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UNESCO
Division of Water Sciences
Natural Sciences Sector
1, Rue Miollis
75 732 Paris Cedex 15, SP France



United Nations
Educational, Scientific and
Cultural Organization



International
Hydrological
Programme



**Workshop on Integrated Modelling
Approaches to Support Water Resource
Decision Making: Crossing the Chasm**

UNESCO-Paris, 20-21 April 2009

*An Opportunity to Invest in Future Tools for
Integrated Water Resources Management*

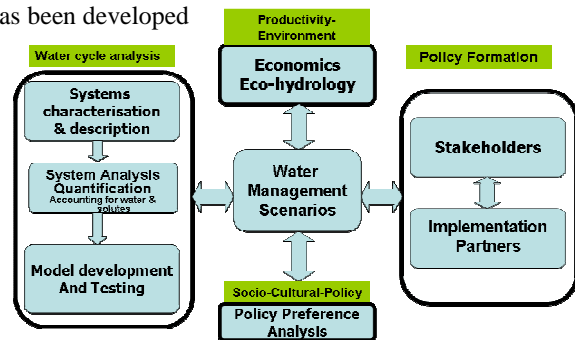
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Background

Modelling can be a powerful tool to inform and support water managers and planners in making integrated water resource management (IWRM) decisions. However, despite the substantial improvements in model development tools and large investment in the development of computer models by scientists and academics, their use as decision support tools by water management practitioners remains low. The suboptimal use of models and modelling in supporting water management decisions can be attributed to failures in two main areas – integration across modelling disciplines and inadequate integration between researchers and practitioners in all phases of the modelling cycle.

Model development is still predominantly focused within narrow disciplinary boundaries such as hydrology, water systems, economics, social science, etc; with little integration across discipline boundaries. This approach ignores the broader economic, social and environmental interactions of water management interventions that change the existing stocks and flows in the catchment or river basins and yields inappropriate responses to water planners and managers. This silo approach to modelling the behaviour of water resource systems in response to water management interventions is usually ineffective in achieving their intended purpose which is to inform water management and policy decisions made by practitioners. This is especially evident in the use of modelling to inform water sharing policies under severe competition between consumptive and environmental uses where despite of extensive modelling carried out by scientists and academics in major river basins that are currently under severe stress, these tools remain under-utilised by planners and policy makers.

System Harmonisation is an approach that has been developed to overcome this lack of integration problem (Khan et al, 2008; Malano & Davidson, forthcoming). However, it is still an evolving framework which often faces the challenge of achieving satisfactory modelling integration. The purpose of this workshop was to scope techniques that can bind different approaches to water management into a more integrated package



The workshop has addressed these integration issues in the context of developing water sharing strategies aimed to harmonise economic uses of water (irrigation, urban, industrial) and environmental demand. It envisages the seamless integration of the water cycle analysis and impacts from alternative water management policies, economic and eco-hydrological analysis and modelling and socio-cultural and institutional elements that may impinge or constraint the application of alternative policies.

Objectives

The aim of this workshop was to discuss strategic approaches that ensure the:

- Convergence of different disciplines in the development of integrated modelling frameworks to assist decision making by water management practitioners, and;

- Convergence of modellers and practitioners in the development and application of modelling frameworks to support water management decision making.

Summary of Key Deliberations

It is pleasing to note from presentations that a number of modeling activities are going on in this area. A synthesis of such activities will be of great use to the water community. Models looking into thresholds may be of great value. Need to continue discussion on whether to integrate everything or keep some tools separate. It is important to distinguish between modelling people's behaviour or model with people? There can be benefits either way. Concentrate on how to use the models rather than which models to use. Need to start thinking about models in a different way for example new machine learning modelling approach.

Need to ask what these models are going to provide and to whom? Several disciplines are needed to provide decision support for different issues. There is a need to integrate modelling capabilities from different disciplines. Local capacity building is required to make sure modelling efforts are utilised by the water managers and decision makers. There are missing links between different components (e.g. between physical and human systems – stakeholders, users and the institutions and policies). Conflict of interest between stakeholders may not be captured by optimisation tools. Can we use optimisation as a negotiation tool with stakeholders?

It was positive surprise to see similar approaches for coupled modelling. Linking biophysical and economics is clear. Link between ecology and water dynamics not clear. Still only water flow based modeling is common in water allocation decision making. Scale is a big issue in linking ecology with hydrology. Water and people possibilities are eye opener – modelling with people can be very useful – bring modelling processes closer to understanding is the way forward. Model together with stakeholders can help with deciding right level of complexity. Modelling is a very time consuming process. There is a need to have quick rough models followed by detailed efforts. Cultural component is an important consideration. Water quality so far has been concentrated on rural aspects what about industrial and urban (point sources). Modellers put a lot effort on model development rather than developing credible water management scenarios (we do a cheap job on scenarios). We need smarter scenarios.

Quantity modelling should go along with quality and environmental considerations. Starting with stakeholders is very important. This can help develop simple tools and indicators. This can also help with ownership and protection of water quality. Landuse is important parameter for understanding water quality dynamics. One water quality indicator is often not adequate.

There was a common thread in all discussions. Modelling of water resources and integration with economics has reached a fairly mature state. This does not apply to ecosystem response and peoples behaviour. People's behaviour is a weak link in modelling water allocation. Integration with water resources systems and economics with people considerations is very important.

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Examples from HELP Basin's focusing on stakeholder driven approaches are complimentary to the system harmonization concept. This can lead to better integration of models and integration of stakeholders and links between the two. Approach to integrating people with the modelling framework is different to modelling people behaviour and the two things compliment each other.

Stakeholders (policymakers, water users and community) need to have access to spatial and temporal based outcomes. Feedback at all stages of modelling is important.

There is a need for water quality indicators which can be used by hydrologists, economists and others involved in the process. Everyone thinks economics can be dealt with quite easily. Coupled models is the way to go but not the only way to go. Bayesian and other approaches need to be explored further. Landuse and water are closely linked together. There is also a need to find a better way of explaining economics (e.g. value, gross margins etc). Modellers need to find ways to explain succinctly, quickly and accurately. Integration of models is still not very clear in some cases. Policy links with models are still very grey. Timing of modeling outputs and policy needs is a big issue – build rough functional models to start integrating with other disciplines.

The key questions to ask include:

- How to use the model?*
- What should be the integrating factor?*
- Relative role of economics and social issues?*
- How to balance different considerations?*

Real time data collection capturing dynamics using a common database structure is important. This can help develop benchmark solutions and to share across different regions. Incorporation of complexity vs adoption of reductionism is an important consideration – complex and accurate models need to be coupled with rules for simplifying information. Impact of big projects on water quantity, quality, environment and links with climate change are important for tackling global issues. Modellers need to deal with uncertainty by explaining it to people while satisfying local vs global interests. Learning machines can help simplify data collection and modelling – floods, droughts and climate change leading to strategy development and mitigation measures. Using models which can show the consequences can be a proper way of putting issues such as global change on the agenda.

It is not clear how to link water models with community schools? Primary and secondary education in the context of community education in water management is key to sustainable development. Modellers need to focus on the appropriate role of optimisation and simulation models. Optimal scenarios as compared with optimisation techniques are different concepts.

Recommendations for Actions

- 1) Setup e-group, facebook, Wiki on modelling in the short term to share these ideas with a wider group
- 2) Standardisation of database platforms (and modelling suites environment) to aid plug-in. HELP, PUB and FRIEND to facilitate this process.
- 3) Need to develop capacity in use of models and engagement with stakeholders. Modellers need to learn appropriate communication skills. (start with training the modellers) – Training workshops (within next 2 years). Needs to be customised to regional conditions
- 4) Publications (Policy brief – 6 months, special volume/book on frontiers in integrated water systems modelling in next 1 years, guidelines (working over 2 year)
- 5) Capture state of art on linking hydrology and ecology in a dynamic framework. study to be aided by a core group. (AIT, University of Essen, Cemagref, MAB, Kiel, ERCE, ICCE and Melbourne). (2 years)
- 6) Integrate modelling with planning, decision making and policy implementation using dynamic feedback from field to modify models and decision making process.
- 7) Need guidelines for stakeholder engagement, scenario development, integration of disciplines, modelling, and decision making activities. (Develop integrated modelling (between models and stakeholders – UNESCO in next 1 year)
- 8) Take into account policy development and implementation time frameworks by defining appropriate inputs and outputs.
- 9) Synthesis of best practices in the use of models to develop, adapt and modify policy e.g. EU Framework Directive, NWI (possible special session in a conference on similar lines by linking IHP system). (2- 5 years)
- 10) Economics need to focus in four areas:
 - Financial assessment, values and costs – neo classical – done
 - Institutional/Ecological economics – minimise transaction costs – need to explore
 - Possible future investments in General Equilibrium models
 - Regional economics assessment – input-output analysis – not included in most models (UNESCO Chair+partners to convene) - 2010
- 11) Need to closely interact with emerging modelling techniques such as the motivated machines (may require integration of existing models with new machine learning methods). This will also integrate with modelling people behaviour with biophysical models. A study of state of art and possible seminar e.g. agent based approaches. (1 to 5 years)

List of Participants

Lotta Anderson
SMHI
601 76 Norrköping
Tel: 011-495 81 44 MEX
Fax: 011-495 80 01
email: lotta.andersson@smhi.se

Anhsuman
Area Convenor
Water Resources Policy and Management
Water Resources Division
The Energy and Resources Institute (TERI) Darbari Seth Block,
India Habitat Center, Lodhi Road, New Delhi. 110 003
Cell: 09899809115
Ph: +91 24682100, +91 41504900, Ext - 2312,
Fax: +91 24682144, 24682145
email: anshuman@teri.res.in

Mukand S. Babel
Associate Professor and Coordinator
Water Engineering and Management (WEM)
School of Engineering and Technology (SET)
Asian Institute of Technology (AIT)
P. O. Box 4 Klong Luang
Pathumthani 12120
Thailand
E-mail: msbabel@ait.ac.th
Tel: (66-2)-524 5790 Fax: (66-2)-524 6425

Brian Davidson
Faculty of Land and Food Resources
University of Melbourne
Parkville Vic. 3010
Melbourne
Australia
Email: b.davidson@unimelb.edu.au

Nicola Fohrer
Fachabteilung Hydrologie und Wasserwirtschaft des ÖZK Olshausenstr. 40
24098 Kiel
nfohrer@hydrology.uni-kiel.de
Achtung! Neuer Studiengang unter
www.ecology.uni-kiel.de/masters
Tel: 0431/880-4030 Tel.: 0431/880-1276 Fax.: 0431/880-4607
<http://www.hydrology.uni-kiel.de/>
Email: nfohrer@hydrology.uni-kiel.de

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J. Alberto Tejada-Guibert
Division of Water Sciences, UNESCO
1 rue Miollis, 75732 Paris Cedex 15, FRANCE
Tel: + 33 (0)1 4568 4096 - Fax: + 33 (0)1 4568 5811
E-mail: ja.tejada-guibert@unesco.org
www.unesco.org/water

Shahbaz Khan
UNESCO Division of Water Sciences
Natural Sciences Sector
1, rue Miollis,
75 732 Paris Cedex 15, SP France
Tel: +33 1 45 68 45 69
Fax: +33 1 45 68 58 11
Email: s.khan@unesco.org

Hector Malano
Department of Civil and Environmental Engineering
University of Melbourne
Parkville Vic. 3010
Melbourne
Australia
Email: h.malano@civenv.unimelb.edu.au

Biljana D. Radojevic
Natural Science Sector
MAB and IHP Programmes
UNESCO
1, Rue Miollis
75 732 Paris cedex 15
France
Tel: +33 1 45 68 37 34
Fax: +33 1 45 68 58 04
E-mail: b.radojevic@unesco.org

Janusz Starzyk
Ohio University,
Athens 45701, USA
<http://www.ent.ohiou.edu/~starzyk/>
email: starzykj@gmail.com