

# ASEM SEMINAR ON WATER AND RIVER BASIN MANAGEMENT

## A GREEN GROWTH APPROACH

VAN PHAT HOTEL, CAN THO CITY, VIET NAM, 20 – 22 MARCH 2013

### PLENARY SESSION IV:

KEY ACTIONS FOR SUSTAINABLE TRANS-BOUNDARY  
MANAGEMENT OF WATER RESOURCES

**PROF. EUGENE NICKOLOV, DSc**

*GENERAL SCIENTIFIC SECRETARY AT BULGARIAN ACADEMY OF SCIENCES*

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# 1. ACADEMIC RESEARCH FIELDS



INFORMATION AND COMMUNICATION SCIENCES AND TECHNOLOGIES

ENERGY RESOURCES AND ENERGY EFFICIENCY

NANOSCIENCES, NEW MATERIALS AND TECHNOLOGIES

BIOMEDICINE AND QUALITY OF LIFE

BIODIVERSITY, BIORESOURCES AND ECOLOGY

CLIMATE CHANGES, RISKS AND NATURAL RESOURCES

ASTRONOMY, SPACE RESEARCH AND TECHNOLOGIES

CULTURAL-HISTORICAL HERITAGE AND NATIONAL IDENTITY

MAN AND SOCIETY

## INFORMATION AND COMMUNICATION SCIENCES AND TECHNOLOGIES:

- Institute of Mathematics and Informatics
- Institute of Mechanics
- Institute of System Engineering and Robotics
- Institute of Information and Communication Technologies
- National Laboratory of Computer Virology
- Laboratory of Telematics

## ENERGY RESOURCES AND ENERGY EFFICIENCY

- Institute for Nuclear Research and Nuclear Energy
- Institute for Electrochemistry and Energy Systems
- Institute for Engineering Chemistry
- Central Laboratory for Solar Energy and New Energy Sources

## NANOSCIENCES, NEW MATERIALS AND TECHNOLOGIES

- Institute for Solid-State Physics
- Institute of Electronics
- Academician Yordan Malinovski Institute for Optical Materials and Technologies
- Academician Ivan Kostov Institute for Mineralogy and Crystallography
- Institute of Metal Science, Equipment and Technologies with Center for Hydro and Aerodynamics
- Institute of General and Inorganic Chemistry
- Institute of Organic Chemistry with Center for Phytochemistry
- Academician Rostislav Kaishev Institute of Physical Chemistry
- Institute for Polymers
- Institute for Catalysis
- Central Laboratory for Applied Physics

## BIOMEDICINE AND QUALITY OF LIFE

- Academician Roumen Tsanev Institute for Molecular Biology
- Institute for Neurobiology
- Stefan Angelov Institute for Microbiology
- Institute for Biophysics and Biomedical Engineering
- Academician Kiril Bratanov Institute for Biology and Immunology of Reproduction
- Institute for Experimental Morphology, Pathology and Anthropology with Museum

## BIODIVERSITY, BIORESOURCES AND ECOLOGY

- Institute for Biodiversity and Ecosystem Research
- Institute of Plant Physiology and Genetics
- Institute for Forestry
- National Museum for Natural History

## CLIMATE CHANGES, RISKS AND NATURAL RESOURCES

- Strashimir Dimitrov Institute for Geology
- National Institute for Geophysics, Geodesy and Geography
- National Institute for Meteorology and Hydrology
- Professor Fridtjof Nansen Institute for Oceanology

## ASTRONOMY, SPACE RESEARCH AND TECHNOLOGIES

- Institute of Astronomy with National Astronomical Observatory
- Institute for Space and Solar-Terrestrial Research

## CULTURAL-HISTORICAL HERITAGE AND NATIONAL IDENTITY

- Institute for Bulgarian Language
- Institute for Literature
- Institute for Balkan Studies with Center for Thracology
- Institute for History Studies
- Institute for Ethnology and Folklore Studies with Ethnographic Museum
- National Archeological Institute with Museum
- Scientific Center for Cyrillo-Methodian Studies

## MAN AND SOCIETY

- Institute for Economic Studies
- Institute for the State and Law
- Institute for Population and Human Studies
- Institute for the Study of Societies and Knowledge



## **2. MEKONG WATER CLUSTER**

**2.1. ENVIRONMENT PROTECTION**

**2.2. NAVIGABILITY**

**2.3. IRRIGATION AND AND AGRICULTURAL DEVELOPMENT**

**2.4. ENERGY PRODUCTION**

## 2. MEKONG WATER CLUSTER

- Agriculture and energy can be identified as the priority sectors in which water saving and efficiency should be improved in order to ensure a balance between future water demand and supply.
- Hydropower generation, physical modification and overexploitation of water bodies and diffuse pollution from agriculture are addressed as significant pressures with cross border impacts.
- Water is identified as a central issue in the four priorities:
  - Environment protection
  - Navigability
  - Irrigation and agricultural development
  - Energy production

## 2.1. ENVIRONMENT PROTECTION

- The Mekong river basin is a transboundary ecosystem comprising a large number of tributaries, lowlands, a remarkable delta and incorporating a rich and unique flora and fauna.
- Deteriorating water quality would affect the provision of ecosystem services.
- The Mekong Region is also facing growing water-related risks related to the increased frequency of extreme weather phenomena and global climate change.

## 2.2. NAVIGABILITY

- Although navigation is an environment-friendly mode of transportation, the Mekong River and its tributaries are not exploited to their full potential and often impeded by seasonally varying water levels.
- At the same time, any measures aiming to improvement of navigability (e.g. through major infrastructure works) shall also take due consideration of their possible impact on the modification of river ecosystems.

## 2.3. IRRIGATION AND AGRICULTURE DEVELOPMENT



- Tackling pressures on water caused by agriculture represents is one of the main challenges.

## 2.4. ENERGY PRODUCTION

- Energy is another intensive water using sector, e.g. water abstraction for hydro-power generation and for cooling of power plants. Altered flow regimes in the Mekong river basin due to climate-induced water level fluctuations or hydro-peaking associated to peak energy supply can impact the water status should a minimum ecological flow not be secured, at the same time putting at risk the capacity of energy supply.

# 3. MEKONG WATER CLUSTER DESCRIPTION

3.1. DATABASE DEVELOPMENT

3.2. HYDRO-ECONOMIC MODELING

3.3. SCENARIO ANALYSES

# 3. MEKONG WATER CLUSTER

- Key actions should be set out that need to be considered by water managers and policy makers to ensure balance of water availability and demand from different sectors and respect the needs of nature.
- In this context a hydro-economic model should be developed to assess the impact of measures on water resources availability and allocation.
- One of the key actions can concern the further improvement of the hydro-economic model and its application at regional and river basin scale.
- The Mekong Water Cluster flagship cluster will contribute to build the knowledge base of the Water-Agriculture-Energy nexus, carry out scenario analyses of impacts of measures taking the Mekong as pilot river basin and compare results for other regions in Asia.

### 3. MEKONG WATER CLUSTER

- The Mekong Water Cluster' can address the environmental and socio-economic consequences of changing agriculture-energy pressures on water.
  - This requires a basin-wide perspective and cooperation with countries in the region taking into account needs of all stakeholders.
- Allocation of available water across different sectors needs to be integrated into the overall economic strategy of the Mekong Region based on optimization concepts in order to maximize growth and minimize the environmental impact.

### 3. MEKONG WATER CLUSTER

- Central to the assessment is development and application of an optimization model linked with dynamic, spatially explicit water quality and quantity models allowing the selection of measures affecting water availability and water demand based on environmental and economic considerations, and hydrological extremes such as floods and droughts.
- Optimization particularly focus on the competing demand between the energy, agriculture, domestic, transport and industrial sectors under a changing environment.
- Outcomes of the bio-physical modeling can be used to assess impacts of changing climate on the navigability of the river.

## 3.1. DATABASE DEVELOPMENT

- A database on inter-dependencies across water, agriculture and energy in the Mekong Region should be developed.
  - The database will cover quantity and quality aspects related to the use of water in agriculture (e.g. irrigation, animal rearing, reuse), the use of energy for water (e.g. long-distance transfers, pumping, treatment) and of water for energy (e.g. power plants, hydropower, shale gas, biofuels). It will also include socio-economic indicators such as demand functions by economic sectors, households, public utilities and unit costs of selected water management options.

## 3.1. DATABASE DEVELOPMENT

- Soil related data for Mekong Basin extracted from a range of Asian assessments will be made available.
- Information on mini hydropower generation potential can be incorporated as background for the modeling and scenario analyses. The assessment methodology is under validation for assessing possible locations and productivity of mini-hydro power plants.

## 3.2. HYDRO-ECONOMIC MODELING

- The calibration and validation of a hydro-economic model for the Mekong region coupling water quantity and quality models with an economic model assessing the damage due to water shortages and with an optimization model based on multi-criteria approaches can be undertaken.
- Based on a multi-criteria approach, the model allows the selection of measures affecting water availability and demand based both on environmental and economic considerations.
- It includes an assessment of water footprint for energy and agricultural production in the Mekong Region taking into account also trade options.

## 3.2. HYDRO-ECONOMIC MODELING

- The suite of biophysical models allows accounting for the variability of the quantity and quality of water resources.
- Simulations will be carried out to assess the effects of water-retention measures, water-saving measures, and nutrient-reduction measures on several hydro-chemical indicators, such as the Water Exploitation Index (WEI), Environmental Flow indicators, the 50-year return period river discharge as an indicator for flooding, and economic losses due to water scarcity for the agricultural sector, the manufacturing-industry sector, the energy-production sector and the domestic sector.

## 3.2. HYDRO-ECONOMIC MODELING

- Water resource use and management involve multiple conflicting objectives and criteria. Selecting the best appropriate combination of water management uses from numerous objectives is difficult and challenging as solutions require compromises that are acceptable by all potential stakeholders.
- Multi-Criteria Decision Models provide a systematic mean for comparing tradeoffs and selecting alternatives that best satisfy the decision maker's objectives.
- Taking economic and environmental constraints into account, the optimization model will allocate available water to all end users while ensuring the best tradeoffs for economic and environmental sustainability.

### 3.3. SCENARIO ANALYSES

- This database model will carry out analyses of future scenarios of water demand and supply, an assessment of tradeoffs between alternative schemes of water allocation across the agriculture and energy sectors, and the selection of optimal management options to reduce vulnerability of water ecosystems and ensure a sustainable agricultural production and the provision of ecosystem services.
- Scenarios will be run on the basis of macroeconomic trends involving changing land use and climate conditions for a future period taking into considerations also water requirements by industry, human consumption and the need to ensure a minimum environmental flow.

## 3.3. SCENARIO ANALYSES

- The changing allocation of water to and within agriculture can have impacts on agricultural production.
- Through bio-physical and crop modeling the impacts of a water supply modified in space and time as compared to today's situation on cereals yield and production will be analyzed and evaluated.
- Based on feedbacks from the second above-mentioned work package, this study will include the impact of changing irrigation water regimes (blue water) as well as changing patterns of precipitation as the natural water supply to agricultural plants (green water) due to climate change for chosen scenarios.

### 3.3. SCENARIO ANALYSES

- The identification of the classes of water management options to be included in the scenario analysis is essential for the definition of the objectives to be evaluated in the multi-criteria decision.
- This assessment will use as boundary conditions the set of scenarios generated for the Mekong region.
- Water management measures to be assessed will comprise e.g. improvement of the efficiency in the use of water (irrigation, energy, industrial uses), increase of water retention capacity through natural (floodplains, polders, wetlands) or technical infrastructure (dams, reservoirs), improvement of the quality of available water by changing farming practices, water transfer from one basin to another.

# 4. SUMMARY

## 4. SUMMARY

- Scenarios of environmental and economic impacts of alternative water allocation measures across competing water-using sectors (agriculture, energy, industry, human consumption, environment) for a future period, including an assessment of the provision/valuation of ecosystem services provided by aquatic ecosystems in the Mekong river basin.
- Methodology for modeling of water resources in the Mekong river basin, integrating quantity, quality, ecology and hydro-morphology.
- Development of information supporting efforts of countries and international cooperation bodies in the implementation process and planning of medium and long-term actions for the 2nd cycle of River Basin Management.



# THANK YOU FOR YOUR ATTENTION!

**PROF. EUGENE NICKOLOV, DSc.**  
**GENERAL SCIENTIFIC SECRETARY AT**  
**BULGARIAN ACADEMIES OF SCIENCES**

**BULGARIAN ACADEMY OF SCIENCES**  
**SOFIA 1040,**  
**1 "15 NOEMVRI" STR.,**  
**TELEPHONE ( 359 2) 987-70-87**  
**E-MAIL: EUGENE.NICKOLOV@CU.BAS.BG**  
**HTTP://WWW.BAS.BG**