STRIVER POLICY BRIEF

Strategy and methodology for improved IWRM
- An integrated interdisciplinary assessment in four twinning river basins

PB No. 10

Modelling Water Pollution with Stakeholders involvement - The twinned experience of Glomma (Norway) and Tungabhadra (India) river basins

We argue that river basin models are fundamental quantitative tools that can be used to evaluate impacts of alternative IWRM scenarios in general and water pollution and subsequent management strategies and policies in particular. Stakeholder involvement in all the phases of the process such as scenarios building and modeling outcome discussions was found to play a key role. We also recognize that modeling pollution is far from an easy task due to scarce model input data and difficulties to include social processes into the model exercise

The STRIVER Policy Brief series translate the results from the EC FP6-funded STRIVER project into practical and useful information for policy makers and water managers

Modelling Water Pollution with Stakeholders involvement. The twinned experience of Glomma (Norway) and Tungabhadra (India) river basins

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Abstract

River water quality related to diffuse nutrient pollution was studied using the same methodological and modelling approaches in two different case river basins: the Norwegian river basin Glomma and the Indian river basin Tungabhadra. The process consisted of a series of steps, including the characterisation of existing conditions, the identification and prioritisation of problems, the assessment of the current conditions and the development and test of future scenarios using watershed models. Scenarios are a synopsis of a projected "realistic" course of action, for future development, based on the perception and the interests of the stakeholders concerned and within the overarching policy framework. In this study we focused on land use scenarios and their impact on water quality. The interaction between stakeholders and scientific experts in the development of scenarios and its impact based on the modelling outcome was particularly stressed.

References

This STRIVER Policy Brief is based on the following research report and scientific literature:

Barkved, L.J., Deelstra, J., Grizzetti, B. and Bouroui F. 2008. Modelling nutrients in the Glomma river basin: scenarios and management recommendations. *STRIVER Policy Brief No. 11*

Korfmacher K.S., 2001. The Politics of Participation in Watershed Modeling. *Environmental Management* 27.2: 161-176

Fazi, S and Lo Porto, A. (Eds). 2008a. Scientific report on pollution source assessment, including source apportionment results, and pollution prevention measures. *STRIVER Report No. D7.1*

Lo Porto, A., Barkved, L.J. and Gosain K.A. 2008b. Modelling water and nutrients balance in Tungabhadra river basin: scenario analysis and management recommendations. *STRIVER Policy Brief No. 7*

Modelling tool used

SWAT - a physically-based semi-lumped model that can be used to assess the spatial pattern in the basin of contribution to runoff and pollutant losses and to generate and compare different environmental (i.e. climate change) and management scenarios (i.e. Best Management Practices, crop rotations,).

Put IWRM principles into practice

During the last decades, the need for a holistic river basin approach has gradually been recognised by many national and regional administrations and river basin organizations. This approach theoretically includes stakeholder involvement and up to-date science and technological knowledge.

The river basin planning process is carried out through a series of steps:

1. ***characterize existing conditions,***
2. ***identify and prioritize problems,***
3. ***define environmental and management objectives,***
4. ***develop protection or remediation strategies and***
5. ***implement and adapt selected actions.***

The latter two steps are according to our opinion particularly important since it require a holistic and integrative view and at same time with solid grounds into the future developments.

Scenarios in particular indicate future directions for development or policy implementation, based on the perception and the interests of the stakeholders concerned. We here argue that the impact of scenarios on water quality and quantity can be evaluated by river basin modelling. We also argue that the interaction between stakeholder and scientists in the development and implementation of scenario modelling is a prerequisite in Integrated Water Resources Management (IWRM).

In the STRIVER project this aspect of IWRM was addressed by twinning the Norwegian river basin Glomma and the Indian river basin Tungabhadra in a water pollution study. More specifically, water quality related to diffuse nutrients pollution was studied in the two river basins using the same methodological approach: implementing the same watershed modelling tool and involving the local stakeholders in the different stage of scenario development and analysis.

Why river basin modelling?

River basin models are tools to represent the hydrological and biogeochemical *'functional'* or generic behaviour of a river basin system. In an IWRM context, they can provide – at least potentially - a knowledge base and/or scientific basis for comparison of present and future management options in the river basin of concern. Therefore, models might raise the awareness about the implications of policies and/or management strategies, such as climate and land use change.
It should be noted that the models differ according to the processes included, the temporal and spatial resolution of data required, and type of results they can provide. It should also be stressed that the choice of a modelling tool largely depends on the specific objectives of the study.

Models need to be parameterised, calibrated and validated for the specific local conditions under concern. These steps require physical and management data information on the river basin generally and availability of adequate monitoring data of water quality and quantity specifically. Nonetheless, there is a clear need to apply models also where data are scarce.
However, we argue that the availability of adequate data is a crucial prerequisite for the model application, as the goodness of the predictions and the quality of the assessment highly depend on the model assumptions and on the quality of input and monitoring data.

It is also crucial that the models can represent the processes involved at various temporal and spatial scales for the river basin under consideration. Moreover, it should ultimately meet the user needs, demands and expectations. The selection of the appropriate model requires close interaction between policy makers, extension offices, catchment an overall basin managers and scientists.

In the case of the STRIVER project, the objective was to assess the principal sources of nutrient loss into surface water and the impacts of agricultural mitigation measures and land use changes on water quality. The modelling tool used in the study included the description of the physical processes and the spatial variation of climate, soil, land cover, agricultural management and industrial and sewerage discharges. The data available sometimes showed severe limitations that in end required assumptions and data constructions. Consequently, this also hampered the possibility to comply to the specific water manager and stakeholder interests.

Bearing in mind the limitations, the model estimated the actual contribution of different sources to nutrient losses to surface water (Lo Porto et al., 2008a) and assessed the impact of future scenarios. Specific modelling results and management recommendations for the Glomma and Tungabhadra river basins are reported in Barkved et al. (2008) and Lo Porto et al. (2008b), respectively.

Stakeholder involvement in watershed modelling and scenario development

Development of scenarios needs to be in the mind-frame of the present day situation and overall stakeholder interests. Therefore the trialogue interaction between scientists/modellers, policy makers and stakeholders is of fundamental importance in the development of realistic scenarios.

The participation of stakeholders in the modelling process provides a substantial input which has been emphasised earlier by e.g., Korfmacher K.S. (2001):

- to understand the watershed main problems, targeting the objective of the modelling
- to select the appropriate modelling tool fit for the specific purpose
- to describe the system, as each watershed presents its peculiar environmental and management characteristics
- to build realistic scenarios that corresponds to the threats and interests of the different parts represented by the stakeholder group
- to analyse the results of the modelling and of scenarios predictions, providing feedback to the scientists and the decisions makers

Fig. 1: Field trip with stakeholders in the Glomma catchment, identifying issues and scenarios to be modeled (photo: Line J. Barkved)

Fig. 2: Stakeholders attending a scenario development meeting in the Tungabhadra basin (photo: Shruti Vispute, SOPPECOM)

Stakeholder involvement in all the phases of the modelling process and scenarios building plays a key role for the success of the whole study and decision making process, assuring representative model predictions and realistic scenarios as well as 'trust' between the partners

The STRIVER project involved the stakeholders at different stages of the modelling process, especially in the scenarios building. Stakeholders meetings were organised especially to address issues related to water pollution and water quantity distribution among users and sectors. Their perception of the main polluting sources related to water quality in the river basin provided important input to the modelling set-up. These interactions are important in raising awareness and increasing understanding at stakeholders, policy makers but not least the scientists and modellers. It also increases the awareness of the importance of data availability and monitoring needs in the specific basins. . The interaction with stakeholders is important in defining realistic scenarios. In the case of the Hunnselva and Lena catchment, two sub-basins in the Glomma River basin in Norway, measures related to agricultural practices, required by the current environmental policies were selected. They included conservative tillage, balanced fertilisation and a shift towards cash crops. In the case of the Tungabhadra river basin, the stakeholders were interested in climate change impacts, improved sewage treatment, irrigation technology and changed rice production.

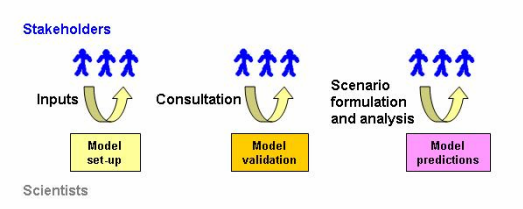

Fig. 3: Interactions of stakeholders and scientists at the different stages of the modelling process.

Difficulties and successes

Although simple in principle, the interaction between scientists and stakeholders in the modelling process and scenarios development may encounter many difficulties in practice. The usage of different terminology between different actors is one such example of a practical problem. Different priorities and approaches is another. Other practical difficulties are linked to the frequency of the meetings, resources available and the physical distance between modellers and stakeholders (coming also from different continents).

An important, hardly mentioned problem is the lack of understanding by the modeller of the physical and social processes and interactions between them at the basin under consideration. In addition, data for watershed modelling were not always available at the required scale and resolution. They were rarely owned by the same institution.

In addition, water managers were not always aware whether the current monitoring network was adequate to answer their requirements.

As a general result in STRIVER, the involvement of stakeholder in all the phases of the modelling process and development of scenarios resulted in a positive experience, which has improved the quality of the analysis and results and provided lessons learned that can be valuable also for similar processes. In particular, the experience of STRIVER has shown that involvement of stakeholders has significantly contributed to:

- prioritise the water quality and quantity problems, targeting the modelling objectives
- describe more correctly the system, providing input and information based on real experience, which, when lacking, had lead to general assumption not always correspondent to the reality of the river basin
- build scenarios of real interest and analyse them

Stakeholders were part of this 'artificial' decision making process, enabling them to raise their own needs and concerns. Moreover, questions raised to the scientists were answered. Stakeholder involvement through the various phases of the model development and the validation improved the transparency of the results and facilitated their understanding and acceptance of the assessment outcome.

The STRIVER project has allowed the exchange of experiences between natural and social scientists of India and Norway, and more in general between Asia and Europe, as the processes were conducted in parallel and the results discussed in common regular meetings. It has also promoted the indirect exchange of experiences of the local stakeholders of the two river basins.

This twinning exercise has showed the flexibility of the methodology and process proposed. In fact, the same approach applied in two river basins using modelling with stakeholder involvement can be regarded as successful despite the two completely different river basin context, with specific environmental and social-economic conditions, and diverse experiences in stakeholder involvement.

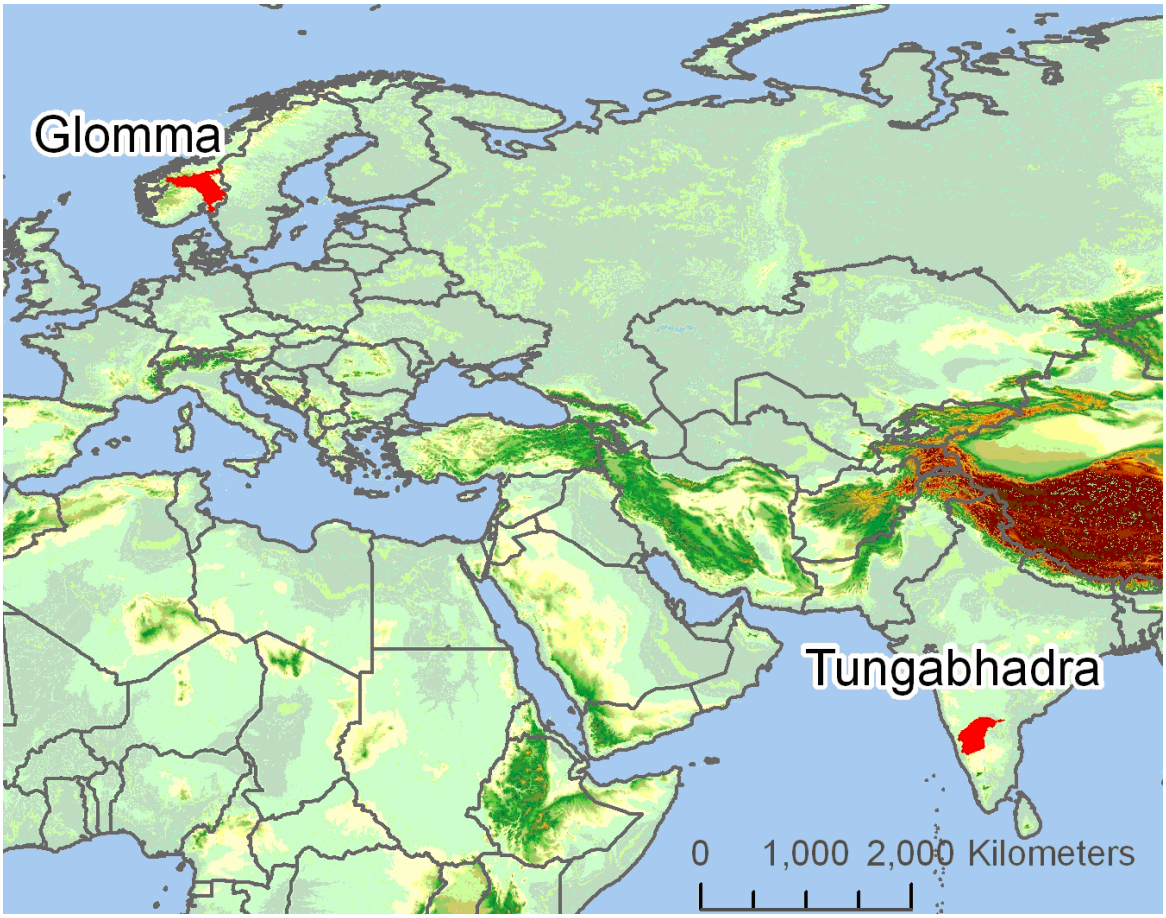

Fig. 4: Location of the Glomma (Norway) and Tungabhadra (India) river basins.

STRIVER

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The Briefs are also available online: www.striver.no

About STRIVER
STRIVER- Strategy and methodology for improved IWRM - An integrated interdisciplinary assessment in four twinning river basins is a three year EC funded project 2006-2009 under the 6th framework programme (FP6) coordinated jointly by Bioforsk and NIVA. The point of departure for STRIVER is the lack of clear methodologies and problems in operationalisation of Integrated Water Resource Management (IWRM) as pointed out by both the scientific and management communities.13 partners from 9 countries participate as contractual partners in addition to an external advisory board.

Title of project:
Strategy and methodology for improved IWRM - An integrated interdisciplinary assessment in four twinning river basins (STRIVER)

Instrument: SUSTDEV-2005-3.II.3.6: Twinning European/third countries river basins.
Contract number: 037141
Start date of project: July 2006 Duration: 36 months

Project funded by the European Commission within the Sixth Framework Programme (2002-2006)

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Frontpage: Left photo: Rice fields along with coconut trees in Tungabhadra river basin (K.J. Joy). Right photo: Hunnselva in GLomma river basin (Line J. Barkved)

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Launch date: 17 November 2008