be primarily financed through their integration into sectoral politics. Currently adaptation measures in Slovakia are financed and co-financed from the Operational Programme Quality of the Environment 2014 – 2020 and Village Restoration Programme. Cross-sectoral synergies should be identified and financial resources should be pooled. The following programmes and mechanisms can be used for financing adaptation measures: European Economic Area Financial Mechanism (EEA) and Norwegian financial mechanism, Program LIFE+ and Horizon 2020.

IMPLEMENTATION AND RESPONSIBILITIES

Coordination of activities (information transfer, adaptation measures monitoring etc.) should be organised as follows:

- the National Contact Point (the Ministry of Environment) provides communication with international organizations and coordinates national activities in cooperation with the Working Group for adaptation;
- the Working Group for Adaptation provides the adaptation activities in the area of its competence, cooperates with professional institutions and other relevant organizations, is responsible for preparation of the documents for the Coordination Committee for Climate Change Policy and for decision-making;
- the High Level Committee for the Coordination of Climate Change Policy (HLC) defines the main tasks and gives overall lines for further policy-making processes on adaptation.

Fig. 1 Coordination Framework



MONITORING AND EVALUATION

Currently, there is no available methodology for monitoring and evaluation of the effect of adaptation measures and it is hard to specify indicators for the monitoring of the progress and effects of adaptation measures. Preparation of a specific set of indicators and methodology is planned for the upcoming years.

Only the costs of adaptation measures implemented within the selected operational programmes for the period 2014 to 2020 will be monitored. Slovakia will use the list of indicators for project evaluation in relation with program LIFE - Climate Action as a starting base for monitoring.

CONCLUSION

The Adaptation Strategy of the Slovak Republic on Adverse Impacts of Climate Change is a framework document for adaptation processes in Slovakia. The strategy should be updated based on experience and new scientific knowledge every 5-10 years - also regarding to the conclusions of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. The update of the National adaptation strategy based on the latest available science will be adopted in 2018. This timing is welcomed because it provides an opportunity to incorporate the tasks and recommendations from the new European adaptation strategy.