Use of participatory scenario modelling as platforms in stakeholder dialogues

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Abstract Water related problems are characterized by complexities, uncertainties, and conflicting interests and there is no single "optimal" way to approach these "wicked" problems. Model-assisted participatory processes have been suggested as one way to meet these challenges. However, the use of models as a scenario tools for local planning of mitigation and adaptation strategies addressing environmental challenges is more often an exception than a common practice. In order to assess future possibilities for successful use of participatory scenario modelling, experiences from two model-facilitated projects are presented and discussed. The participatory scenario modelling described in this paper, implies modelling *with* people, as opposed to agent based modelling which is based on modelling *of* people's behaviour and its consequences. In the first project, a participatory model-assisted process was conducted to formulate a locally proposed remedy plan to reduce nitrogen and phosphorus loads in local lakes and the coastal zone. In the second project, a similar process was used to formulate local adaptation strategies to climate change impacts on water allocation, farming and the environment. Based on the experiences of these projects; recommendations are made to how model-assisted participatory processes can best be organised and conducted. A key message is that modellers need to rethink their role as "solution providers" to become "process facilitators".

Key words participatory water management; participatory modelling; stakeholder involvement; catchment modelling; eutrophication; EU Water Framework Directive; climate change; adaptation; mitigation; South Africa; Sweden

INTRODUCTION

Integrated Water Resource Management (IWRM) is characterized by complexities, uncertainties, and conflicting interests. Consequently, there is not one single "optimal" way to approach these "wicked" problems. The framing of the need and the implementation possibilities of various mitigation and adaptation measures can vary between stakeholders. Consequently, there is a need for a collaborative decision-making approach. Computer-based hydrological models are able to synthesize large sets information, making it possible for stakeholders to see where and why problems exist today and how they might be reduced or even increased in the future, depending whether and how various mitigation and adaptation strategies are implemented. However, the use of models by planners at the local level, as a tool for formulation of mitigation or adaptation plans to address environmental risks is still more often an exception than a common practice. One apparent limiting factor is the lack of access to modelling systems that can be used by people other than professional modellers. It can be hypothesised that if relevant actors are invited to validate the databases used and assumptions made during the various steps of the process, the quality, as well as the confidence and trust in the findings will increase, thereby increasing the value of models as decision-support tools at the local level.

This paper assesses the use of catchment models as scenario tools for stakeholder-driven local planning of mitigation and adaptation strategies to address environmental risks. Based on the experiences of two projects, recommendations are made as to how model-assisted participatory processes related to environmental challenges, can be organised. In both projects hydrological models were used as a platform for communication among a number of stakeholder groups and modellers. The model facilitated process, as described in this paper, implies modelling *with* people, in contrast to agent based modelling which is based on modelling *of* people's' behaviour and its consequences (Pahl-Wostl, 2002). Firstly, we address *why* stakeholder groups should be involved in matters of hydrological modelling. Secondly, we use the examples from the two projects to discuss *how* such ambitions can be translated into practice. Finally, we identify some challenges that need to be overcome and suggest recommendations to ease the way forward.

TWO MODEL-ASSISTED PARTICIPATORY PROJECTS

The project “Participatory Catchment Modelling of Nutrient Transport for Sustainable Water Management” (DEMO) was carried out in the Kaggebo Bay area in Sweden from 2005–2007 (Arheimer *et al.*, 2007; Jonsson *et al.*, 2007; Andersson *et al.*, 2008). The model-assisted participatory process was based on a sequence of meetings, where outputs from integrated nutrient transport models at the scale of field, catchment and coastal zone served as a platform for dialogue and co-production of knowledge (Andersson *et al.*, 2008).

The project “Participatory Modelling for Assessment of Climate Change Impacts on Water Resources” (PAMO), was carried out in 2007–2009 in the Thukela River Basin, South Africa. The project aimed to assess and encourage sustainable adaptation strategies based on the stakeholder’s perceptions of climate induced risks to water allocation, farming and the environment. The process was assisted by scenario-modelling, based on a set of climate change scenarios that was linked to a hydrological/agrohydrological model. Additional information about both projects is given in Table 1.

WHY INVOLVE STAKEHOLDERS IN HYDROLOGICAL MODELLING?

While placed in different geographical and social contexts, the DEMO and PAMO projects have been designed to include stakeholder groups in the set-up and/or use of hydrological models. Such “co-production of knowledge” is expected to be beneficial to model development and application (Lemos & Morehouse, 2005). By integrating stakeholders’ perspectives in the modelling process, the projects have sought to enrich the understanding of environmental risks and the range of societal obstacles that challenge the management of such risks. The involvement of affected social groups has aimed at increasing stakeholder confidence and ownership of the results and conclusions from the projects, including the formulation and dissemination of local adaptation and/or mitigation plans.

HOW TO TRANSLATE PARTICIPATORY AMBITIONS INTO PRACTICE?

Participant selection

Depending on the aim and scope of the task, the participants can either be representatives of organised interests (i.e. stakeholders), or experts with academic or non-academic training. The DEMO project came about upon the initiative of local stakeholders within the agricultural sector, more specifically, a local branch of the Federation of Swedish Farmers, LRF, particularly with the help of one local champion. This circumstance facilitated the stakeholder involvement process and allowed the participatory modelling process to gain legitimacy by linking into local networks at an early stage. However, whereas the farmers involved in the process were part of a well-organised national farmers’ network and therefore became a strong stakeholder group, residents were less organized and therefore more efforts were needed to contact, motivate and engage them. In contrast, the PAMO project was initiated by foreign researchers seeking to test a predefined research agenda in a new country context. In a heterogeneous society such as South Africa, there are fundamental differences in how environmental risks and water allocation problems affect people in different socio-economic groups. Although the main opportunity for a better future lies in fruitful dialogue and cooperation between various social groups, the asymmetries in wealth and influence made it difficult for the PAMO project to organize joint meetings for various groups. The research team found and engaged a local champion, who helped overcome the historical mistrust among the involved stakeholders. Working as a well-known and respected agricultural

Table 1 The DEMO and PAMO projects.

	DEMO	PAMO
(a) Background	Initiated by local farmers. Researchers were invited as facilitators.	Initiated by Swedish researchers in co-operation with South African researchers within the IHP-UNESCO programme HELP (Hydrology for Environment, Life and Policy).
(b) Financing aim and rationale (only for initiators of the process)	Farmers: Leader+; to be a step ahead of the authorities in the implementation of the EU WFD and to improve the possibility to have a real impact on the local water management. Researchers: Swedish Research Council Formas; assess how models can be used in stakeholder dialogues, with emphasis on eutrophication.	Modellers: Sida/SAREC. Use of model-facilitated dialogues to assess the severity of stakeholder identified water problems in relation to climate change, and the need for strengthening adaptation strategies and measures to accommodate possible climate change and variability related changes and to reduce vulnerability.
(c) Research partners	Lund University (LUCSUS), Linköping University (CSPR), SMHI.	SMHI, University of KwaZulu-Natal, Umgeni Water.
(d) Stakeholder groups involved	(i) farmers, (ii) residents in the drainage area, including summer cottage owners; (iii) the three municipalities sharing the drainage basin	(i) government authorities; research institutes; and companies; (ii) large-scale commercial farmers; and (iii) small-scale subsistence farmers
(e) Interactions with stakeholders	Around 50 meetings during a period of more than two years, including meetings for separate sectors under (d) as well as a joint meeting with all sectors in the catchment. Stakeholder involvement in compilation of databases and in monitoring, as well as in environmental obstacles for remedial implementation to reach identified goals.	Ten meetings during a period of two years, including a set of three parallel meetings with the three groups under (d), followed by a joint meeting with representatives from the three groups. Stakeholder involvement in identification of prominent climate and water related issues, climate and water related information to be produced, adaptation measures to climate change, including institutional/policy related obstacles that need to be addressed in order to ensure sustainable conditions under a changing climate.
Use of models	Field-scale models for nutrient transport from agricultural fields, linked to a catchment model and a coastal zone model.	Scenario-modelling, using several regionally downscaled climate change scenarios, linked to hydrological/agro-hydrological models.
Dissemination to society	Local remedial plan delivered to the Water Authority of Southern Baltic (2007). A local water council established (2009).	Locally customised impact assessment and recommendations for adaptation strategies to cope with climate change impacts on water resources. Dissemination to participant organisations and relevant governmental organisations, municipalities and schools.

extension officer, this key actor facilitated the participation of small-scale farmers. He also functioned as a bridge between the local farming community, the commercial farmers and the representatives from local authorities. Consequently, both DEMO and PAMO demonstrate the trust and confidence building role that champions, can play in participatory research (Blomqvist, 2004).

Issue framing

The DEMO and PAMO experiences suggest that the framing of the issues at stake is of great importance. When setting up computer-based models of environmental conditions, substantial amounts of information about landscape characteristics, human activities and observed variability of climatological and hydrological/oceanographic variables are needed. Earlier experiences have shown that model applications at the national scale (e.g. for national reporting) can and need to (due to temporal and economic constraints) be based on standardised input data such as soil type, vegetation, topography and climatic regions. When applying models to local conditions (where mitigation/adaptation measures are carried out), the value of model applications for decision-support increases significantly if based on local information (Alkan-Olsson & Berg, 2005; Brandt *et al*., 2007). In DEMO, with its focus on mitigation, the stakeholders are themselves a part of the environmental problem and the solution, so confidence in the local representativity of the model set-up was critical. In PAMO, however, the critical issue was to ensure that the modellers provided information that was relevant to the water and climate related problems identified by the stakeholders. Since PAMO was related to adaptation to natural variability, as well as to global climate change, the stakeholders were, as compared to in the DEMO case, less concerned about the local representativity of the model results. Instead it was the relative *change* of climate-related conditions that was important to the stakeholders.

In the DEMO project, farmers provided data from soil sampling at the farm level and identified "typical management practices" at various types of farms. The stakeholders also participated in the monitoring of water levels and sampling of water for nutrient analyses, verified official databases and contributed with "soft data" (e.g. observations of overland flow or of flow in macropores). Local data including rainfall and temperature data was offered to the PAMO modellers but updated data was not added to the set-up of the hydrological model which already included earlier collected local data. Decisions regarding the degree of participation in certain stages of the modelling process need to be based on a proper balance between conducting a time-efficient process and ensuring that results are representative for local conditions, and trusted by stakeholders.

Participatory exercises during meetings helped the modellers adjust their outputs to meet local requirements. In addition, exercises were included to assess the participants' concerns and visions of the future. Consequently, the framing of the PAMO project over time partly shifted from a strict focus on climate change, to issues related to climate variability which were more relevant to the current reality of the participating stakeholders. A similar change of framing occurred for the DEMO project, where the original focus on the coastal zone was broadened to include lakes in the catchment, in order to increase interest and participation from participants in the upper parts of the catchment.

Project design and implementation

The DEMO and PAMO experiences suggest that practicalities such as the meeting venue, time of the day and year, and provision of refreshments affect the willingness of the targeted stakeholder groups to participate. Organising meetings in locations familiar to the participants is important, not in the least because it gives the modellers and other meeting facilitators the role of guests rather than meeting hosts. This affects the power dynamics of the meetings and facilitates local trust building and ownership of the process. In the DEMO and PAMO cases, the modellers and facilitators initiated the process with lectures outlining the issues.. These lectures ensured that all participants received a shared understanding of the environmental problem in focus. Gradually, however, a shift towards more active participation by the stakeholders took place, including lively discussions and group exercises where several types of knowledge surfaced, which allowed participants to develop "interactional expertise" (Carolan, 2006) that enhanced the co-production of knowledge. Consequently, rather than acting as detached providers of information, the DEMO and the PAMO researchers became active participants in the process of compiling a picture of current environmental conditions and possible scenarios for the future. However, far from all participatory research projects result in this transformation, especially if consisting of single or few meetings or one-way lectures. The DEMO and the PAMO projects suggest that the number of meetings organised and the degree and the atmosphere which encourages all participants to speak and actively participate are pivotal factors in creating trust and confidence building during the process. Successful participatory processes must be grounded in an open and inclusive attitude from modellers and facilitators.

CHALLENGES THAT NEED TO BE OVERCOME AND WAYS FORWARD

Both the DEMO and PAMO were conducted in parallel to local policy making, although the institutional framework for ensuring that the research-driven process could have a real impact on local policy was rather vague. The DEMO project had, compared to the PAMO project, a larger number of meetings, which combined with the fact that it was locally initiated, probably provided a better starting point for a perception of local ownership. In both projects, most stakeholders concluded that it was the process in itself, including dialogues with external experts, people in their own sector, as well as other local groups with other perspectives, that influenced their understandings and possible future action. The inclusion of the results from hydrological models was useful to the extent that they provided content for the constructive dialogues. It remains clear that successful participatory processes require substantial investments in time and trust. The issue at stake must be seen as meaningful by all participants, and a fair balance needs to be found between model-derived information and other inputs to discussions. As noted by Abelson *et al.* (2005), the willingness of non-scientific actors to invest time and resources into participatory exercises often hinges on their ability to make a difference and have real policy impact. While both the DEMO and PAMO projects have tapped into pressing environmental policy issues, the direct influence of the co-production of knowledge over political decision making was limited. We conclude that involved modellers and other scientists have to reflect upon and make their role and their goals and clearly specify where the research process ends and policymaking begins. A balance must be struck between the willingness of various stakeholder groups to engage in the participatory process, and the value such engagement adds to the research process. Since model-assisted participatory processes are challenging tasks that require a great deal of commitment by all involved actors, they can not suit every purpose. Hence, before embarking on time consuming model-assisted participatory exercises, we encourage planners and researchers to take careful note of when and how model-assisted dialogues add value to the process of local participation in environmental policy making.

KEY LESSONS FOR THE HYDROLOGICAL COMMUNITY

There is no “blue-print” of how to design and implement a model-assisted participatory process. Consideration should be given to influential issues to the process such as if the problem in focus is mainly related to mitigation or adaptation, or who has initiated it, when deciding if and how a participatory modelling process should be set up and conducted. If models are used in a way that is well adapted to prevailing circumstances, it can indeed be a platform for dialogues. If not, it might be better to just put a glass of water at the table, since mistrust of what is presented might hamper rather than facilitate the process.

– The usefulness of models in management of “wicked” water problems is not mainly attributed to the possibility to provide “solutions”, but to facilitate dialogues between experts, different stakeholder groups and decision-makers. Modellers need a rethink of their role from “solution providers” to “process facilitators”.
– A model-assisted participatory process is greatly facilitated if based on the involvement of local champions and existing local networks. The time and effort needed to build trust and confidence should not be underestimated.
– Ensure that models are transparent and include stakeholders in all stages of the modelling process in order to improve model outputs and ensure avoidance of disappointment by stakeholders who are the local experts on prevailing environmental conditions and hydrological processes.
– Understand and respect the fact that participants have different and sometimes conflicting interests. Participatory modelling provides information as content to a dialogue where different views can be shared to increase understanding and cooperation

- Be open and clear about what the project has for its focus and goals and how rigid its framework and outputs are to funding agencies and different participants. If possible allow a focus shift within the postulated framework that increases benefits and relevance to all stakeholders.
- Bridge the gap between research and policymaking by being transparent about where one agenda ends and the other begins. Participatory processes should be set up and run according to specific and transparent goals that are clear to all participants.

REFERENCES

Alkan-Olsson, J. & Berg, K. (2005) Local stakeholders' acceptance of model-generated data used as a communication tool in water management – The Rönneå study. *Ambio* **7**, 507–512.

Andersson, L., Alkan Olsson, J., Arheimer, B. & Jonsson, A. (2008) Use of participatory scenario modelling as a platform in stakeholder dialogues. *Water SA* **34**(3), 439–447.

Andersson, L., Wilk, J., Graham, P. & Warburton, M. (2009) Local assessment of vulnerability to climate change impacts on water resources in the Upper Thukela River Basin, South Africa – Recommendations for adaptation. *SMHI Rep. Climatology No 1, September 2009. SMHI, Norrköping, Sweden. ISSN 1654-2258, 47 pp.*

Arheimer, B., Andersson, L., Alkan-Olsson, J. & Jonsson, A. (2007) Using catchment models for establishment of remedy plans according to the WFD. *Water Sci. Technol.* **56(**1), 21–28.

Blomqvist, A. (2004) How can stakeholder participation improve European watershed management? The water framework directive, watercourse groups and Swedish contributions to Baltic sea eutrophication. *Water Policy* **6**, 39–52.

Brandt, M., Arheimer, B. & Andersson, L. (2007) Catchment modeling for quantification of Swedish nutrient transport to the sea and effects of measures. In: *Reducing the Vulnerability of Societies to Water Related Risks at the Basin Scale* (ed. by A. Schumann &M. Pahlow), 84–89. IAHS Publ. 317. IAHS Press, Wallingford, UK.

Carolan, M. S. (2006) Sustainable agriculture, science and the co-production of "expert knowledge": the value of interactional expertise. *Local Environment* **11**, 421–431.

Jonsson, A., Andersson, L., Alkan Olsson, J. & Arheimer, B. (2007) How participatory can participatory modeling be? A discussion of the degree of influence and stakeholder and expert perspectives in six dimensions of participatory modeling. *Water Sci. Technol.* **56**(1), 207–214.

Lemos, M. C. & Morehouse, B. J. (2005) The coproduction of science and policy in integrated assessments. *Global Environmental Change* **15**, 57–68.

Pahl-Wostl, C. (2002) Towards sustainability in the water sector – The importance of human actors and processes of social learning. *Aquatic Sciences* **64**, 394–441.