



Participatory Modelling in Natural Resource Management: A Comparison of Four Case Studies

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ABSTRACT

The need to understand what might constitute best practice in participatory methods for resource management is becoming ever more important as the requirement for a high level of participation becomes prescribed in the environmental directives of the EU and elsewhere. Since there are numerous potential stakeholders who may participate, various different goals of participation and many potential participatory methods designed to achieve them, there is a need for better understanding of how the methods can be practicably applied to particular stakeholders and for what purpose. As input into this process, this paper presents an overview of four natural resource management projects carried out using participatory modelling methods involving stakeholders in the co-design and social learning of management solutions. From these case studies, a description is elicited of the different types of participatory process structures adopted, as well as an analysis of the influences behind the selection of stakeholders and their level of involvement. Six influences in the design of such structures are identified and illustrated with examples: project goals, democratic participatory goals, existing power structures, stakeholder numbers, researchers' normative beliefs and the scale at which decisions need to be supported. These influences place limits on the freedom of practitioners to develop the type of processes they might otherwise intend.

Classification of the process structures according to the level of involvement of stakeholders and their scale of action leads to a discussion about a particular problem of co-design processes: a scale of action mismatch. That is, some process structures, due to the influences mentioned above, end up not involving all the necessary decision makers in the co-design of management solutions. As a result, there has to be additional methods employed to ensure that the results of co-design, i.e. a set of management options, can be passed on to and adopted by excluded decision makers. The paper concludes by briefly looking at examples of possible methods, such as process extensions, e.g., consultation meetings and information campaigns, and the adoption of institutional safeguards.

Keywords: integrated assessment, stakeholder, co-design, decision makers, participation.

1. INTRODUCTION

1.1. Problems in Applying Participatory Methods

Participatory methods have been defined as “methods to structure group processes in which [stakeholders] play a central role and articulate their knowledge, values and preferences for different goals” [1]. The use of participatory methods, i.e., participation, in management processes has been a goal of integrated assessment and management for some time [2]. In Europe, such goals have been institutionalised in the form of the European Water Framework Directive of the EU (Article 14, Directive 2000/60/EG no. L327/1) which states that future river basin management in the member states of the EU must be undertaken with relevant stakeholders participating in the setting up, appraisal and implementation of plans. This recognition of

participation as having a role in natural resource management is also prevalent outside Europe. For example, in Thailand, the role of public participation in public policy and decision making is acknowledged in the Constitution [3]. In China, it is recognised in the current five and ten year environmental plans.

The problem is that there is little indication in such institutions of the type of participatory process that ought to be set up. That is, there is little indication of what is considered to be best practice. Von Keitz and Schmalholz [4], for example, point out that the Water Framework Directive is unclear about who should be included as a stakeholder. They go on to mention that the wording of the directive covers a large range of possible participatory methods, from simple information provision to participatory planning. No real direction is given on which approaches

should be used. In response to this problem, the EU is investing money in European-wide research projects (e.g., HarmoniCOP – www.harmonicop.info) in order to improve scientists', policy makers' and practitioners' knowledge about techniques and methods for successful participation in environmental management. The ultimate aim is to be able to confidently link particular methods to particular constellations of stakeholders, roles and goals. Even in Australia, where participatory management methods have been used for many years in the form of agricultural LandCare schemes, this problem is echoed in the realisation that “one set of tasks is sorting what we want from participation and the many ways in which people can participate, and then matching them together” [5], p. 96.

In summary, it is unclear what the selection criteria for stakeholders are, what methods ought to be used to ensure suitable participation by them, or even what the role of the stakeholders should be. The main problem is one of ubiquity: of stakeholders, of methods, of participatory roles and of goals.

1.2. The Ubiquity of Stakeholders, Methods, Roles and Goals

With regards to the numerousness of stakeholders, the problem stems from the all-encompassing definitions used to define who a stakeholder may be. For example, a “well received... field tested” definition provided by Engi and Glicken is that a stakeholder is “an individual or group influenced by – and with an ability to significantly impact (either directly or indirectly) – the topical areas of interest” [6]. Such inclusive definitions mean that the source of possible stakeholders is very large indeed. In contrast, the amount of resources needed to practicably organise so many types of stakeholder means that choices have to be made about excluding certain groups and restricting the level of involvement of others.

Whilst excluding stakeholders goes against certain goals of participation, such as increasing democratic input into management processes (see below), this can sometimes be advantageous for other reasons. For example, the demarcation of levels of involvement between stakeholders naturally makes explicit those who are deemed to be competent to carry out the work [7]. This then also implies that those who are not competent have been excluded. Citing Jasenoff, [7] notes that, at the interface between science and policy, making clear demarcations, i.e., doing *boundary work*, can be “crucial” to building up the “political acceptability” of advice provided by experts.

As a result, there exist many different roles that participating stakeholders may be allowed to take. Accordingly, many classificatory typologies of these roles have been developed (e.g., [8], see also [3]). For example, six categories of roles have been identified by Mostert [9], which will be used in this paper. They specify varying *levels*

of participation, ranging (in increasing order of intensity of involvement) from:

- simply receiving information (the Information level);
- providing information (Consultation);
- two way interactive discussions with government (Discussion);
- active involvement in analysis of problem and design of potential policy (Co-designing);
- joint decision-making with government policy (Co-decision-making); and
- independent decision making (Decision-making).

With the identification of different levels of participation, comes the need for methods to facilitate participation at these levels. There are, once again, many methods from which to choose. Van Asselt et al. [1] in their overview of participation in Integrated Assessment, identify seven types of participatory method involving stakeholders in different ways to generate a variety of different outputs:

- *focus groups* for the facilitated identification of diverse public opinions;
- *scenario testing and envisioning workshops* to generate and discuss future possible trends;
- *citizen juries and consensus conferences* to support an informed debate about policy by a limited sample of stakeholders on presented scientific evidence;
- *participatory planning* for improving stakeholder empowerment and generating stakeholder-supported management plans;
- *participatory modelling* for the involvement of stakeholders in the development and use of system models which will lead them to a better understanding of the system and its management c.f. group model building: [10, 11].

Complicating the matter further is that there exists a wide range of possible, sometimes contradictory, goals that participation is meant to achieve, each of which may require the use of different methods. Participatory goals [1, 6–9, 12] include:

- to empower stakeholders and to improve democracy in decision making;
- to increase the legitimacy of management decisions;
- to increase project effectiveness;
- to improve management in response to high uncertainty and risk;
- to include local knowledge in decision making;
- to manipulate public opinion; and
- to encourage social learning (the group learning by stakeholders of the complexity of the system as well as the sharing of management perspectives [13]).

The difficulty in this case, for example, is that focus groups can be used to include a wide spectrum of local knowledge and opinion into a process, but they are not ideal tools

for social learning, which are more readily supported by intensive interactive group work such as group model building. Also, the elicitation and use of local knowledge may not necessarily lead to an increase in project effectiveness (see [14]).

1.3. The Scope of This Paper

This paper seeks to provide a further input into the search for best practices in participatory methods for natural resource management. It does this by moving from descriptions of case studies to looking at the participatory process structures behind them and thence to a better understanding of what factors influence the choice of participatory structure. The term “participatory structure” refers to the manner in which different stakeholders, operating at different scales of action,¹ are used in different participatory roles. Understanding the factors influencing structure will lead to better understanding of how to apply particular participatory methods within a participatory process, given different stakeholder groups, management problems and process goals. At a later date these may help form the basis of guidelines for best practice.

2. THE FOUR PARTICIPATORY PROCESSES – AN OVERVIEW

2.1. The Choice of Case Studies

This document takes four case studies from around the world and compares their process structures positively, rather than normatively, in terms of process goals and their problem and stakeholder characteristics. The choice of case studies was made in order to explore the influence of certain factors in participatory design whilst at the same time keeping constant other factors. In particular, the choice allows the paper to focus on the application of one type of participatory method. Along these lines, the case studies all have the following in common:

- they involve participatory modelling;
- their process goals include social learning (see Box 1);
- all have co-design as the highest level of stakeholder involvement.

They were also selected for their variety. They represent not only work carried out on three continents – Africa, Europe and South East Asia – but also represent the work of researchers from different participatory research cultures – Australian, African, Asian and European. They also represent problem domains at different scales – from regional scale projects to those at village scale – and ranging from urban and rural water management to land use management (see Table 1).

¹By “scale of action” we mean the largest spatial scale level across which a stakeholder’s decisions can have an effect.

Box 1: Social Learning – an overview.

The term social learning may be traced back to a psychological theory of behaviour, or more accurately, of behavioural modification, developed by Bandura [15], called social learning theory. Since then it has become a very important concept in participatory methods research [16]. Social learning, according to Bandura, has two central tenets concerning the manner in which humans modify and learn new behaviours. Behavioural modification is essentially a “vicarious” process of social imitation rather than one of personal trial and error. Bandura calls this a process of “learning by modeling,” with the model in this case referring to a social, role model. The second tenet is that the relationship between behaviour and the environment is not unidirectional (behaviour is not simply determined by the environment, neither is the environment simply determined by a person’s behaviour), but rather reciprocal. According to reciprocal determinism, behaviour and environment are in a constant feedback loop, affecting each other.

These ideas are important for participatory methods since they provide theoretical justification for the bringing together of stakeholders into groups in order to learn about management systems and to develop new ideas. The theory suggests that each member of the group represents an environment role model for the other and that in such group situations, a positive feedback loop of mutual learning can occur. Put simply: when you bring people together, they will learn far better than when they are in isolation, learning things by rote or by trial and error. Such assumptions are prevalent in modern definitions of the term in participatory practice (see definition in Section 1.1 above) and in concepts such as *participatory learning* [8] or *mutual learning* in integrated assessment [1].

An important warning to add to this overview is that Bandura wrote that social learning processes could instigate both positive and negative feedback loops. The outcome of participatory methods encouraging social learning may not always be positive, as suggested by the well documented problems of groupthink and research into the problems of participatory environmental processes in developing countries [14].

On a more pragmatic note, the case studies were also selected due to familiarity (Zürich & Mae Chaem) and the ability to communicate with the responsible researchers (Ngnith & Mahuwe). The choice of case studies does not reflect normative evaluations and the cases are therefore neither representative of the best nor the worst of participatory processes, but we believe their value lies in them being representative of what is currently happening in the field of applied participatory modelling.

Table 1. Categorisation of the case studies with respect to problem and stakeholders.

| Study site | Country | Management domain | Key problem area | Project goal | Potential number of stakeholders | Highest/lowest scale of action of potential stakeholders | Local political structure | Nationality of principal researchers |
|-------------|-------------|----------------------------------|--|--|----------------------------------|--|---|--------------------------------------|
| Zürich city | Switzerland | Urban water resources management | Inefficient water supply | Identification of possible management solution | 100,000s | National/household | Direct democracy | German, Swiss & British |
| Mahuwe | Zimbabwe | Vegetation resource management | Pressurised, limited grazing areas and unclear grazing rights | Identification of possible management solution | 1000s | Regional/household | Inherited rule – tribal but quasi-consent based | Zimbabwean, N. American |
| Ngnith | Senegal | Rural water resources management | Conflicts between herders and farmers for water use | Negotiation of possible management solution | 100s | Regional/household | Representative | French |
| Mae Chaem | Thailand | Rural water resources management | Conflicts between up and down river inhabitants for water irrigation | Decision support system for management, research extension | 1000s | National/household | Inherited rule – monarchical | Australian, Thai |

2.2. Zürich, Switzerland, Central Europe [17, 18]

This case study in the Swiss city of Zürich was set up to investigate the use of participatory modelling in urban water resources management. Historically the water utility has relied on a risk averse, supply-side approach to water management, in which the capacity of the water supply was successively increased in response to peak demand. However, changes in water consumption patterns, leading to a general decrease in water consumption, have left the city with an expensively maintained, arguably inefficient, over-capacity in drinking water. The groups making up the stakeholders of this problem are diverse, representing scales of action from the national level right down to the household. These include not only the water utility, but also the households who consume the water and may vote on the utility's financing plans,² the waste water utility who has to treat the used product, manufacturers who produce and advertise water saving products, politicians who must oversee utility spending and professional bodies which set water industry standards. It is the complexity of the interdependencies between these different stakeholders and the lack of existing formal communication structures between them that encouraged the setting up of a participatory process to identify new insights into management solutions.

2.3. Mahuwe, Zimbabwe, Africa [19]

This case study was set up after the realisation that previous projects aimed at getting community support for vegetation management schemes had failed to work in this Zimbabwean ward. Researchers thus opted to use a participatory approach which shelved original assumptions about the needs and objectives of the community. In order to develop improved strategies for vegetation resource management, they instead tried to identify, by bringing the stakeholders together, what the stakeholders thought were the problems and system dynamics at work. By doing so, they wished to improve the level of villager input into the otherwise more autocratic leader-based management system, whilst at the same time maximising the chance that the leaders would take the agreed action. Of particular concern to the villagers was the immigration of new farmers into the district who added new pressures to the scarce grazing resources, a problem about which they had limited decision-making responsibilities but bore the effects of such activities.

2.4. Ngnith, Senegal, Africa [19]

The researchers wanted to develop a simulation tool to help the stakeholders, the rural council (elected members of villages responsible for management decisions) and villagers

to better negotiate herder/farmer agreements. To this end, the researchers went to local villages to help construct a model of each village's management problem. Using the model, the process at the village and inter-village levels was aimed at generating a common understanding of management problems and options between the villagers and the rural council. This paper focuses on the participatory process carried out in one of these villages, Ngnith. Here, the management problem was one of negotiating an equitable management solution to the conflicting water requirements of village herders and farmers. Farmer activity around surface water resources had started to push the herders towards the intensive use of groundwater wells with corresponding damage to groundwater levels and local vegetation. Organising a participatory workshop for model building meant bringing together stakeholders from the rural council and villages, from the regional level to the household. These workshops would focus on political decisions and their implications, rather than purely on technical options.

2.5. Mae Chaem River Catchment, Northern Thailand, Asia [20, 21]

The project focused on the Mae Chaem catchment in northern Thailand where there are conflicts of interest between upriver and downriver communities in the management of the river catchment. The main goal of the project was the development a decision support system (DSS). The DSS was to aid government agency staff in understanding the behaviour and consequences of household decisions in response to policy changes and other climatic, economic and social shocks (e.g., price changes, increased migration into the catchment). It was hoped that they could investigate, on a scientific basis, the impact of different land users' responses to changes in management options and resource availability. This improved understanding would then be able to be fed into agency level decision making relating to natural resource management. The researchers also wanted to provide training and extension of appropriate research tools and methods to staff in local universities and government agencies. Stakeholders representing national, regional and household levels were incorporated in different ways into the participatory modelling process.

3. OVERVIEWS OF THE PROCESS STRUCTURE USED IN EACH CASE STUDY

Table 2, illustrates a categorisation of the case studies according to the participatory process.

3.1. Zürich

The goal of employing a participatory process was to increase communication and the generation of new strategies

²Switzerland operates a direct democracy. One effect of this is that the public may vote upon the activities of public services.

Table 2. A categorisation of the four case studies with respect to participatory concepts.

| Study site | Participatory goal (in addition to social learning) | Levels of participation | No. of stakeholders involved in co-design group | Participatory method (principal) | Models to be developed | Process direction ^a |
|-------------|--|---|---|--|----------------------------------|-----------------------------------|
| Zürich city | Improve communication | Co-design, consultation (information) | 6–8 | Participatory modelling | Simulation, role playing game | Top-down |
| Mahuwe | Increase effectiveness of problem identification & improve democracy | Co-design, consultation (appraisal) | 20–25 | Participatory modelling | Spidergrams | Bottom-up |
| Ngnith | Increase chances of success of negotiation | Co-design | 25–30 | Participatory modelling | Simulation, role playing game | Bottom-up |
| Mae Chaem | Increase effectiveness of model built | Co-design, consultation (information) | 10s | Participatory modelling | Simulation | Top-down |

Note. ^aHere, the process direction refers to whether the process structure encourages a bottom-up or top-down influence on management process. Bottom-up is where stakeholders at the lower levels of action are involved in *co-designing* or *co-deciding*. Top-down is where those stakeholders at the higher levels of action are involved. These two categories are similar, respectively, to *popular* participation and *stakeholder* participation, the World Bank's favoured form of participation, as described by [3]. The difference here is that unlike stakeholder participation, a top-down process predominantly involves the highest level of stakeholder.

amongst stakeholders. This was to be achieved by generating a group environment conducive to social learning which would focus on understanding the complexities of the system. Individual representatives of the main stakeholders, apart from the householders, were brought together for regular meetings in a co-design group consisting of upwards of 8 people (excluding the research team). The householders were represented in this group by consumer associations and by housing associations. During these sessions the co-design group took part in data elicitation exercises, problem identification, model building (developing a simulation model as well as a role playing game) and scenario testing exercises, all aimed at generating common representations of the system and sharing conflicting perspectives. Householders were only used at the level of consultation. Information and ideas from the householders were elicited through focus groups to provide contextual information to the co-design group in order to focus discussions. The process direction was therefore top-down. However, householders influence the consumption of water and thus there is partial mismatch between the levels at which the co-design process operates and the scale at which important consumption decisions are made.

3.2. Mahuwe

The goal of employing a participatory process was to increase the effectiveness of management by employing social learning between the villagers and leaders that would lead to better identification of problems and solutions. A coordinating committee involved in co-design was set up into which local leaders were co-opted. The committee was then joined by normal villagers elected as representatives of the villagers and female representatives. Together with a communications team and the project team this amounted to about 20–25

people.³ During sessions, the co-designing group of stakeholders took part in data elicitation and model building exercises aimed at developing paper-based spidergram models, a type of directed graph. Naturally, the problem for the researchers was to then get feedback and support from the villagers as a whole about the concerns identified in the co-design group. The solution was to feed back the findings to all the villagers for popular appraisal through a consultation process. With their agreement, the problems were formally represented back to the village leaders. The leaders were requested to act on solving these problems. The process was bottom-up, but with those responsible for making policy decisions also included in the co-design process.

3.3. Ngnith

The goal of employing a participatory process was to increase the effectiveness of regional and household decision making by employing social learning between the villagers and leaders that would lead to better negotiation of water resource usage between the herders and the farmers. Stakeholders involved in co-designing in Ngnith consisted of about 25 herders and farmer households from the village and 2 to 4 local representatives of the rural council. Over three days, problems were identified, a model built by the participants and management options generated and tested using both role playing and computer simulation versions of the model. The inclusion of the villagers as co-designers made the process bottom-up. Since the problems had to be solved at a regional scale, an additional problem was to integrate the desires of each village and to make sure that the rural council in its entirety acted on these views.

³Personal communication – Tim Lynam, 26 March 2002.

3.4. Mae Chaem

The main aim of this project was to design a DSS for enabling better decision making at the policy or government agency level. Thus the membership of the co-designing group was targeted at the sponsoring government agencies and partner research universities. This group worked with the researchers to develop and use the simulation model at the core of the intended decision support system. The role of the householders was limited to information provision through a process of consultation. Household level decision making was represented using simulation models derived from this information. This information was used to give the decision makers in the co-design group a better idea about the influence their decisions might have on the householders and the way in which householders would respond to external influences such as climate and policy. This formed the basis of a sort of social learning environment for the policy makers, albeit one in which the two groups (policy makers and householders) seldom met. Given the importance of householders' decision making on management in this region [21], there is a potential scale of action mismatch between those involved in co-designing and the scales at which household decision-making occurs. However given that the aim of the project was to understand, rather than to influence household decisions, in order to support agency level decisions, this potential scale of action mismatch has arguably not been realised in the project.

The process structure and the level of participation of each stakeholder in each case study is summarised in Figure 1.

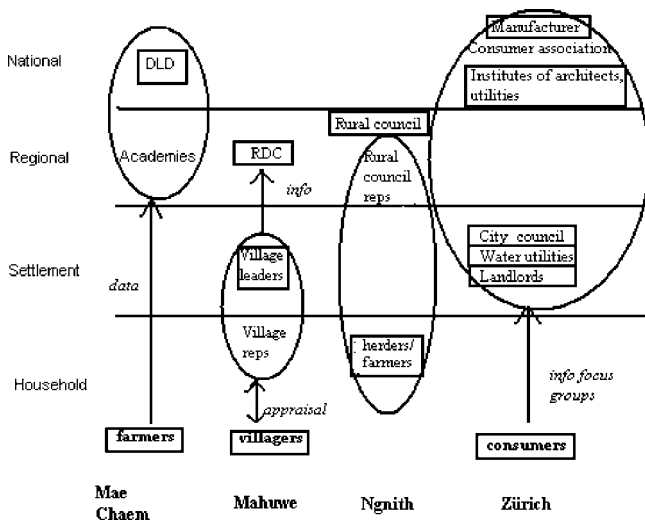


Fig. 1. A comparison of the scales of action of stakeholders in the 4 case studies and their presence in or out of the co-design group. Boxed names represent decision makers. Circles encompass the members of the co-design group. **Bold** indicates stakeholders participating in consultation only (Note: DLD is Department of Land Development; RDC is Regional District Council).

4. WHAT INFLUENCES PROCESS STRUCTURE?

The process structure of these case studies depends on decisions made as to which stakeholders should be represented in the co-design group and which stakeholders must have lesser levels of involvement. The outcome of these decisions determines whether or not the process may be described as top-down or bottom-up (the process direction). Six influencing factors were identified for these case studies.

4.1. Project Goal

When the production of a DSS is a primary project goal, the intended scale at which decision making is being supported by the tool and the technical capability of various stakeholders will influence the way in which different groups of stakeholders participate in the DSS development. In the case of Mae Chaem, this helped to generate a more top-down participatory process, since higher level organisations (such as government bodies) were the decision makers to be aided by the DSS. Since the focus of the DSS, in the study, was to aid government level decision-making (by providing insights into the perspectives and possible responses of householders), householders themselves were only utilised in a consultative manner. As such, this study is an interesting case of social learning in which the behaviour of one group of stakeholders (householders) is represented in a computer model, rather than as "role models" in the co-designing participatory group.

In projects seeking primarily to aid the identification or negotiation of management solutions, the use of models can be subsumed within the process. Indeed, computational models need not play a major role at all. In Zürich and Ngnith, conceptual models are first adapted into board-based role-playing games that require no computer use or literacy from the stakeholders. Only after acclimatization is a computational model used by the stakeholders. In Mahuwe, initial models (spidergrams) were paper-based, thus overcoming concerns about computer literacy. The range of potential stakeholders that can be permitted to join the co-design group can be increased.

4.2. Potential Stakeholder Numbers

The size of the potential stakeholder community affects how many ultimately appear in the co-design group. Working with a single village (Ngnith) the researchers can incorporate a wide selection of the villagers (upwards of 25) as co-designers. As a result, householders are highly represented as a direct part of the negotiation process. In the city of Zürich, where up to 150,000 households are potential stakeholders, inclusion of householders as co-designers is not feasible. In this case, the householders take on the role of consultants to be occasionally asked their opinions during

focus group sessions, and the co-design process focuses more on higher level stakeholders who are smaller in number.

4.3. Democratic Participatory Goals

Desiring to empower a wider range of stakeholders within the decision-making process and therefore make it more democratic will tend to make the process more bottom-up since lower level stakeholders tend to be the more numerous. In Mahuwe, a bottom-up process was developed as a consequence of realising that the existing management system was not working and that decision processes needed to be democratised in terms of including more householders.

4.4. Normative Beliefs of the Researchers

In Ngnith, the researchers had the normative belief that a bottom-up, self-organising, learning-by-doing approach was the best manner in which to carry out participatory modelling and management.⁴ Hence the process focused on household inclusion in the co-design group.

4.5. Existing Political Structures

The existing political structures in the management area can also have a large influence on the level of stakeholder involvement. It has already been mentioned how, in Mahuwe, the failure of the existing management and power structures encouraged the researchers to look for new methods of identifying problems, and thus they involved more groups of stakeholders from the village community. However, the realities of the political situation required the co-option of local leaders into the process to enhance the probability of success.

On the other hand, in Zürich, the practice of direct democracy, in which the public get the opportunity to vote for or against water utility management plans, should have meant that as many public stakeholders as possible be involved at a high level of participation. Whilst representation of the high level stakeholders was reasonably exhaustive, the sheer number of householders made full householder participation infeasible. Naturally, one influencing factor can negate another factor's effect.

4.6. The Scale at Which Decisions are Supported

In Ngnith, despite the intention that the processes be bottom-up, the fact that the process would eventually have to support decisions made at the regional scale meant that the rural council had to be involved. Similarly in processes where a DSS, rather than the process itself supports decision-making, the level at which decisions are being supported by a DSS,

i.e. from the bottom-up or the top-down, will also affect the types of participation seen and the technology used. For example, a DSS created to support, from the bottom-up, farmers' crop planting decisions will necessarily include different stakeholders in co-design and utilise different technologies than one created, as in Mae Chaem, to illustrate the magnitude of trade-offs as a consequence of national or regional scale policy decisions to aid agency level decisions.

5. SCALE OF ACTION MISMATCH

What becomes apparent from classifying the case studies according to scale of action and level of involvement of stakeholders (Fig. 1) is that not all decision makers are included in the co-design group within these case studies. This we refer to as a *scale of action mismatch*. That is, not all relevant decision makers are involved at high levels of participation in what should, in principle, be inclusive exercises in the improvement of management through social learning. Since co-design does not itself involve decision-making and instead only policy option generation, such exclusion could prove to be problematic if the results of the participatory process are meant to be taken up by the absent or poorly represented decision makers. In a top-down process, the problem is that neglecting to include lower scale decision makers in the co-design group can lead to poor acceptance or dissemination of policies, leading to policy failure. In a bottom-up process, when higher scale decision-makers are missing, the problem may occur that policies designed at the bottom-scale are not considered or permitted by those higher scale decision makers.

The quality of representation of stakeholder groups in the co-design group is another important factor that needs to be considered. In bottom-up processes such as in Ngnith, where representatives of the rural council are used in co-design groups as opposed to the complete council, a mismatch would have still occurred had the selected representatives had little or no decision-making power or influence within the council they represent. Such a problem may of course also affect the representatives of the city water utilities used in the top-down process described in the Zürich case study, or the village representatives used in the Mahuwe case study.

As this paper suggests, there may be several reasons for mismatches, all linked to the influences on process structure already identified in Section 4. Ultimately however, there has to be a method of passing the newly co-designed management options onwards to the decision makers, with an expectation that they be accepted as legitimate input into decisions.

5.1. Improving the Uptake of Co-designs: Extending Processes

All the case studies show examples of how stakeholders not included in the co-design group have been subsequently

⁴P. d'Aquino, personal communication.

linked into the larger process structure through some sort of process extension. In Mahuwe, for example, extensive public consultation meetings and information campaigns aimed at excluded householders have followed up the co-design process so that plans and ideas may be appraised by them before they are finally returned for consideration by village leaders. Similar information provision was aimed upwards towards the regional district council, aided by the presence of a Councillor from Mahuwe on the Regional District Council. In Zürich, process extension was carried out through the use of focus groups but it did not entirely overcome the mismatch. It is therefore hoped that a public information campaign aimed at the excluded householders can be used to promote the findings of the co-design group. In the Ngnith case study, the situation was complicated by the fact that, although each co-design process was carried out at the scale of individual villages, the final decision had to be made at a regional level affecting all villages, so the mismatch here was that each village in the region did not take part in the co-designs of other villages. The mismatch was overcome by the rural council organising its own follow-up workshops which brought together the rural council and the regions' villagers (about 100 people in all) to decide on which management options generated by the co-design group should be adopted.

In Mae Chaem the potential scale of action mismatch may be addressed by follow-up work which extends the findings of the DSS to excluded stakeholders through active discussion of the differences between the stakeholders' expectations of impacts and the output of the DSS. Currently, the project has been extended to include a broader range of agencies. The preliminary DSS was used to excite interest in the potential of the project among a broader range of policy makers and other stakeholders. In particular many of the models are being simplified to allow extension officers to use the DSS to illustrate potential outcomes of changed land practices to household groups. Additionally, new survey work is being undertaken to identify stakeholder preferences and decision responses to various situations.

5.2. Improving the Uptake of Co-designs: The Institutional Approach

Recent examples of the use of public participation in natural resource management highlight difficulties in achieving goals such as local capacity building and conflict resolution. For example, Slee [22] states that while these were the goals of the Regional Forest Agreement (RFA) process in Australia, the reality was that "RFAs have in some cases polarised and exacerbated conflicts." He adds that "the implied equality of stakeholders' views neglects the reality of how policy is made... the enhanced access of certain actors and groups to key policy-forming bodies means that not all views will be treated equally." To avoid these types of situation, some form of institutional arrangement may be

necessary that strengthens the likelihood that decisions in the co-design group can be passed to and acknowledged by excluded decision-makers. One aim might be to foster a sense of "procedural justice" (a term used by Joss and Brownlea, as cited by [12]) i.e., stakeholders will trust that the outputs of such institutionally strengthened processes will have been derived through fair practices and are therefore worthy of equal consideration.

Lack of institutions supporting participation has been cited as a basic weakness of current participatory practice by Dovers [23]. He suggests that participation needs to be institutionalised in Australia so as to make "community participation as mainstream to the way we manage landscapes, not marginal" [5]. In this manner, one can imagine such institutionalisation of participation into the mainstream leading to the natural acceptance by decision makers of community co-designs as legitimate support tools for decision making. However, whether this should be informally or formally institutionalised is left unsaid.

An option for formal institutionalisation could be borrowed from the German federal legislation for environmental assessment practices⁵ [24]. In such cases, decision makers' use of the findings from participatory processes is required in law to be explicitly audited. This means that they must note down which information has or has not been used and the reasons why. This practice at least ensures that the results of participation are formally and transparently incorporated into decision making processes. Whether or not it would transfer to other cultural settings is worth consideration.

6. RELATED WORK ON PARTICIPATORY PRACTICE

There have been a number of recent reviews looking at good participatory practices. Included in these is Glicken [6] who counsels practitioners on the need for clear statements of purpose, proper stakeholder analysis and process documentation. Van Asselt et al. [1] also provide a checklist for considering issues such as stakeholder selection and sampling, the assignment of stakeholder roles (expert, leader, moderator etc.) and data collection. Pretty [8], investigating participation in agricultural extension, proposes a form of participatory learning combined with strict "trustworthiness criteria" to ensure a participatory success.

Attempts at matching participatory goals to methods are also represented in the literature. Van Asselt et al. [1] have categorised participatory methods along two dimensions of goals: whether the process is seeking consensus information or diverse information; and whether the process is aimed at increasing democracy or using stakeholders in an advisory way (termed *advising*). In such a categorisation all methods

⁵§ 12 Umweltverträglichkeitsprüfung.

except for participatory planning fall into the category of advising, whilst the largest sub-grouping of these is seeking diversity of opinions. The problem with this categorisation schema is twofold. First the authors commit a category error by mixing, into the “goals” criterion, both goals (e.g., democratisation) and levels of participation (i.e., advising). Seeking advice itself is not a goal of participation, but a level of participation which can be used to achieve a goal such as democratisation.

The second problem is that for purposes of practical application, this schema lacks the most important requirement of any classification: to be able to distinguish between methods. Out of the four possible groupings (processes seeking diversity & advising; consensus & advising; consensus & democracy and diversity & democracy), the first grouping gathers together four out of seven methods, the second groups two, the third only one and the last none at all. Using the “dimension” of *democracy to advising* to categorise methods appears to have had little impact on distinguishing these methods from one another, since all but one appears on the “advising” side (which itself is not a participatory goal).

As in this paper, van der Sluijs and Kloprogge [7] analyse four participatory case studies, but this time in the field of climate change. They found four basic criteria for categorising them: the methods used; whether they were top-down or bottom-up; whether stakeholders were generally passive or active in their involvement; and which phase of the process was open or closed to stakeholder (non-scientific) involvement. Whilst the focus of this paper was on a single method, participatory modelling, van der Sluijs and Kloprogge looked at case studies which employed a variety of methods (e.g., focus groups, dialogue workshops⁶). They focussed less on the level of participation, preferring instead to assess whether participation occurred at all in particular process phases, i.e., problem identification, risk assessment and options assessment. “Options assessment” is the closest to the concept of co-design and two of the four case studies exhibited open active involvement in this phase. Once categorisation was completed, however, the work did not take the next step, as this paper does, to look at the factors behind why stakeholders were used in particular ways. An insight into the reasons for particular designs (for which the results of this paper provide some additional support) are instead provided by Mostert [9] who views the power structure of the society, culture and stakeholder education as influencing process structure.

7. CONCLUSIONS

The work described in this paper complements previous reviews of participatory practice by providing an analysis about how participatory modelling has been implemented in

four recent case studies, in order to provide insights into the design of future processes. Each case study represents an alternative way of carrying out a participatory modelling exercise involving stakeholders in co-design and social learning. Four different process structures (two bottom-up and two top-down) used to achieve two basic project goals (management solution generation and DSS design) have been described along with six influences on process structure: project goals; democratic participatory goals; researchers’ normative beliefs; existing management power structures; stakeholder numbers and the scale at which final decisions need to be supported. While these categories of influence will not surprise practitioners, the case studies provide their own unique illustrations of how the influences can manifest themselves.

This knowledge certainly shows how the normative beliefs and goals of the researchers can mould structure. It may also be used to increase awareness of the limits of intentional process structure design. Put simply, a particular design may be desired but there are many ways in which a slightly different design may arise as a result of cultural or domain specific aspects of the problem beyond the control of the research team.

Whatever the reason, the eventual structure that evolves will in turn have an influence on the success and ease with which participation is carried out. One of the benefits of classification is that inconsistencies in what is being classified can be more easily seen. Often the result is an awareness of something one might refer to as obvious, but is nevertheless salutary. The classification of process structures, according to stakeholder scale of action and the level of involvement, highlights the problem of so-called scale of action mismatches. That is, some process structures, due to certain factors, end up not representing all the necessary decision makers in the co-design group. This is important with respect to co-design processes. Since *co-designers do not themselves make the decisions*, there has to be some conduit between the co-designers and decision makers along which the results of co-design, i.e., a set of management options, can pass and be taken up by the decision makers. There is a risk that, without such conduits, excluded household or regional decision-makers will not accept the results of the co-design process.

The case studies show different examples of how processes may be extended to bring the results of the co-design group to excluded stakeholders. Mahuwe held village-wide consultation and appraisal meetings to allow all villagers to assess the results of the co-design group. The regional district council was also kept informed. In Senegal, the rural council organised its own post-process region-wide villager meetings with the complete council (not just representatives) to assess village-scale solutions in terms of a single regional-scale strategy. In Zürich, information campaigns have been suggested to inform important, yet excluded, consumers.

⁶These appear to be a form of scenario analysis workshops.

As discussed, guidance documents on best practice may have to be accompanied by institutional support to bolster or create these uptake conduits. This could involve the general introduction of the concept of participation into management institutions as illustrated by the EU Water Framework Directive or by Dover's call for the "mainstreaming" of participation into management practices in Australia. Alternatively, the use by decision makers of the results of participatory processes could be regulated within law, as in the case of German federal environmental assessment laws. Whether to create general or more rigid institutional supports will be bound to be a lively debate amongst practitioners. Since all of the case studies mentioned in this paper are ongoing in some form, it will be interesting to have a future look at how successfully results from the processes were eventually transmitted to and used by decision-makers.

ACKNOWLEDGEMENTS

This paper is an extended and revised version of a paper appearing in the International Environmental Modelling and Software Society's (iEMSs 2002) Biennial Conference in Lugano, Switzerland. Thanks go to Tim Lynam and Patrick d'Aquino for answering questions about their studies. Any possible remaining errors in interpretation of their studies remain the authors' responsibility.

Matt Hare would like to thank members of the FIRMA research consortium for fruitful discussions about the issues of participation, as well as Claudia Pahl-Wostl and her research group at the University of Osnabrück. His work is funded under the Fifth Framework EU Project *FIRMA* (Freshwater Integrated Resource Management with Agents – contract EVK1-CT1999-00016) by the Bundesamt für Bildung und Wissenschaft (BBW), Switzerland.

Thanks should also be extended to ACIAR for funding the case study in the Mae Chaem catchment in northern Thailand. The Royal Project Foundation is also acknowledged for its support.

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