

# **Participatory Planning for Climate Change Adaptation in the Brahmatwinn Project**

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**Abstract:** The NetSyMoD methodological framework has been designed through a series of research projects and applications over the last decade. The aim of the approach is facilitating the integration of multiple actors' interests and preferences in decision or policy making processes in the field of natural resources management. The methodology is organised in six main phases, which can be recursively applied in an adaptive management context. Apart from the last phase, focusing on putting in place the selected Actions and Monitoring of their effects, a comprehensive application of the approach was carried out during the Brahmatwinn EU Project, for the development of climate change adaptation strategies to cope with flood risks in the Upper Brahmaputra and Upper Danube River Basins. The paper reports on the experience of implementing the five phases of Actors' Analysis, Problem Analysis, Creative System Modelling, DSS Design and Analysis of Options, in parallel in the two case studies. Strengths and weaknesses of the approach adopted are presented in light of its further development and application in other case studies in the near future. Insights into the roles of the researchers and the involved local actors and their interactions are derived from a series of participatory workshops over a three years time span.

**Keywords:** knowledge integration; planning process; participatory modelling; climate change adaptation.

## **1. INTRODUCTION**

Agenda 21, the action plan which was the result of the UNCED held in 1992, identified "information", "integration" and "participation" as key factors for helping countries to achieve sustainable development. Potential benefits are many and varied, but also challenges are numerous. In order to exploit the potential benefits and to limit pitfalls and shortcomings, robust methods are needed for the management of planning processes with the participation of stakeholders, i.e. people bearing interests, information and various forms of knowledge.

The BRAHMATWINN<sup>1</sup> project (2006-09) recognised the importance of involving local actors (LA) – experts and stakeholders – in analysing climate change adaptation strategies in two river basins in Europe (Danube) and Asia (Brahmaputra). The main objective was the enhancement of the capacity to carry out an adaptive and harmonised integrated water resources management (IWRM) approach in river basins with headwater catchments in glaciated alpine mountain massifs, as addressed by the European Water Initiative (EUWI). The NetSyMoD<sup>2</sup> methodological framework was thus adopted, with the purpose of ensuring that the scientific knowledge generated by the research consortium could be effectively integrated with the perceptions, views and preferences of LAs who would ultimately be the end-users of the project's outcomes in the two areas.

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<sup>1</sup> "Twinning European and South Asian River Basins to enhance capacity and implement adaptive management approaches" (<http://www.brahmatwinn.uni-jena.de>).

<sup>2</sup> "Network Analysis - Creative System Modelling – Decision Support". See Giupponi et al. [2008] for details.

This paper reports on the participatory process organised in parallel in the Upper Brahmaputra (UBRB) and Upper Danube River Basin (UDRB), with the aim of analysing strengths and weaknesses of the approach adopted, with specific reference to the Assam case study in India, in light of further developments and applications in other case studies in the near future. Insights into the roles of the researchers and the involved LAs and their interactions are derived from a series of participatory workshops over a time span of three years. The main emphasis is on the contribution of research projects for delivering methods (and tools) for the management of the planning process to facilitate policy/decision makers in the identification of scientifically sound strategies in the field of natural resources management and climate change adaptation.

## 2. METHODS

One of the main challenges of the project was the management of interactions between the research consortium and the two communities of LAs, in Europe and Asia. The application of the NetSyMoD approach was thus planned through a series of parallel steps, allowing the sharing of experiences between the two study cases and facilitating building of a common knowledge base about water management and climate change adaptation strategies.

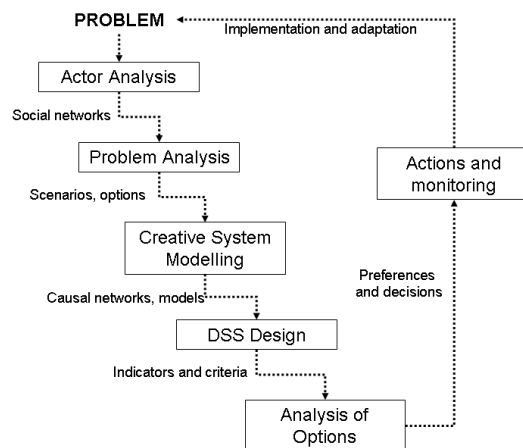
A generic decision making process is formalised in NetSyMoD as a sequence of six main phases (Figure 1) and is briefly introduced in the following section.

**Actor Analysis.** A generic planning process should start with the identification of all LAs involved in, or affected by, decisions to be undertaken. Of crucial importance is the role of a task force group, who has the role of identifying LAs to be involved and organise activities with them. When all the relevant actors have been identified, a Social Network Analysis (SNA) is undertaken, with the aim of

assessing the relationship among actors. Through the use of questionnaires and interviews, the SNA allows the identification of key actors, the assessment of power structures among the actors, and the characterisation of their role and position with respect to the decision to be taken. SNA should also ensure that the participatory modelling and/or planning process is not hijacked by powerful groups, but rather it is truly representative of the whole spectrum of interests and positions. There are thus three main outputs from the SNA phase, which will be an input into the preparatory phase for the Creative System Modelling (CSM) activities:

1. a list of key local actors to be involved in the next phases of NetSyMoD;
2. the analysis of power will highlight potentially problematic actors and relations;
3. a conflict analysis on the basis of position and roles of actors within the network.

**Problem Analysis.** The key actors are then involved by the researchers in a series of activities to scrutinise the problem (or conflict) at hand from various perspectives and viewpoints. The environment in which the problem is embedded is explored, and the relevant factors are identified. The problems faced by environmental planners and managers are complex and their drivers interwoven. It is necessary to identify the most relevant aspects, by focusing on those which, when altered, can lead to the more significant (positive) changes in the system. The exploration of the problem includes also the analyses of the legal and institutional frameworks, as well as the economy on various spatial levels and the state of environment. Main outputs are:



**Figure 1.** The planning process in the NetSyMoD approach.

1. a list of most relevant drivers governing the perception of the problem at hand;
2. a preliminary list of possible solutions to be assessed;
3. a set of scenarios regarding the future development of the main drivers and cause-effect relations

**Creative System Modelling.** A shared cognitive model of the social and ecological system is needed for a robust and participative evaluation of planning options. The ambition is to put in place a participatory modelling process, through the elicitation of knowledge and preferences from actors, thus building not only a common understanding of the problem, but also the conceptual – and later operational – framework for supporting decisions. In searching for a simplified conceptual framework to be used as a reference for LAs, the Driving Force-Pressure-State-Impact-Response (DPSIR) scheme, promoted by the European Environment Agency [1999], was adopted, because it is very useful to formalise cause-effect models. The DPSIR scheme enables formalising and communicating the main links existing between human activities and their consequences for the biophysical environment, thus exploring the effects of a human Driving force through a certain Pressure to a change in the State of the environment, the consequent Impacts and the identification of suitable Responses. Very importantly the European Environment Agency's framework is now very well known by policy and decision makers, and thus it represents a good interface with the research community and scientific modelling.

In the CSM phase the key local actors identified before are invited to participate to workshops, during which creative thinking and cognitive mapping techniques are used to develop a shared model of the socio-ecosystem and of problem at hand. The CSM is used also to refine planning scenarios, identify most suitable evaluation criteria to be later assessed through research activities, and their weights, to be used for the evaluation of strategy options through Multi-Criteria Analysis (MCA).

**DSS Design.** In this phase the knowledge developed so far is used for designing the toolbox of procedures to be implemented in the software, capable of managing the data required for developing informed and robust decision in the following phase. This is necessary to manage and to communicate the information flow between various process phases, including exchange, transformation, integration, validation and documentation of gathered knowledge. Many of the previous analyses employ computer-based tools such as databases, visualisation components, and simulation models. These tools require a common interface to efficiently contribute to the analysis of planning options, and such interface is provided by the DSS. NetSyMoD adopts mDSS a tool developed originally by the MULINO research project [Giupponi, 2007] and later maintained for about a decade through a series of research grants. Through the adoption of mDSS and the management of participatory modelling activities the DSS Design phase provides the following outputs:

1. User interface which guides user through various stages of the NetSyMoD process;
2. quality assurance regarding the integration of different components;
3. documentation and reporting, explaining the process and facilitate the interpretation of results.

**Analysis of Options.** The analysis of options consists of evaluating solutions to the problem (i.e. in this case the IWRM strategy options to cope with the hydrological risks deriving from climate change in the UBRB and UDRB), and producing a ranking from their performances according to the various criteria previously selected and the preferences of LAs. Decision methods belonging to the family of Multi-Criteria Analysis are used to avoid inconsistencies underlying judgement and choice, and to make decisions more compatible with normative axioms of rationality, transparent, and informed to the perspectives or viewpoints of all actors. All the above contributes to a higher acceptance of the policies.

**Action and Monitoring.** This phase was not implemented, as its scope is beyond the goals of the research project, therefore we will skip its description for the sake of brevity.

### 3. RESULTS

The following sections reports on the experience of implementing the NetSyMoD approach in the Brahmawinn project, with specific reference to its application in the portion of the UBRB of the Assam State of India.

### 3.1 Actor Analysis

The identification of which stakeholders to contact for both the SNA questionnaires and participation to the workshops was undertaken using a snow-ball technique in collaboration with local partners. It was a difficult task, however, as there are no established forums where IWRM issues are regularly discussed. Furthermore, the number of relevant actors is fairly wide and from different organisations and departments, dealing with fragmented issues and oftentimes with overlapping functions. Without a SNA, it would have been difficult to identify relevant actors, keeping their number to a manageable size, yet ensuring that all interests and positions with respect to IWRM in the basin were represented in the meeting. While finalising the questionnaire for collecting SNA data, a great effort was put in place to contact as many of the identified stakeholders as possible, to profile their background and to ensure their participation in the upcoming workshops. LAs were identified at the institutional level by contacting the heads of selected Departments/Organisations, who were asked to depute at least one member for being involved in project activities. The SNA questionnaire was circulated among this list, but with limited success in terms of responses which led to the acquisition of 13 filled questionnaires in total. This problem was partially compensated by the fact that one of the questions asked for the identification of the 10 institutions most relevant for IWRM and vulnerability in the area, and respondents were then asked to assess the presence and strength of different types of relations with each of them. Nevertheless, the analysis that could be undertaken with the limited number of respondents is clearly different from what could be done, if all institutions included in the initial roster could be interviewed. Examples of institutions considered in the SNA are the Brahmaputra Board, the Water Resources Department of Assam, the Irrigation Department, the Electric Power Corporation.

The questionnaire was therefore designed to investigate specific relations, addressing different problems: water management in general, flood management in emergency situations, and post emergency issues, when the area is recovering from a flood.

Specific descriptions of the setting of the network in the different situations were produced. For instance, the post-emergency network showed the largest number of outsiders – that is, actors with no specific role in managing recovery from floods. SNA provided a set of quantitative indicators such as the diameter of the network providing a measure of the number of steps that are necessary to go from one side of the network to the other. The diameter is critical in a case of an emergency, when communication needs to flow quickly and freely: a diameter of 1 calculated in this case indicates a fairly good working relation and a good basis for coordinated response to emergency. Network density is another indicator calculated as the number of existing ties, expressed as percentage of the number of ordered/unordered pairs which could theoretically be possible. In more dense, compact networks, information is more likely to spread fast. Looking at the data, coupled with the figures, we conclude that the institutional networks are not very tight.

Figure 2 shows a comprehensive picture of the Assam network, with a diameter of 2, and a density of 0.069, including 17 nodes (i.e. institutions) with 3 of them (outsiders) with no apparent relations to the others, a crucial role played by the Brahmaputra Board (BB). The elaboration of the questionnaire allowed further refinements of the list of actors to be involved in the CSM workshops, taking into account the diversity of opinions and the power and communication relationships highlighted by the SNA.

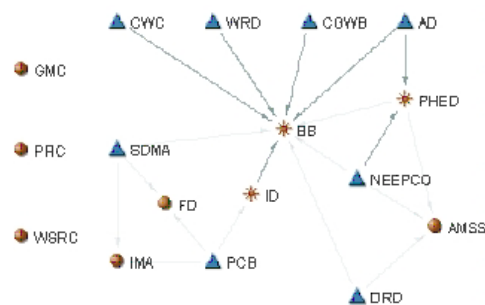


Figure 2. Overall Network of Assamese institutions.

### 3.2 Problem Analysis

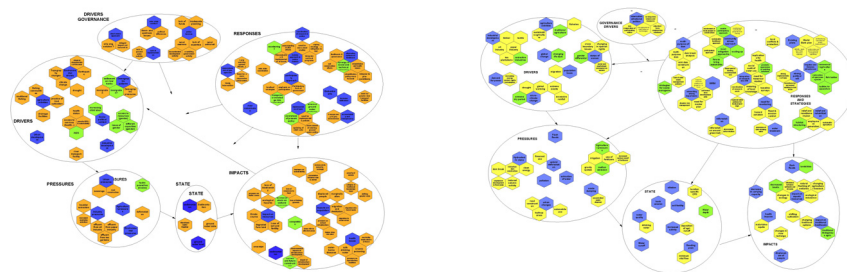
The first stakeholder workshop was organized in Guwahati, State of Assam (India) on 11

and 12 April 2007. In the enrolment phase, the facilitator explained the exercise idea and its goals, and introduced the 48 participants (key local actors identified in the previous AA phase) to the workshop techniques and rules. During the brainstorming, individuals contributed ideas through a semi-structured, open discussion, initiated by guiding questions projected with a projector on a screen. Once all participants' perceptions were collected, the concepts were roughly clustered by the facilitator and then shown back to the group. Further comments were integrated as participants reviewed each other's contributions and built on one another's ideas in a plenary session. Linking concepts and building causal loops for further evaluation was then exploited to initiate discussion around causes and effects, to facilitate the building of a shared understanding of the problem.

The semi-structured brainstorming was structured around the following questions, designed in accordance with the DPSIR framework:

1. What are the main issues facing the Brahmaputra river basin in Assam?
2. What are the drivers of change (economic activities, human activities, global patterns) in the Brahmaputra river basin in Assam?
3. What are the effects of the identified issues: on the people and their environment?
4. What are the existing strategies? And are there any potential strategies that you can think of?

Figure 3 presents the outcome of the brainstorming exercise of the meeting with hexagons identifying the issues raised by participants, with the following color codes: orange and yellow (contributions of the participants), green (contributions of the BRAHMATWINN researchers), blue (titles of the clusters).



**Figure 3.** DPSIR coded socio-economic issues (left) and physical elements (right).

### 3.3 Creative System Modelling

In the CSM phase the concepts expressed in the brainstorming session were refined (e.g. redundant concepts were removed) and the DPSIR allocation consolidated.

Among others, a range of emerging issues for the area were pointed out. One of the first interesting results was the several contributions dedicated to the common pitfalls of governance, including gender issues, corruption problems, lack of enforcement and implementation, etc. When considering the Drivers of changes in the basin, the most important one according to the contributors concerns the population boom which is underway, following the DPSIR causal loop chain, that generates heavy Pressures on the environment of the basin (built up area, city expansion, sewerage etc...). Other worrying pressures are the ones related to the sand and timber extractions activities, the oil withdrawals, the effluents from different industries and the energy production. These pressures lead to a general worsening State of the environment which does have some significant direct or indirect Impacts on the natural resources and on livelihood. The Responses needed, as pointed out by the participants, concern mainly the need to integrate participatory approaches and research into traditional Decision Making.

Very importantly for the integration of the various disciplinary components of the project activities, the elements of the DPSIR cognitive model developed in Guwahati were used as entries of a table in which an interface was built with the quantitative approaches applied in parallel and, in particular with the planned outputs of the modelling activities. A series of Delphi rounds were conducted with project partners for the identification of a catalogue of planned outputs in form of indicators, clustered according to a hierarchical level envisaging a first aggregation at the level of sub-domains, a second of domains and a third level of

themes identified as the four pillars of sustainability: Environment, Economics, Society and Governance (i.e. the institutional dimension). A so called Integrated Indicator Table was thus produced having on the one side the indicators (supply of knowledge by the project) and on the other the elements of the DPSIR cognitive model (demand of knowledge and issues raised by LAs who participated in the workshop), both converging at the level of sub-domains.

### 3.4 DSS Design

Building upon the information acquired in the participatory activities carried out in the first two years of the project (in both the UDRB and the UBRB) and referred to in the first three NetSyMoD phases, a second workshop was organised in Kathmandu, Nepal (November 2008), with the aim of the Decision Support System (DSS) Design, and of providing a preliminary assessment of the effectiveness of the four response categories to cope with flood risks under the pressure of climate change (as described in the subsequent phase: Analysis of Options). The 19 participants for this workshop were chosen among those administrators that most likely will use the outcomes of the project. Some of them were previously involved in project activities in the Assam state mentioned above, others joined the project from different Himalayan areas.

The workshop started with the presentation of the goals of the evaluation exercise and of the climate change scenarios and was followed by a brainstorming session for the elicitation and consolidation of possible response strategies. Then the participants were asked to identify the most important sub-domains to be used as criteria for the evaluation of strategies. The selection was carried out by every LA through a voting exercise, to be repeated three times for the environmental, economic and social pillars. The votes were then summed up and the criteria with the highest scores selected. After having identified the evaluation criteria, participants were involved in the exercise to attribute sub-domain weights, i.e. the relative relevance to be given to the criteria, within the set of nine selected, in order to identify the most promising responses to cope with the issue of flooding under the pressure of climate change (Table 1). The criteria weighting procedure was based on the method proposed by Simos [1990] and revised by Figueira and Roy [2002]. Experience shows that this method is very appropriate for these workshops, because it provides a simple and effective approach for weighting, without the need of a computer lab.

weight	sub-domain
0.145	ENV Vulnerability
0.133	ENV Forest management
0.132	SOC Population dynamics
0.125	SOC Poverty
0.125	ENV Basin morphology
0.103	ECON Agricultural production
0.101	ECON Energy production
0.100	SOC Infrastructure pressures
0.056	ECON Employment

**Table 1.** Weights for selected sub-domains.

The calculation of weights by means of average aggregation, however, can homogenise and flatten the values. Aggregate values can therefore hide important information, such as divergence and convergence of participants' opinions. For this reason, the following phase considered both the average values and the preferences expressed by every single LA in parallel, as described below.

### 3.5 Analysis of Options

During the same workshop, four broad categories of responses to flood risk according to future scenarios were examined: Planning (PLANNING); Knowledge and capacity building (KNOW-CAP); governance and institutional reforms (GOV\_INST); Engineering and land management (ENG-LAND). The exercise was thus aimed at exploring the expectations of LAs for the four types of responses, as a preliminary step for a more focused second exercise going at the level of specific strategies (not reported here for brevity).

In the second part of the Kathmandu workshop LAs filled a matrix with Likert scales expressing the expected performances of the four strategies considered according to the

nine criteria selected. The results show that none of the categories of responses clearly dominates the others, as shown in Table 2. All the average criterion scores (row) or responses (columns) are in a range between “very high effectiveness” and “medium effectiveness”, meaning that all the responses are considered to be potentially good for responding to flood risk. This stresses the potential validity of the four categories of responses.

Analysis Matrix		KNOW-	GOV-	ENG-	Average	
Average values		PLANNING	CAP	INST		LAND
SOC.1	Poverty	2,43	2,62	2,00	3,33	2,60
SOC.2	Population dynamics	1,76	2,52	2,33	3,19	2,45
SOC.3	Infrastructure pressures	2,00	2,86	2,67	2,19	2,43
ENV.1	Vulnerability	1,71	2,43	2,24	1,95	2,08
ENV.2	Basin morphology	2,38	2,67	3,10	2,43	2,64
ENV.3	Forest management	1,86	2,10	2,10	1,95	2,00
ECO.1	Agricultural production	2,15	2,50	2,48	2,29	2,35
ECO.2	Energy production	2,19	3,00	2,43	2,10	2,43
ECO.3	Employment	2,43	2,57	2,43	3,52	2,74
<b>Average</b>		2,10	2,58	2,42	2,55	

**Table 2.** Analysis Matrix - average values of LAs’ evaluations on the potential effectiveness of each response in coping with the issues expressed by the criteria (rows) by the response options considered (columns).

The last part of the analysis consisted of the calculation of the ranking of alternatives by applying the MCA capabilities of the mDSS software. Decision rules aggregate partial preferences describing individual criteria into a global preference and rank the alternatives. The ELECTRE III method was adopted in order to be coherent with the revised Simos methodology used for weights elicitation. ELECTRE III, as any ELECTRE aggregation procedure, consents to give an intrinsic weight to each criterion, which does not depend neither on the range of the scale nor on the encoding and unit selected, as shown by Figueira and Roy [2002]. The preference (P) and indifference thresholds (Q) were parameters defined by the research team as an input, while no veto threshold (T) was introduced in the analysis, because not pertinent to the selected indicators. The Normalised Average Matrix was used as input for the analysis, producing as a result a ranking with PLANNING showing the greatest expectations, followed by ENG-LAND, GOV-INST and KNOW-CAP, at the same level.

Results were confirmed by running in parallel the evaluation of every single LA and combining the results through the Borda rule in mDSS (Table 3). This result is coherent with the outputs of ELECTRE and with the AM, confirming that PLANNING instruments (e.g. design and implementation of relief and rehabilitation plans, hazard zoning, etc.) are considered the most promising responses in terms of effectiveness to cope with problems related to flood risk under the pressure of climate change.

	PLANNING	ENG-LAND	KNOW-CAP	GOV-INST	sum of votes in favour	BORDA Mark
PLANNING	-----	10 (I=6)	16 (I=3)	12 (I=5)	38	1°
ENG-LAND	5 (I=6)	-----	9 (I=4)	8 (I=6)	22	2°
KNOW-CAP	2 (I=3)	8 (I=4)	-----	8 (I=6)	18	3°
GOV-INST	4 (I=5)	7 (I=6)	7 (I=6)	-----	18	3°

**Table 3.** Group Decision Making marks. The first number refers to the number of votes in Favour, while “I” refers to the votes of Indifference.

#### 4. DISCUSSION AND CONCLUSIONS

Integration of disciplinary modelling approaches (e.g. hydrology and social science) and sectoral policies (e.g. drought management and climate change adaptation) is an ever growing need, in particular when facing the new challenges derived from global change scenarios. Integration should not be limited to the experts of different disciplinary fields, it should include all relevant stakeholders: policy/decision makers and interested parties in general (institutions, groups, individuals).

Researchers have their own networks, communication systems, languages, priorities, tools, similarly have policy makers and stakeholders in general, who have also their own priorities, preference, etc. Therefore, research in support of policy/decision making should – at least attempt to – bridge the gaps between the different communities, providing methods for managing the roles of different actors through the policy making process.

According to the Brahmawinn experience:

- The implementation of simulation capabilities and DSS tools within widely accepted conceptual and policy frameworks can significantly contribute to the uptake of research products and thus to the quality of decision/policy making process;

- Only rarely fully integrated assessment models are available; more frequently different sources of knowledge must be loosely coupled, thus requiring a robust and transparent integration framework (IF);

- Many different application contexts exist: (re)use of research products (models and DSS's) has remarkably improved by the availability of IFs, but it requires also specific efforts in the future;

- Research projects are needed for developing and experimenting innovative methods, but specific limitation should be acknowledged, and in particular the limits in the possibility of effectively involving relevant stakeholders, mainly because of limits in motivation (applications in research projects are usually at least partially just simulations of real world cases); and the limits in the capability of a research consortium in managing participatory processes deriving usually from: limited funds, mismatch with the timing of local debates, problems in communicating the role of research efforts with respect to the management of local issues and planning processes.

Therefore, the feasibility of deriving scientifically robust support to policy making from IFs must be assessed on a case by case basis (effectiveness of participation, normalisation effects, non-linearity, aggregation algorithm, etc.).

## ACKNOWLEDGEMENTS

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