

# **Healthy Rivers and the Implementation of Sustainable Water Resources Management**

Georgios SYLAIOS<sup>1</sup> · Jinsong GUO<sup>2</sup> · Menelaos HATZIAPOSTOLIDIS<sup>3</sup>

<sup>1</sup> *Department of Environmental Engineering, Democritus University of Thrace, Xanthi, Greece*

<sup>2</sup> *Department of Urban Construction and Environmental Engineering, Chongqing University, Chongqing, China*

<sup>3</sup> *Prefectural Authority of Drama-Kavala-Xanthi, Xanthi, Greece*

## **1. Workshop Framework**

Under the auspices of the China-Europe Forum, the Chongqing Science and Technology Commission (CSTC) and the Chongqing Municipality, the University of Chongqing organized in China (21-24/10/2009) a joint scientific workshop on promoting ecohydrology for the sustainable management of wetland ecosystems and water resources. The workshop received the code name T52c and was one of the numerous events organized in parallel in various cities of China, covering all the challenges Europe and China are currently confronting. The scope of this workshop was to establish new ways of comprehensive dialogue on modern environmental issues facing both societies, seeking common solutions by involving all types of public and private stakeholders. To fulfill the Forum's obligations on relying on four categories of strong partners, our workshop involved local authorities from Greece and China, scientific networks such as the UNESCO Ecohydrology Working Group, based in Europe as well as in China.

Ecohydrology was selected by both parties as an innovative and exciting topic, considered as the science of interplay between biota and hydrology, falling exactly within the context of Forum's category: "Relations of humankind and biosphere". For this reason, the organized workshop aimed to provide integrative solutions on issues related to water, people and the environment by focusing on demonstration projects and specific

case studies that promote ecosystem improvement and public awareness at local and regional scale.

## 2. *Workshop Participants*

Professors Sylaios and Guo were the European and Chinese prime movers, respectively, responsible for the scientific coordination of the workshop. Mr. Hatziapostolidis was the project general coordinator. Most European delegates were selected from the existing UNESCO Ecohydrology Working Group. These were:

### 1. Prof. Majez ZALEWSKI

Director of the European Regional Center for Ecohydrology under the auspices of Unesco

Professor at the department of Applied Ecology, University of Lodz, Poland

### 2. Prof. Luis CHICHARO

Director of the International Center for Coastal Ecohydrology approved by Unesco

Professor at the University of Algarve, Portugal

### 3. Prof. Ioan JELEV

National Research & Development Institute for Environmental Protection

Professor at the Oradea University, Romania

### 4. Prof. Andrew PLATER

Director of the Institute for Sustainable Water, Integrated Management and Ecosystem Research, Department of Geography, University of Liverpool, UK

### 5. Prof. Angelika KALLIA-ANTONIOU

Professor on European and National Environmental Law in the National School of Public Administration

## 6. Prof. Georgios SYLAIOS

Professor at the Department of Environmental Engineering,  
Democritus University of Thrace, Xanthi, Greece

Chinese experts, researchers and managers were selected based on their relevant work and interest on the specific workshop's subject. These were:

### 1. Dr. Jiang ZHU

Director of WWF Wuhan Office

### 2. Dr. Fengchang WU

Deputy Director of Key Laboratory of Ministry of Environmental Protection for Lake Pollution Control, Chinese Research Academy of Environmental Sciences

### 3. Dr. Genwei CHENG

Deputy Director of the Institute of Mountain Hazards and Environment, Chinese Research Academy of Environmental Sciences

### 4. Xuezhong YU

Chief Engineer, Department of Water Environment Research, Institute of Water Resources and Hydropower Research

### 5. Prof. Daming HE

Center for International Rivers in Asia, Yunnan University

### 6. Prof. Walter TANG

Department of Civil and Environmental Engineering, Florida International University, Visiting Professor at Chongqing University

Special guests were invited by the Productivity Promotion Center of the Chongqing Science and Technology Commission (CSTC) and participated in the Workshop. These were:

1. Dr. Guenter SUBKLEW

Researcher at the Juelich Research Center, Germany

2. Arnd KHUN

Researcher at the Juelich Research Center, Germany

3. Hans-Dietter NARRES

Researcher at the Juelich Research Center, Germany

3. *Workshop Presentations*

The venue of the Workshop was the Wanyou Conifer Hotel in the city of Chongqing, the place where all EU delegates were accommodated. EU participants arrived in Chongqing on October 21, 2009 and on the next morning they attended the Opening Ceremony of the “International R&D Institution Mission to Chongqing” at the Chongqing Empark Grand Hotel. In the afternoon a tour of the Chongqing University took place. Also, following an invitation, a lecture on the European Union Institutions and the European Environmental Legislation was given by Prof. A. Kallia-Antoniou to the students of the Department of Urban Construction and Environmental Engineering.

The Workshop commenced on October 23, 2009 at the Feicui Hall of the Wanyou International Conference Center. The morning session was chaired by Prof. Guo while the afternoon session by Prof. Sylaios. All presentations lasted approximately 20 minutes, followed by a 10 minutes period for questions and discussion. The Workshop began with an introductory host speech given by Prof. Guo, to welcome all participants and introduce the delegates from China, EU and the CSTC officers. CSTC officers also welcomed the delegates and stressed the importance of such cooperation programs for Europe and China.

Prof. Zalewski presented the general framework of Ecohydrology and its implementation in the context of the International Hydrological Programme. Prof. Sylaios presented the environmental impacts of river damming with particular reference to Nestos River, and illustrated the application of ecohydrology principles, as potential solutions to improve

the riparian, deltaic, wetland and coastal ecosystems. Prof. Yu presented an index to assess the level of 'green' hydropower. He produced quantitative indicators and technical criteria for the environmental management of hydropower dams. Dr. Subklew reviewed the research projects carried out at Juelich Research Center and focused on studies concerning the nutrient and water movements in the cells of plants, the mass-fluxes of agro-ecosystems, the determination of the hydraulic and transport properties of catchments and the fate of xenobiotics (pesticides, antibiotics and fertilizers) in the water environment. Prof. Jelev discussed the impact of human activities on the Danube River and the Danube Delta environment and assessed the proposed solutions for Danube River re-arrangements. Prof. He considered ecohydrology as a new and innovative idea for China, serving as a tool for the ecological conservation of river systems. He presented a numerical model for the assessment of the environmental impacts from river damming and expanded on these impacts arising from climate change scenarios. Prof. Chicharo presented several ecohydrology applications to reduce the environmental impact of river dams on the coastal zone, with particular reference to the Guadiana Estuary. Prof. Zhu assessed the environmental changes observed in Yangtze River after the construction and operation of the Three Gorges Dam. Main consequences involved the decrease in fish fry, the biodiversity reduction by 20-50%, the frequent occurrence of eutrophication at the reservoir and the decline of carp species at the downstream river part. Prof. Plater discussed the changes in the coastal sedimentation rates due to human impacts on river systems and climate change concluding that high rates of sea level rise (3-6 mm/yr) and low sediment supply increases coastal erosion vulnerability and the risk for coastal inundation. Prof. Cheng examined the optimum conditions that the Three Gorges Dam should operate in order to achieve the ecological objectives considered. Prof. Kallia introduced the participants into the European Water and Biodiversity Legislation, with particular reference to the Water Framework Directive. Prof. Guo reviewed the present research findings on the tributaries of the Yangtze River, summarizing eutrophication and bank erosion as the main environmental problems in the region. He considered that ecohydrology could offer solutions for

environmental problems on a river basin scale, something that could be achieved by designing multi-purpose dams.

#### *4. Workshop Conclusions*

Workshop conclusions were reviewed and summarized by Prof. Sylaios during the morning of October 24, 2009. After their presentation, all participants contributed with their ideas for their improvement. The conclusions drawn are:

It is presently evident that almost 80% of the Earth surface has been altered by Man. Rivers have been amongst the most modified aquatic systems. Recent developments show that river water and the associated coastal degradation are expected to continue in the future due to the need for more food production and increased water use. Therefore, more water will be stored and used by dams, thus affecting the functioning of river, estuarine and coastal ecosystems. Test cases presented in the workshop from Guadiana, Nestos, Yangtze and Danube Rivers revealed the impact of freshwater impoundment due to dams. Several adverse effects have been observed (as eutrophication, river bank and coastal erosion, reservoir siltation, etc.) to these river ecosystems as a result of similar interventions. Our results depicted clearly that although differences exist in the scales of processes and impacts among the systems presented, most problems are common, requiring a common approach for their solution. Action to improvement must be taken now as climate change impacts are expected to add to the above adverse effects produced by river damming. For the case of cascading dam systems, as the Three Gorges Dam (TGR) case, it is evident that their present operation principles could be improved by tuning to minimize environmental impact. At the branches of TGR, eutrophication and soil erosion appear as the most significant problems. However, solutions to the above problems are yet to be addressed fully.

Today, Ecohydrology (EH) offers a new innovative and cost-effective tool which can help minimize the impacts of the above effects, by increasing the carrying capacity (sustain water, reverse biodiversity decline and provide ecosystem services to society) and by studying processes at the entire watershed scale. Especially in the case of dammed

river systems, EH may tune their operation in order to minimize their impact on water quantity and quality at the downstream part of the watershed. Multi-purpose dams or series of small dams could be considered as tools to improve environmental conditions, if separated by sections of the free-flowing river. The use of constructed wetlands, the use of water-plants-soil interaction, the regulation of hydrodynamics to alter phytoplankton dynamics are some examples discussed thoroughly in the workshop. Further, the concept of Green Hydropower and the proposed indicators presented should also be adopted as a tool linked to EH, assessing the effectiveness of the measures adopted by the Hydropower companies aiming to improve the environmental functioning of the system.

All participants agreed that in this case we are able to provide efficient and viable solutions through the EH approach. EU legislation could adopt these solutions, especially as a tool for improving the WFD requirements in river basins and associated estuaries and coasts. Moreover, adoption of the solidarity principle expressed in the EU water legislation for neighboring countries or regions should be considered to find appropriate solutions to common problems. At the same time, participants underlined the significance of the involvement and the contribution of Local and Regional Authorities (LRA). Thus, EU policy and legislation on water management may be considered as a useful tool to be taken into account by the China-EU Forum.

##### *5. Collaboration Achievements during the Workshop*

A project proposal for future co-operation between the UNESCO Ecohydrology Group and the Chongqing University has been developed, concerning the tributary branches of TGR. This proposal will serve as a basis for further collaboration, focusing on the impact of TGR on tributary branches hydrology and the problems of eutrophication and soil erosion determined. The proposal will be modified and adapted according to the results produced during the workshop and will be sent by e-mail to EU participants. Within the context of diagnostic methodology and the establishment of an early warning system for harmful algal blooms, an initial agreement between the University of Lodz, the UNESCO

Ecohydrology Center and Chongqing University has been signed for further collaboration.

### *6. Proposed Future Action*

A step-by-step approach was adopted by all participants for future collaboration. According to this approach, both parts should look for funding opportunities towards scientific and education exchange and the possibly for pilot project development and implementation through EU or other financial instruments. Other universities and research institutes should be involved to cover the trans-disciplinary and integrated approach and the large spatial scale of the TGR system. Stakeholders as hydropower organizations, local authorities and NGOs should also be involved in the EH approach.

The newly published Ecohydrology book, which will be translated in five languages and possibly in Chinese, could serve as a basic textbook for teaching ecohydrology in University classes. Further, the Erasmus-Mundus Master Program in Ecohydrology could receive Chinese students from Chongqing University, offering scholarships throughout their postgraduate studies. Finally, the present UNESCO Ecohydrology Working Group could expand and include one or two eminent Chinese scientists from Chongqing University at the various types of UNESCO meetings. UNESCO exchange grants could be investigated to support short-term student visits and exchanges.