IMRR Project – integrated and sustainable management of Red-Thai Binh Rivers System in a changing climate

The IMRR project, funded by the Italian Ministry of Foreign Affair (International Cooperation), involves the Politecnico di Milano (Italy) and the Institute of Water Resources Planning (Vietnam). The project aims at developing and promoting strategies for the sustainable management of water resources in the Red-Thai Binh Rivers System through coordinated decision-making and stakeholders' participation, supported by advanced modeling and optimization tools, and through capacity building of young researchers.

The Red-Thai Binh Rivers System is the second largest river basin in Vietnam and is experiencing rapid development in terms of population and economic growth. People are moving from rural areas to the main cities and to the capital Ha Noi, producing an increase in water and energy demands, and also in the potential impact of extreme floods. Around 20 million people currently live in the delta region, with 6.5 million only in the Ha Noi metropolitan area. As part of the medium-long term energy and food security national strategy, a number of strategic dams were constructed on the Red River tributaries. The installed hydropower capacity accounts for more than 20% of the national one, while agriculture involves around 50% of the local workers in 501,000 ha of cultivated fields, distributed among 22 irrigation districts.

Official welcome from Dr. Piccioni (Ambassador of Italy in Vietnam), TS Thang (Ministry of Agriculture and Rural Development) and TS Sach (Institute of Water Resources Planning).

The main project result is Red-TwoLe, a sophisticated computer system integrating a variety of models to support the real-time operations of the four strategic reservoirs in the Red-Thai Binh Rivers system. Red-Twole has been installed and configured on IWRP's server. During the Final Basin Meeting on 19th November 2015, a copy of Red-TwoLe was also delivered as ready-to-run virtual machines to the Ministry of Agriculture and Rural Development and the Ministry of Natural Resources and Environment.

Dr. Piccioni and Prof. Soncini-Sessa deliver the Red-TwoLe to the Ministry of Agriculture and Rural Development and the Ministry of Natural Resources and Environment.

The computational challenges of IMRR project were extremely relevant: more than 2,000 alternative management strategies, corresponding to different tradeoffs among the multiple sectors involved, have been designed, for a total computational effort of 20 computing years relying of massive parallel computation. These solutions were evaluated under historical hydro-meteorological conditions and current water and energy demands. Project results show that there is room for improving the existing system regulation with respect to 2010 conditions, potentially attaining a reduction of 10-33% in energy deficit, 70% in flood damages, and 93% in water supply deficit. In addition, IMRR solutions ensure no overcoming of the 13.4 m dykes protecting Ha Noi downtown in case of extreme floods (i.e., 500 years return period), while also attaining better performance in water supply under extreme droughts. These solutions seem also to outperform the existing flood management guidelines under such extreme conditions.

Since the variation of the hydrologic regime due to climate change is likely to alter the medium and long term performance of the solutions designed over historical climate, IMRR first identified their main vulnerabilities under different projected climate scenarios. Then, we assessed the expected costs if no adaptation is implemented and, finally, we explored the advantage of re-designing the existing management strategies in order to mitigate climate change adverse impacts, without the need of structural upgrades and their associated financial outlays. Project results show that, depending on the climate scenario considered among the five produced by the Vietnam Institute of Meteorology, Hydrology and Environment, the performance of the existing operations with no adaptation are predicted to change from -7% to +5% in hydropower production, +35% to 520% in flood damages, and +15% to +160% in water supply deficit. However, the re-design of the management strategies allows adapting to climate change and saving 60% of the projected flood damages.

Finally, IMRR also demonstrated the impacts and opportunities associated to the use of El Nino and La Nina information for improving the management of the system, as well as the role of reservoirs' construction and sand mining on river networks evolution.

During the Strategic Meeting on 17th November 2015, all these alternatives have been evaluated and negotiated by sectorial experts, who identified a set of four solutions representing possible compromise management strategies to be recommended to the water authorities.

The methodology and results developed during the project represent state-of-the-art techniques and valuable scientific findings, as demonstrated by the 24 publications in international scientific and the 49 contributions to several international conferences.

Politecnico di Milano and IWRP staff presenting project's results during the Final Basin Meeting.