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CLIMATE CHANGE AND SECURITY IN THE DNIESTER RIVER BASIN

Report of project meetings in Kyiv, Ukraine
12-13 December 2013

Executive Summary

The sectoral workshop on 12 December 2013 and the meeting of the bilateral Moldo-Ukrainian Working Group on Flood Management and Climate Change Adaptation on 13 December 2013 were conducted within the project component "Climate Change and Security in the Dniester River Basin" implemented by the UNECE and OSCE which is an integral part of the larger project "Climate Change and Security in Eastern Europe, Central Asia and the Southern Caucasus" funded by the European Union's Instrument for Stability and the Austrian Development Agency in the framework of the Environment and Security Initiative (ENVSEC).

The sectoral workshop was conducted in cooperation with the Alliance for Global Water Adaptation (AGWA), and focused on analysing in more detail the selected key sectors (flood management, agriculture and irrigation, ecosystem protection), potential impacts upon them of a changing climate, and possible adaptation measures. In particular, the participants discussed which risks under climate change could be accepted and to what degree, and developed performance metrics for each of the selected sectors to explore stakeholder tolerance for not meeting sectoral objectives.

The eighth meeting of the Working Group focussed on a discussion of the draft of the Strategic framework for adaptation to climate change in the Dniester basin, and on priority adaptation measures for possible fast-track implementation in the basin with the project's support. The meeting also reviewed the progress of flood risk modelling in the Dniester delta within the project "Reducing vulnerability to extreme floods and climate change in the Dniester river basin" funded by the governments of Finland and Sweden.
The results of the workshop and the meeting will be used for further developing the Strategic framework for adaptation and for the prioritization of measures to be supported through the project. The agenda and the list of participants can be found in Annexes I and II.

Sectoral workshop on basin-wide adaptation

12 December 2013

Opening

Ms. Sonja Koeppel and Mr. Leonid Kalashnyk welcomed the participants on behalf of UNECE and the OSCE. Ms. Sonja Koeppel also gave a short introduction to the activities within the project component "Climate Change and Security in the Dniester River Basin", and introduced the co-organiser of the sectoral workshop, the Alliance for Global Water Adaptation. Mr. Leonid Kalashnyk informed that "Climate Change and Security in the Dniester River Basin" is an integral part of the project "Climate Change and Security in Eastern Europe, Central Asia and the Southern Caucasus" funded by the EU's Instrument for Stability and the Austrian Development Agency.

Performance metrics and risk tolerance

Mr.Rolf Olsen (AGWA) described the structure and the objectives of the sectoral workshop. In particular, the workshop aimed to assess the performance of water resources management under the threat of future climate change using a 'bottom-up' approach[1]. The speaker informed the meeting about main concepts and terminology in risk assessment, and gave several examples of their application by AGWA for assessing flood damage (with reference to how some of them can be applied to the Dniester).

Mr. Eugene Stakhiv (AGWA) described the evaluation and decision making framework for risk-based adaptation of ecosystems to climate change. Mr.Stakhiv emphasized the importance of knowing which specific goals stakeholders want to achieve (e.g. lowering vulnerability) and of bearing in mind that climate change adaptation involves many uncertainties including difficulties with understanding the ecosystems' responses. In this respect it is also necessary to consider the value of species and ecosystem functions impacted by climate change. Mr.Stakhiv provided an overview and examples of ecosystem-based adaptation measures, including their application in two regulation plans for the Great Lakes in the USA.

Climate change impacts and vulnerabilities and water sector priorities in the Dniester basin

Mr. Nickolai Denisov (Zoi Environment Network) informed the meeting about main projected changes in climate parameters in the basin by 2050, including temperature, precipitation and water flow, based on earlier research in Moldova and Ukraine facilitated by the project "Reducing vulnerability to extreme floods and climate change".. He stressed that although more research is needed, e.g. for analysing the influence of changing precipitation patterns on water flow, the results already obtained within the project are enough for understanding the general patterns. Key priorities in adaptation in different sectors were described using the graphs presented below.

[1]A bottom-up approach is a stakeholder driven process to assess vulnerability rather than a reliance on predictive models of the future.

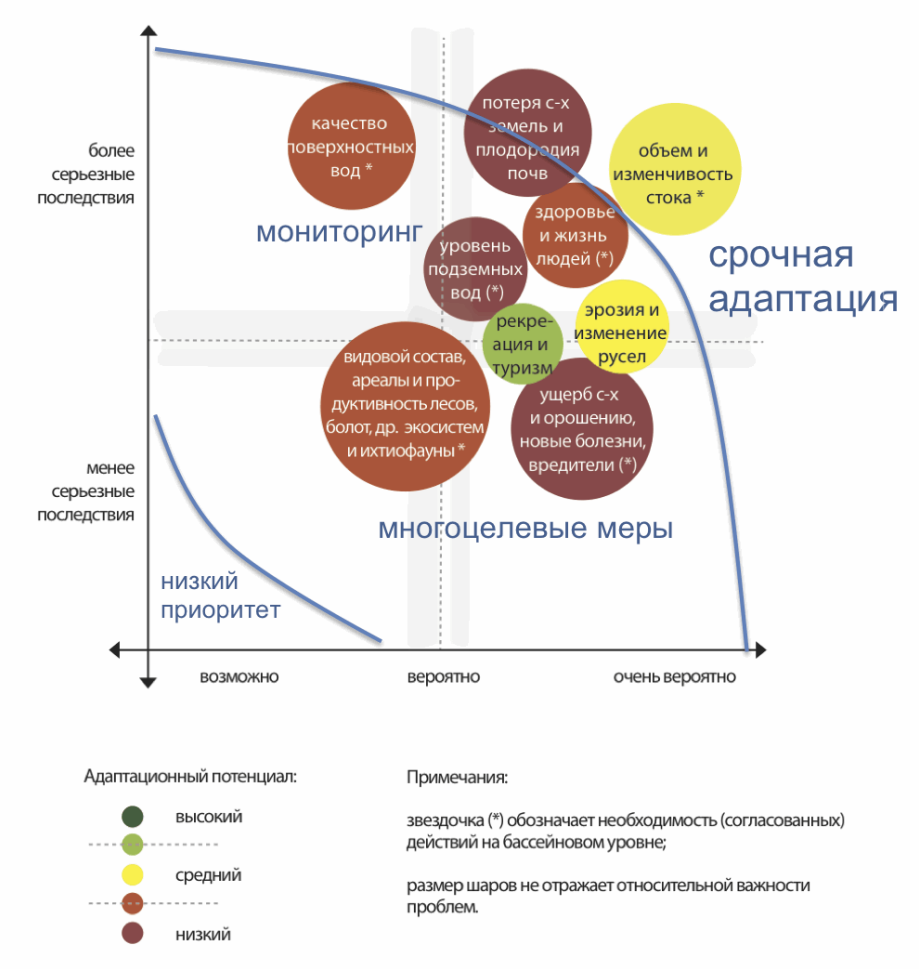

Fig. 1 Ranking of water problems in the Dniester river basin (based on consultations in Moldova and Ukraine in 2012-13(in Russian).

	1. Больше воды (паводки)	2. Меньше воды (засухи, падение уровня)	3. Состав воды (качество, связано с 1 и 2)	4. Воздействия, не связанные с водной средой
Сельское хозяйство	•	•••	•	•••
Водоснаб-жение	••	•••	•••	•
Инфра-структура	•••	•	•	•••
Здоровье и благополучие	•••		•••	•••
Около/водные экосистемы		•••	••	•••

• слабая связь •• средняя связь ••• сильная связь

* цветом выделены группы проблем, непосредственно связанные с изменениями режима и состояния водных ресурсов

Fig. 2 Relation of changes in water environment to other resources and sectors (in Russian).

In the following debate Mr. Anatoliy Polevoy (Odessa State Ecological University) emphasised that it would be important to analyse the influence of floods on agriculture and that in his opinion there should be a stronger relation between agriculture and water quality.. He also commented that nowadays a quick change of extreme events is observed since draughts can follow heavy precipitations. Mr.Stanislav Soloninka (Dniester-Prut Water Management Board) emphasized that in order to adapt to climate change one needs the type of management that ensures a sustainable use of available resources. Such an approach i.a. requires the automation of certain information processes to support and facilitate decision-making.

Developing performance metrics

The workshop participants were divided into three groups according to their expertise: flood management, agriculture, and irrigation and ecosystem protection. Each group worked with specific questions (please see Annex III) covering the issues, current and required management actions, management objectives and measurement metrics, and risk tolerance levels for each sector. Subsequently, the groups reported back to the plenary. A short summary of the discussion in groups is presented in Annex IV.

Decision Methodologies

Following the group discussions and the presentation of their results to the plenary session, Mr. Rolf Olsen presented to the participants a set of possible decision methodologies which include modelling, analysis of uncertainty and alternative decision pathways, and flexible governance mechanisms. The presentation by Mr. Olsen was complemented by examples from the study on International Upper Great Lakes. In the discussion Ms. Olga Zhovtonog (Institute of Water Problems and Melioration) mentioned that stakeholder participation is crucial for making proper decisions, sharing experience, and ensuring continuous communication among relevant officials, practitioners, scientists and experts.

Summary and next steps

It was concluded that risk assessment methodologies, as they are developed by AGWA, would be helpful for the Dniester basin, in particular for example for analysing and reviewing management options of the Dniester reservoirs. AGWA representatives informed that they would implement their study in cooperation with the Global Water Partnership Mediterranean and present preliminary outcomes at the next meeting of the Working Group on Flood Management and Climate Change Adaptation, to be held in July 2014 in Chisinau. A longer stakeholder workshop would be needed to really discuss the matter. Mr. Sonja Koeppel and Mr. Rolf Olsen thanked all participants for their active participation and contribution, and informed them about the agenda of the following meeting of the Working Group on Flood Management and Climate Change Adaptation on 13 December 2013.

Eighth meeting of the Working Group
on Flood Management and Climate Change Adaptation
13 December 2013

Opening

During the opening session the representatives of national authorities, international organisations and donor governments welcomed the project component “Climate Change and Security in the Dniester River Basin” funded by the EU’s Instrument for Stability and the Austrian Development Agency. Mr. Alexey Chunarev (State Agency of Water Resources of Ukraine) emphasized the impact of natural disasters in the context of climate change, highlighted that coordination and involvement at all levels is essential for addressing disasters such as floods, and thanked the project for providing a new impulse for cooperation and reducing risks in the basin. Ms.Nadezhda Chilaru (Ministry of Environment of the Republic of Moldova) briefly described the history of the Dniester process and mentioned the importance of the bilateral Dniester Basin Treaty, signed in November 2012 at the sixth session of the Meeting of the Parties to the UNECE Water Convention in Rome, for the sustainable management of the basin. Mr. Rene Bebeau of the OSCE Project Coordinator in Ukraine acknowledged that cooperation of the governments is necessary for making communities on both banks of the Dniester more resilient to climate change impact, and also expressed hope that the Dniester Basin Treaty would soon come into force. Ms. Sonja Koeppel informed the participants about planned activities within the project. Mr.Vaclav Voracek (EU Delegation to Ukraine) highlighted the importance of regional and transboundary aspects in water cooperation and in this regard noted the adoption of the EU Council Conclusion on Water Diplomacy in July 2013. Mr. Johannes Aigner (Embassy of Austria in Ukraine) highlighted the necessity of applying common approaches to develop mitigation and adaptation measures as well as to increase resilience to climate change impacts. Mr. Franz Schneider (Embassy of Switzerland in Ukraine) informed the meeting that water issues and disaster issues are among the priorities of the 2014 Swiss Chairmanship of the OSCE.

Ms. Christine Kitzler (OSCE) presented the whole project “Climate Change and Security in Eastern Europe, Central Asia and the Southern Caucasus” funded by the EU through the Instrument for Stability and by the Austrian Development Agency, and informed that the project component “Climate Change and Security in the Dniester River Basin” is part of this project. She presented the project’s overall goals and other main activities. The Dniester river basin was selected as pilot region for developing an adaptation strategy (Strategic framework for basin wide adaptation) in the EECCA region within this project”

Ms. Nataliya Kruta (Lviv Oblast Board of Water Resources) informed the participants about the outcomes of the basin-wide 2013 art contest “Colours of the Dniester” which was supported by the project as one of the adaptation measures in the field of raising public awareness. Awareness raising on sustainable management of water resources in the Dniester Basin has been identified as one of the possible adaptation measures by the joint working group on flood management and climate change adaptation :. Aiming to engage children and youth in sustainable management of water resources, the contest involved more than 400 participants in Moldova and Ukraine, 76 of whom won a prize in the categories “Drawing”, “Photo”, “Video or Slide Show”, “Water Resources Rehabilitation Activity” and “Short Story, Poem, Scientific or Popular Essay”. As tokens of appreciation of their inputs and contribution, the representatives of national authorities, international partners and donor organisations were presented some of the winning works..

Strategic framework for adaptation to climate change in the Dniester basin

Mr. Nickolai Denisov presented the draft of the Strategic framework for basin adaptation to climate change, one of the main project outputs, which includes a description of the main climate expected impacts and vulnerabilities, proposes priority adaptation measures, and assesses the financial and institutional issues of its implementation. Mr. Denisov informed the participants about the main principles in developing the strategic framework for adaptation such as:

- putting the focus on problems related to **climate** change
- taking the **basin** level as the key perspective;
- paying primary attention to **water-related issues** caused by the changes in the regime and conditions of water resources.

The speaker emphasized that one is only aware of general climate tendencies (e.g. increase in temperature, decrease in precipitation, intensification of extreme floods); therefore, while developing adaptation policies significant uncertainties should be taken into account. Mr. Denisov described the priorities and risks among water-related sectors in the Dniester basin, concluding that among the highest priorities which requires urgent actions is the anticipated impact of climate change on water flow. The strategic framework under development intends to suggest adaptation measures to be implemented either on the basin level jointly by Moldova and Ukraine, or in each country separately but considering and leading to a transboundary effect. The speaker emphasized that it was very important to coordinate the elaboration of the strategic framework for basin adaptation with nationally-focused plans and policies for adaptation to climate change, flood mitigation and water resource management, as well as the relevant international processes and projects. Mr. Denisov concluded that eventually adaptation to climate change should become a part of an integrated approach to managing and developing the Dniester basin.

Complementing the draft framework document as good and containing the sufficient level of detail and insight, the participants suggested additional perspectives to further improve its scope and content. Main comments include the following:

- the resulting strategic approach should be robust enough in order to be able to cope with uncertainties while developing adaptation policies;
- the entire watershed area should be taken into account, covering small tributaries in addition to the main stream of the Dniester;
- among adaptation priorities should be monitoring system and data management and exchange, including the improvement of hydrological (e.g. flood) forecasting, the further automation of the network, assessment of current and future water balances for the entire basin; the improved use of precipitation data for flow modeling; and the development of the Dniester geoinformation portal;
- exploitation of the entire system of Dniester reservoir (including Dniester and Dubossary HPP) should be taken into account while developing the framework for adaptation;
- more specific vulnerability assessment as well as updated modeling according to new models of the Intergovernmental Panel on Climate Change might be useful;
- the framework could recommend activities for studying the geomorphology of rivers and the delimitation of water bodies;
- Moldova is developing the river basin management plan of the Moldavian part of the Dniester basin according to the EU Water Framework Directive funded by the Millennium Challenge Corporation. Some aspects of climate change adaptation should be included there. Some coordination with and inputs from Ukraine would be necessary for this. The strategic framework for adaptation could suggest the development of a framework document outlining approaches towards a joint transboundary management plan;
- the EU's ongoing projects, e.g. "Clima-East" and "Environmental protection of international river basins", are open for cooperation.

Ukraine also expressed their intention to develop a river basin management plan for the Ukrainian part of the basin in the medium term. It was suggested by Moldova that the Working Group on Flood Management and Climate Change Adaptation could serve as a venue for discussing the river basin management plan

development. For example, the next meeting scheduled for July 2014 in Chisinau could include such a discussion.

Mr. Denisov agreed to the spirit of most of the comments, and once again emphasized the importance of transboundary cooperation as well as coordination with other relevant projects and processes.

The Working Group was informed about the recently completed selection of two national consultants in each of the countries whose tasks should be to provide comments and input to the strategic framework for basin adaptation and to ensure its consultation at the national level with different institutions. National authorities were invited to cooperate with these experts to strengthen the linkages between the development of the strategic framework and relevant national processes in the area of climate change adaptation.

The Working Group decided that additional comments on the draft strategic framework for basin adaptation should be sent by 31 January 2014 to the UNECE and OSCE Pilot region focal points.

Updates of relevant national adaptation activities

Mr. Vitaliy Dragomiretskiy (State Environment Investment Agency of Ukraine) described the recent developments in national adaptation policy in Ukraine, including the collection of comments to the third revision of the National Adaptation Plan. The research on adapting to climate change in energy production, public health and agriculture was conducted, and its results were presented at regional workshops on the development of adaptation plans for the Donetsk, Ternopil and Poltava oblasts.

Mr. Gherman Bejenaru (State Hydrometeorological Service of the Republic of Moldova) informed the meeting about the progress in elaboration of the national adaptation strategy in Moldova in the second half of 2013. Moldova plans to approve the strategy in early 2014. The research on adaptation in water supply and disposal was performed, and the adaptation strategy in agriculture is in the process of official review and approval. In December 2013 UNDP started the project on policy planning adaptation to long-term climate change focusing on the implementation of the adaptation strategy and development of the national adaptation plan according to UNFCCC. Another project indirectly related to adaptation, and focused on flood prevention through the automation of hydrological monitoring, is supported by the World Bank. In the discussion Ms. Nadezhda Chilaru added that the newly adopted in Moldova Water Law also foresees the development of management plans for reducing risks from droughts and floods. Ms. Alexey Andreev ("BIOTIKA") emphasized the importance of including the issue desertification into national adaptation activities.

The Working Group stressed the importance of coordination and cooperation with processes on climate change adaptation, disaster risk reduction and water management at the national levels since many of the measures suggested by the project would need to be implemented at the national and local levels. Ensuring such linkages with the national processes would be among the tasks of the national consultants of the project.

Prioritization and implementation of adaptation measures

Ms. Hanna Plotnykova presented the proposed adaptation measures some of which could be implemented within the project. The proposed measures focused on the improvement of hydrological monitoring (e.g. automation of the network, improvement of data exchange, flood modelling and mapping, awareness raising) and ecosystem restoration (e.g. restoration of flooded areas in the Dniester delta, re-forestation, awareness) aimed to strengthen adaptation to climate change on the transboundary level. Participants agreed to the majority of the proposed measures, commented on many of them, and suggested additional ones (please see Annex V for the description of measures incorporating the participants' comments). There was also a suggestion to consider adaptation measures in agriculture. Mr. Nickolai Denisov added that it would not be possible to support all the suggested measures within the current project; however, the organisations implementing the project were looking for additional financial mechanisms to support adaptation in the Dniester basin.

Flood management activities: monitoring and information

GWP (Global Water Partnership) and WMO (World Meteorological Organisation) activities
Mr. Andrey Demydenko (GWP) informed that GWP and WMO had just started a new Integrated Drought Management Initiative which included activities in Eastern Europe, including the Dniester river basin. Ms. Anna Tsvietkova (GWP) added that the project was intended to support Dniester basin countries improve agro-climatic monitoring and forecasts (e.g. the revision of agroclimatic zoning for the basin) and management policy, raise public awareness, better exchange experience and implement pilot measures. Mr. Andrey Demydenko also informed that another area of cooperation is focused on flood risk reduction which includes mapping and modeling as tools for identifying priority measures and training stakeholders.

State of and perspectives for adaptation of the geoinformation monitoring system in the Dniester river basin to global climate change related processes
Mr. Stanislav Soloninka suggested that the Dniester basin geoinformation portal could be used for adaptation purposes and for making relevant calculations easier and quicker; however, it would need further development and promotion among relevant stakeholders and users. It is important to provide the maximum amount of data to the portal, including hydrological information.

Flood risk modelling in the Dniester Delta area (results of data preparation and 2013 field work)
Mr. Aleksey Ishchuk (GIS-Analytic centre) informed the meeting about the recent results of field work and data preparation for flood modelling in the Dniester delta carried out within the preceding ENVSEC project "Reducing vulnerability to extreme floods and climate change". BlomInfo Ukraine, State Hydrometeorological Service of Moldova and Hydrometeorological Centre in Transdnistria collected relevant data on the topography of the river channel, the geometry of protective dykes, and the location of buildings and infrastructure in the delta area. The collected data are of high quality and are fully suitable for further modelling and flood risk mapping. The results of this work will be integrated into the Dniester geoportal.

Cooperation with other international and national projects and activities
Mr. Aleksey Andreev presented the projects on wetlands in the Middle and Lower Dniester in relation to ecosystem-based adaptation to climate change, including the identification, management and conservation of wetlands of national importance and those at high risk as well as Ramsar sites "Lower Dniester" and "Unguri-Holoshnica".

Ms. Liliya Grichulevich (Mama-86-Odessa) presented the project on developing recommendations for the afforestation of the Dniester riverbanks disseminated among foresters and representatives of the Basin Council. Three pilot areas were re-forested in the Lvov, Vinnica and Odessa oblasts through the project. Mr. Grichulevich emphasized the importance of the identification of hot-spots for re-forestation.

Mr. Olga Shevchenko (National Ecological Centre of Ukraine) described the Ukrainian part of the regional project "Climate East Forum" coordinated by the Austrian Red Cross. The Ukrainian part of the project is devoted to involving NGO community in adaptation to climate change, and includes the study of climate change impacts on big cities (Ternopil, Poltava and Donetsk), developing criteria for their assessment, as well as the elaboration of adaptation measures.

Mr. Diana Chelac (Ministry of Environment of Moldova) informed the meeting about the project "Environmental protection of international river basins" which included the development of a management plan for the Prut river basin in Moldova and Ukraine) and the above mentioned COMPACT project for the development of the management plan for the Moldovan part of the Dniester river basin. There is good coordination between these projects. Ms.Chelac emphasized the need for coordinating activities on the management plan of the Moldavian part of the Dniester basin with Ukraine and the application of a transboundary approach in this context.

The Working Group stressed the importance of coordination and cooperation with these numerous ongoing other similar projects and requested the national consultants to ensure regular contacts.

Conclusions

The meeting ended with the following conclusions following the presentations and discussions:

- the Working Group members who wish to do so will send to UNECE and OSCE comments on the draft of the Strategic framework for basin adaptation and potential adaptation measures to be implemented through the project by the end of January 2014;

- UNECE will send official letters, informing about the project's progress and including information about national consultants selected for supporting the further development of the Strategic framework for basin adaptation, to the Ministries of the Environment of Moldova and Ukraine, water agencies, authorities responsible for climate change adaptation and hydrometeorological services by the middle of January 2014;

- the second meeting of UNECE Global network of basins working on climate change adaptation will be conducted on 13-14 February 2014 in Geneva, Switzerland where the Dniester basin representatives will be invited to present progress of the project; the next meeting of the Working Group on Flood Management and Climate Change Adaptation will be held in early June in Chisinau, Moldova.

Annex I

AGENDA

CLIMATE CHANGE AND SECURITY IN THE DNIESTER RIVER BASIN

Sectoral workshop on basin-wide adaptation

Kiev, Ukraine
12 December 2013

Introduction

This workshop will be conducted in the framework of the project "Climate Change and Security in the Dniester River Basin" and as an integral part of the larger ENVSEC project "Climate Change and Security in Eastern Europe, Central Asia and the Southern Caucasus", implemented with funding from the European Union's Instrument for Stability and the Austrian Development Agency.

During the workshop a risk assessment of the performance of water resources management under the threat of future climate changes and variability will be conducted through a 'bottom-up' approach. The meeting will build on a previous assessment of impacts of climate change which shows potential consequences and likelihood of impacts on different sectors in the Dniester River basin.

The workshops will refine this approach by examining in more detail the selected key sectors (flood management, agriculture and irrigation, ecosystem protection), potential impacts and possible adaptation measures. In particular, working groups will develop performance metrics for each of the selected sectors to explore stakeholder risk tolerance for not meeting sectoral objectives.

The workshop will also discuss the possible application of cutting-edge methodologies in adaptive planning (adaptation pathways) and the economic valuation of adaptation measures to the Dniester basin. The workshop will contribute to the development of a strategic framework for basin-wide adaptation and in particular the prioritization of measures.

Agenda
12.30-13.00 Registration

13.00- 13.30: Opening and introduction to the aims of the workshop
Introduction to climate change impacts and vulnerabilities in the Dniester basin

13.30-14.30: Performance metrics and risk tolerance: Presentation and questions *(R. Olsen, E. Stakhiv)*

14:30-14:45: Water sector priorities for the analysis: presentation and discussion *(N. Denisov)*

14:45-16:45 (with a coffee break) Developing performance metrics
Breakout session

16:45-17:30 Decision Methodologies: Presentation and discussion

17:30-18:00 Summary and next steps

Dinner at the restaurant «Rida Hata» (Zhytomyrsks St., Petlyury St., 126-a / 23)

Eighth meeting of the Working Group
on Flood Management and Climate Change Adaptation

Kiev, Ukraine
13 December 2013

09.30-10.00 Registration

10.00- 11.00: Item 1: Opening session
Welcome speech by representatives of the Republic of Moldova and Ukraine
Opening by the representatives of UNECE, OSCE, ENVSEC, donors
Presentation of the project: Climate Change and Security in Eastern Europe, Central Asia and the Southern Caucasus (C. Kitzler)
Presentation of the results of the contest «Colours of the Dniester-2013» (N. Kruta)
Results of the preceding workshop held on 12 December (R. Olsen, E. Stakhiv)
11.00-11.15 Coffee break

11.15-12.15: Item 2: Strategic framework for basin adaptation for the Dniester
- Most important outcomes of the vulnerability assessment (N. Denisov)
- Development of the strategic framework: presentation of the draft, followed by discussion (N. Denisov)
- Updates of relevant national adaptation activities (G. Bejenaru and V. Dragomiretskiy)

12.15-13.30: Item 3: Prioritization and implementation of adaptation measures
- Road towards prioritization of measures (S. Koeppel)
- Proposed adaptation measures to be implemented through the project (H. Plotnykova)
- Elaboration of an implementation plan and resource mobilization strategy in 2014 (S. Koeppel)
- Discussion
13.30-14.30 Lunch break

14.30-15.30: Item 4: Cooperation with other international and national projects and activities
- Project "Environmental protection of international river basins"
- Red Cross project (O. Shevchenko)
- BIOTICA's projects
- other relevant projects

15.30-16.25 Item 5: Flood management activities: monitoring and information
- State of and perspectives for adaptation of the monitoring system in the Dniester river basin to global climate change related processes (S. Soloninka, A. Tonievich)
- Flood risk modelling in the Dniester Delta area (results of data preparation and 2013 field work) (G. Bejenaru, A.Drozdov, A.Ishchuk)
- GWP activities (A. Demydenko and A. Tsvetkova)
- Discussion

16.25-16.30: Item 5: Summary and closing
16.30-16.50 Final Coffee-break

Annex II

LIST OF PARTICIPANTS
(In Russian)

Sectoral workshop on basin-wide adaptation
12 December 2013

№	Имя	Организация / Должность	Контактная информация
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Eighth meeting of the Working Group
on Flood Management and Climate Change Adaptation
13 December 2013

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BREAKOUT SESSIONS: GUIDING QUESTIONS
CLIMATE CHANGE AND SECURITY IN THE DNIESTER RIVER BASIN
Sectoral workshop on basin-wide adaptation
Kiev, Ukraine
12 December 2013

Introduction

The purpose of these sessions is to begin to develop a risk management framework for climate adaptation. Three critical sectors have been selected for evaluation: flood risk management, ecosystems, and agriculture. Participants will first define the system of interest, identify problems affecting the sector, and discuss current and potential management actions. They will then identify the climate and hydrologic conditions causing problems. They will also identify other non-climate stressors.[1] The participants will define their goals for the sector and define metrics[2] that show how well their system is performing. Finally, the participants will discuss their risk tolerance[3] to a range of potential future problems.

[1] *Stressors* are changes that have a major influence on the sector.

[2] A *metric* is a measurable quantity that can be used to measure the performance of a system.

[3] *Risk tolerance* is the willingness to bear a risk based on its severity and likelihood.

Flood Risk Management

Part 1: Facilitators will summarize study results. Participants can then comment and discuss. (40 minutes)

Define the System

- What are the current flooding problems in the Dniester river basin? Discuss problems during past major floods. What are the priority areas? Why are they considered critical?
- Where are the major locations of significant flood damages? (Urban and rural locations)
- Is major/critical infrastructure (transportation, water supply, wastewater treatment, industry) located in the flood plain?

Identify Management Actions

- What are current management actions that are used to reduce the impact of flooding? How effective are they? What actions would make them more effective? What are other possible flood reduction management actions?

Part 2: Interactive discussion

Identify Problems and Stressors *(25 minutes)*

- At what flood water levels and flood flow values are populations affected? At what flood water levels and flood flow values does major infrastructure become unusable?
- What non-climate stressors/variables affect flood risk management?
    - Examples: population living in floodplain; important infrastructure in flood plain

Outline the System Goals *(20 minutes)*

- What flood risk management objectives are you trying to achieve?
    - Examples: reduce long-term flood damages; reduce vulnerability of infrastructure to disruption; reduce human fatalities from flooding
- What metrics would you use to define success or failure?
    - Examples: reduction in flood damages

Define Risk Tolerance Levels *(20 minutes)*

- What range of conditions would have unfavorable though not irreversible flood impacts?
    - Examples: disruption of transportation; damaged homes; reduced economic output
- What range of conditions would have severe, long-lasting or permanent adverse impacts?
    - Example: population does not return and rebuild after a flood

Ecosystems

Part 1: Facilitators will summarize study results. Participants can then comment and discuss. (40 minutes)

Define the System

- What are the major ecosystems of interest?
    - Examples: river fisheries; wetlands and aquatic ecosystems in lower Dniester; floodplain ecosystems
- What are the current major ecosystem problems?
- What is the major source/cause of ecosystem disruption (infrastructure, floods, droughts, or pollution)?

Identify Management Actions

- What are current management measures that are used to preserve and restore ecosystems? How effective are they? What else is needed?

Part 2: Interactive discussion

Identify Problems and Stressors *(25 minutes)*

- What river flow values support these ecosystems? How has drought affected ecosystems? Have changes in flow patterns caused by reservoir regulation altered ecosystems?
    - Examples: natural flow patterns; periodic inundation of floodplain/ wetlands
- What non-climate stressors (variables) affect the ecosystems of interest? Has infrastructure and development modified habitat and reduced the connectivity between habitats?
    - Examples: water quality (toxic chemicals, dissolved oxygen, water temperature); overfishing

Outline the System Goals *(20 minutes)*

- What specific ecosystem restoration/protection objectives are you trying to achieve?
    - Examples: improve biodiversity; preserve wetlands; increase fish stocks
- What metrics would you use to define success or failure?
    - Examples: biodiversity indicators; fish biodiversity and catch amounts; health of indicator species

Define Risk Tolerance Levels *(20 minutes)*

- What range of conditions would have unfavorable though not irreversible impacts on ecosystems?
    - Examples: loss of wetlands; diminished fish stocks
- What range of conditions would have severe, long-lasting or permanent adverse impacts?
    - Example: extinct species

Agriculture and Irrigation

Define the System *(20 minutes)*

- Where are the major irrigated and non-irrigated agricultural regions?
- Where are the sources of water supply for irrigation (Dniester River withdrawals, groundwater)?

Identify Management Actions *(20 minutes)*

- What are current management measures that are used to improve agricultural water supply? How effective are they? What else is needed?

Identify Problems and Stressors *(25 minutes)*

- What are the current problems for your system? Discuss problems during past droughts.
- What drought characteristics concern you?
    - Examples: severity of drought - magnitude of decrease in water supply; duration of drought – number of months or years with reduced water supply; timing of drought)
- What non-climate stressors (variables) affect your ability to meet your performance goals?
    - Examples: irrigation infrastructure not performing as designed; soil fertility

Outline the System Goals *(20 minutes)*

- What agricultural objectives are you trying to achieve?
    - Examples: increase agricultural production; increase farm income
- What metrics would you use to define success or failure?
    - Examples: area of land irrigated; crop yields

Define Risk Tolerance Levels *(20 minutes)*

- What range of conditions would have unfavorable though not irreversible agricultural impacts?
    - Examples: reduced farm income; lower agricultural productivity
- What range of conditions would have severe, long-lasting or permanent adverse impacts?
    - Example: farmland is abandoned

RESULTS OF THE DEVELOPING PERFORMANCE METRICS DURING DISCUSSION IN GROUPS

Introduction

The purpose of this workshop was to begin the development of a 'bottom-up' risk assessment of the performance of water resources management in the Dniester River basin under the threat of future climate changes. A bottom-up approach is a stakeholder driven process to assess vulnerability in both quantitative and qualitative terms, rather than a sole reliance on predictive, deterministic models of the future. Three critical water resources sectors were selected for evaluation: flood risk management, ecosystems, and agriculture. For each sector, the first section describes the system of interest and the problems affecting the sector. Climate and hydrologic conditions causing problems are identified along with other non-climate factors that impact the sector. The next section discusses current and potential management actions. The final section lays out information to develop a risk assessment for the sector. This will include the participants' goals for the sector and possible metrics[2] that show how well their system is performing. Participants' view of the possible severity and consequences of future risks are discussed.

Flood Risk Management

System Definition and Problems

Significant work has already been completed on the vulnerability to floods in the Dniester River basin. In the upper Dniester basin, fast-moving floods limit the lead time for flood forecasting and warning. In the middle region of the basin, there are reservoirs that provide some flood storage, but some cities and communities are still vulnerable to floods. In the lower part of the Dniester River basin, representatives from the Republic of Moldova characterized the main negative effects of floods as being the flooding of cities and towns and the flooding of agricultural lands, including private lands.

It was noted that the local population continues to settle on flood-prone areas even after houses were damaged or destroyed by flood waters. This is explained by the socio-economic factors, and, apparently, by employing non-optimal methods to assess the risk of flooding in certain areas. Building norms and regulations tend to be stricter for designating sites where critical infrastructure could be built. So such infrastructure seems to be located in less flood-prone areas.

Management Actions

Key areas for improving flood protection were summarized as: a) optimization of the legislative and regulatory basis (legal aspects); b) engineering solutions; c) optimal operation of reservoirs; d) improving the quality of hydrological forecasting; e) need for quick and effective decision-making during floods; f) flood forecasting in sub-basins of small rivers in the basin (to mitigate downstream effects); g) flood plain mapping (particularly in residential areas); h) restoring natural features of channels and floodplains.

A participant from the Republic of Moldova highlighted the role of reservoirs in regulating Dniester River flows. He emphasized the need to manage reservoirs more optimally by employing reservoir regulation by balancing the need for storing flood waters with the need for water supply during dry periods. In this regard, he said there is a need to develop new rules of operation for the Dniester reservoirs. Some participants (although not agreed by all) said the main priority with reservoirs is the requirement for hydropower and the energy sector.

[2] A metric is a measurable quantity that can be used to evaluate the performance of a system.

Participants discussed the possibility of reducing flood risk by restoring natural features of channels and floodplains. According to participants, this could be a viable option, but the practical application may be limited due to high population and infrastructure density in the basin. Moldova even considered the possibility of partially flooding the inundated farmlands, which, however, would entail high costs due to compensating land owners for flood damages. The best sites for testing the restoration approach would be the parts of the basin where settlements were relocated to reduce damages from floods.

Risk Framework Information
The participants described factors associated with the risk of flooding, as well as the main parameters for assessing damage from the passage of flood waters. It was stated that the threshold value for the Dniester discharge downstream from the Dniester dam is 2600 m^3. Water discharges in excess of this value lead to a critical flooding situation in the lower basin. Additional risk factors include the influence of the lateral inflow and the state of flood protection structures that were designed to reduce flood risk on population, infrastructure and agricultural lands.

The primary metrics used to evaluate flood impacts and flood risk management are the number (presence of) human deaths, economic costs of the flood damage including costs required to repair damaged infrastructure, and economic losses associated with the loss of crops.

Participants of the meeting also discussed problems of assessing levels of risk associated with floods. In accordance with the current Building Norms and Regulations, the criterion that is used for the issuance of building permits is a probability of flooding less than 1% per year. Engineering structures for flood protection are designed for the same level of risk. It was stated that sometimes more stringent values are used to protect critical infrastructure (e.g. roads) (e.g. 0.1 % per year flood probability for railroads). Currently, risk assessments based on economic calculations of expected damage are not used in Moldova and Ukraine.

Ecosystems

System Definition and Problems
Significant work on the vulnerability of ecosystems to climate change has been done in earlier Dniester River basin studies. Problems are different in different parts of the Dniester - upper watershed, above Ukrainian dam; the middle section of river; and the lower, estuarine section of river. The ecosystems of interest are: aquatic, marsh, wet meadows within the Dniester, and reservoirs.

A great deal of ecological degradation has already occurred, and is continuing, on the tributaries of the upper watershed and lower estuary. There are several major causes of ecosystem disruption. Other anthropogenic impacts may be far greater than climate change effects. Many tributary streams have been dammed causing major ecosystem alterations. Fish migration patterns have been disrupted due to ineffective or no fish ladders. Other infrastructure has harmed ecosystems, such as the transport of electricity through wetlands. Eutrophication is occurring in many systems due to untreated wastewater and non-point source pollution. Upper watershed deforestation has had a large adverse impact on aquatic ecosystems – both in tributaries and the main stem of the Dniester River. Other problems include flood and drought impacts, decrease in precipitation, landscape changes, disappearance of native species, growing number of invasive species, scarcity of vegetative cover around watercourses, and hazardous sanitary and toxicological conditions in the water environment. The majority felt that contemporary problems of unregulated growth and unfettered resource exploitation (e.g. new irrigation systems, water withdrawals for electric power cooling, and new pumped storage facilities) were a far greater threat to ecosystems than climate change.

Management Actions
Participants said there already exist many ecosystem protection rules and criteria, but there was frustration that they were not being enforced. The majority felt that simply enforcing existing rules and criteria would go a long way towards protecting ecosystems. Many simple solutions exist – enforcement of existing codes and rules, and better water management during extreme periods of floods and droughts.

Other management actions were mentioned. Fish ladders need improvement to help migratory fish species move through the system. Plans for thermal electric power stations should require better designs for cooling towers, so as not to cause thermal pollution. Future water withdrawals for thermal power cooling will be a major problem during drought periods.

Risk Framework Information
The following objectives were identified: biodiversity; conservation of ecosystems with all components; optimization of water use; increasing the ecosystem productivity; and improving the sanitary and toxicological characteristics of the water environment. Many rules and criteria for environmental protection already exist; use of forest resources; waterways, etc. – but they are not enforced. There are maps of ecological protection zones, but these zones are not enforced. There is also a water code that defines the 100-year floodplain, but those provisions are not enforced, either. The group identified a tolerable range of flow for most ecosystems as a minimum flow of 450 cubic meters and maximum flow of 700 cubic meters.

Most felt that there was a prerequisite need to undertake existing and future water use projections, and then overlay climate change scenarios. What is needed is an overall water balance approach, that projects future water demands and overlays those against future climate change impacts – one cannot be considered without the other.

Agriculture and Irrigation

System Definition and Problems
There is a strong dependence between irrigation and crop yields. In Moldova, farmers need irrigation to grow vegetables and grapes in Moldova. Only about 3 to 5 crops can be grown without irrigation but these provide only a small profit.

Climate is not the only factor causing changes in agriculture. There are socioeconomic changes underway as significant as climate. Privatization is changing agriculture. Irrigation was established under the centralized Soviet system. Irrigation was run by the State. Now (in Moldova) an association of water users is a legal entity that is responsible for managing irrigation water. There are problems with irrigation infrastructure. Pumping stations do not meet needs. Some infrastructure needs repair.

The water quality in the Dniester River is fit for irrigation. However, smaller Moldovan rivers are not fit for irrigation. Soil erosion is another risk to agricultural quality. In addition, there is not enough storage for irrigation water.

A warming climate has already brought about some switching of crops. Agricultural crops are moving north. Corn is now grown more in Ukraine. Cotton can now be grown in new regions in Ukraine. These changes have been a benefit of a warmer climate. One opinion was climate change may not be a disaster for Ukraine in next 15 to 20 years. The agriculture sector can adapt. Another opinion is climate change could be scary for Ukraine.

Droughts cause a reduction in agricultural productivity. The consequences of drought depend on the season. Drought that occurs in early summer and spring has the most devastating impact on crops. In addition to major droughts, there are periods of 3-4 weeks with no precipitation around mid- June to mid-July or longer. In addition, high temperatures and low humidity may cause crop

loss. Dry winds make droughts worse. In addition to drought, major rain storms can damage crops. Flood inundation of soil that causes major losses occurs about once in ten years.

In Moldova, during all periods Dniester River water has been available for irrigation. However, infrastructure is not now available to take water from the Dniester. The infrastructure is now being rehabilitated, which means there will be more demand on water from the Dniester.

Management Actions
New irrigation technologies are being applied, such as drip irrigation. Drip irrigation reduces water use by 40%. The Moldovan government subsidizes 40% of the cost to buy new irrigation technology. In Ukraine there is a combination of big farms and small farms and drip irrigation is being used in small and medium sized farms. Research on soils may increase agricultural productivity, since certain soils are more predisposed to irrigation than other soils.

One possible adaptation for agriculture in Moldova would be to further develop the land near the Dniester River. This could lead to a deficit of water in the future. One proposal is to transfer water from the Dniester to smaller tributary rivers in Moldova, but this measure would be very expensive. Another possible adaptation measure is a different crop selection. A risk management approach to agriculture would be to introduce rain insurance for farms. If a farm has a loan, the farmer may be required to have rain insurance in case a drought occurs.

Risk Framework
The group said the objectives for the agriculture sector are 1) agricultural productivity; 2) quality of yield; and 3) the environment (avoid adverse environmental impacts). Economic factors are the most important and primary performance metrics. Crops that provide higher profits are selected for planting, such as soybean and rapeseed (in Ukraine). Farmers may also want to diversify to reduce the risk of a poor harvest.

Review of past droughts provides some understanding of the likelihood and consequences of drought. In the 2011-2012 drought, precipitation levels were about 50-60% of normal precipitation. The 2007 drought had long standing consequences. Participants thought a drought affecting agriculture occurs on average every 5 to 7 years.

In Moldova, during past droughts Dniester River water has been available for irrigation. However, infrastructure was not available to take water from the Dniester. The infrastructure is now being rehabilitated, which means more water could be taken from the Dniester in the future.

Some participants stressed that socioeconomic changes are as important as climate changes. Socioeconomic scenarios should be considered in addition to climate scenarios. Some issues that should be considered are a) who will be the consumers of agricultural products? and b) how will rural populations change? There was a study in the Crimean Region to evaluate future agriculture. The study used four climate scenarios and four socio-economic scenarios (capitalist, state, sustainable, security oriented). These study methods could be applied to the Dniester.

Conclusions

One of the goals of the breakout sessions was to determine from the experts and stakeholders their willingness to bear known risks based on the severity and likelihood. The goal was to define 'coping zones' to show relative degrees of 'risk tolerance.'[3] The flood risk group did identify the 1% likelihood of flooding in any year as a criterion used by communities. Critical infrastructure may have a more stringent criterion (0.1% flooding probability in any year for railroads was mentioned). In the ecosystems and agriculture groups, it was difficult for participants to focus on specific quantitative criteria for risk tolerance levels. However, participants in these groups did describe specific vulnerabilities and conditions that caused problems.

Another theme from the ecosystems and agriculture groups was that non-climate factors affecting their sector were as significant (if not more so) as climate. A risk assessment of water resources management should include these factors in the assessment. Many of the non-climate threats could be managed more effectively.

Many of the participants noted that within each sector, there existed many regulations and rules that addressed the issues under discussion. However, they are problems with their enforcement. So, a major first step in improving the performance of integrated water management was to simply begin enforcing existing standards and regulations. These rules, regulations, standards and criteria should serve as the basis for a practical risk management approach.

One of the issues that was brought up during the sessions was the operation of the Dniester River reservoirs. Participants expressed the need to balance flood storage with other demands for reservoir storage, such as water supply and hydropower. The need for reservoir storage for agricultural water supply may increase as irrigation infrastructure is repaired and if dry periods become more frequent. Reservoirs can also be managed to provide flows to better support aquatic and riparian ecosystems. Based on the feedback from the workshop participants in the later sessions, the AGWA team decided to focus their effort on modelling the Dniester reservoirs. The team will develop a model of the main stem Dniester River reservoirs. The model will be used to test reservoir management alternatives under a range of climate conditions.

[3] Risk tolerance is the willingness to bear a risk based on its severity and likelihood.