ADAPTIVE MANAGEMENT OF UPLAND RIVERS FACING GLOBAL CHANGE:

GENERAL INSIGHTS AND SPECIFIC CONSIDERATIONS FOR THE RHONE BASIN

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EXECUTIVE SUMMARY

The growing awareness of complexities, the unexpected consequences of management strategies and an increase in uncertainties have triggered critical reflection about prevailing water management paradigms. This paper provides arguments for the need to change towards more integrated and adaptive water management regimes. The example of the Rhone basin is used to illustrate the challenges upland watersheds face in times of increasing uncertainties due to global and climate change. The analysis of a large water management project, the 3rd Rhone correction, provides evidence that changes in water management practice are slow and limited, however there is expressed political will and initial tentative steps. Reasons for the barriers to change are analysed and it is concluded that processes of social learning are of paramount importance to initiate and sustain change. A number of recommendations for policy making are given. Developing adaptive capacity with a long term vision would be a wise strategy rather than responding to disaster and escalating conflicts.

1. CHALLENGES FOR WATER MANAGEMENT

Water management has been successful in the past in securing the availability of water related services and protecting society from water related hazards through technical means. Rather than adapting to periodic variability in water levels (i.e. flooding), the approach has been to control rivers to provide for hydropower production or shipping. The control approach can reach its limits in upland rivers that experience extreme weather events. For example, channelled rivers with high rainfall can have severe floods and there has been an observed increase in damage since people began settling in vulnerable areas such as flood plains. However, once high risk areas are settled, economic investments and assets need to be protected from natural disasters, despite the fact that land use should have been originally restricted. Reliance on engineered infrastructure for protection against water related hazards means that societies have become more vulnerable when this infrastructure fails.

Water quality has been the preliminary focus of improving the ecological integrity of riverine ecosystems. Consequently, there has been a lack of attention to the structural changes in riverbeds and changes in the spatio-temporal variability of water flows which have a strong influence on habitat diversity and ecological function. The building of reservoirs and the use of hydropower have altered the flow regimes of many rivers resulting in detrimental effects on stream ecology (Ward 1998; Pahl-Wostl, 1998; Bergkamp et al., 2000). Efforts are being increasingly undertaken to restore the ecological integrity and functions of river basin ecosystems by focusing on the structural properties of river and ecosystem flow requirements (Tockner and Stanford, 2002). Prospects of climate and global change leading to possible increases in extreme weather events and fast changing socio-economic boundary conditions mean that more attention needs to be focused on water flows and river structure. The growing awareness of complexities, unexpected consequences of management strategies and an increase in uncertainties have triggered critical reflection about prevailing water management paradigms (Pahl-Wostl, 2006b). There are now calls for more robust, flexible and adaptive strategies (Gleick, 2003; Mönch et al, 2003; Kabat and van Scheick, 2003; Pahl-Wostl, in press).

2. ADAPTIVE MANAGEMENT

Adaptive management in relation to ecosystem management has been discussed for several years (Holling, 1978; Walters, 1986; Pahl-Wostl, 1995: Lee, 1999). It is based on the insight that the ability to predict future key drivers influencing an ecosystem, as well as system behaviour and responses, is inherently limited. Therefore, management must be adaptive and have the ability to change depending on environmental events.

Adaptive management can more generally be defined as a systematic process for improving management policies and practices by learning from the outcomes of implemented management strategies. One form of adaptive management employs management programs that are designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses about the system being managed (e.g. Gunderson, 1999; Kiker et al, 2003: Richter et al, 2003). This implies that hypotheses can be generated and that the outcomes of experiments can distinguish the comparative advantages of different hypotheses. An experimental approach may also structure dialogue and in the spirit of reflexive governance support processes of social learning and develop the capacity of actors to deal with uncertainties and to learn from experience.

Capacity in adaptive management is needed to deal with different kinds of uncertainties:

- There are ambiguities and conflict of interest in defining operational targets for different management goals, thus participatory goal setting based on different kinds of knowledge is needed.
- Outcomes of management measures are uncertain due to the complexity of the managed system, furthermore there are uncertainties in environmental and socio-economic developments that influence the performance of implemented management strategies.

- New knowledge about system behaviour may suggest options for change in management strategies.
- Changes in environmental and/or in socio-economic boundary conditions may demand change in management strategies.

Overall, a clear need for a more coherent and comprehensive approach can be identified based on sound conceptual foundations that deal with uncertainties in integrated water resource management (IWRM). Uncertainty has often been perceived as an impediment for effective and efficient resource management and the main goal has always been to reduce and control uncertainties. However, such a strategy may be counterproductive when uncertainties cannot be reduced. Acknowledging uncertainties along with open negotiation processes may help move entrenched positions and start constructive dialogue as different actors may perceive opportunities in collaborative efforts rather than continuing to defend their rigid positions.

The requirements for implementing adaptive management in river basins include:

(1) New information that is available and/or consciously collected (e.g. indicators of performance of management regimes, indicators for change that may lead to desirable or undesirable effects) and monitored over appropriate time scales (longer than those mandated by short-term political objectives).

(2) Actors in the management system must be able to process new information and draw meaningful conclusions. This can be best achieved if the learning process is open and transparent by uniting actors in all phases of assessment, policy implementation and monitoring.

(3) Management must have the ability to implement change based on the availability of new information. Implementation of changes in adaptive river basin management is part of a learning process where it must be made clear who decides how and when to change management practices based on available evidence.

It can be argued that current water management regimes are not adaptive (Pahl-Wostl, 2002; Tilman et al, 2005). Large infrastructure and investment costs prevent change. Rigid legal regulation prescribes technical standards and practices and leaves little room for innovation. Infrastructure (flood protection, water supply, waste water treatment) is designed to cope with extremes which is a strategy very sensitive to errors in the prediction of extremes. Water supply and waste water infrastructure have for example been designed to meet peak loads rather than trying to break demand peaks by introducing flexible pricing schemes (Tillman et al, 2005). In addition, the professional culture in the water sector tends to be risk averse and does not reward innovative thinking. Such attitudes are partly understandable given the task of the water sector is to protect the public from water related hazards and guarantee water related services. Processes of social learning are needed to develop structural conditions, as well as to implement and to sustain adaptive and integrated water management regimes. The following section critically explores the situation in the Swiss Rhone basin using the background and arguments already presented.

3. RHONE – ANALYSIS OF CURRENT MANAGEMENT REGIME AND SUGGESTIONS FOR IMPROVEMENT

The implications of climate change for Switzerland in general and the Rhone basin in particular are summarized in Box 1.

Box 1 - Expected Impacts of Climate Change in Switzerland

- Temperature: Increase of 3-5 degrees by 2100.
- Temperature extremes: increasing a maximum of +5 degrees, increasing a minimum of + 1-4 degrees
- Precipitation: Heavy rains and higher precipitation during winter seasons will become more frequent
- Snow: Rise of the snow line to approximately 200-300 meters.

- Floods: More frequent winter floods
- Drought: Southern part drier, low flow conditions more frequent
- Glaciers will largely disappear
- Permafrost: rise of the altitude of permafrost
- Landslides: Increased likelihood due to melting of permafrost soil

Sources: Frei and Schär, 2001. OcCC, 2002. Schmidt et al, 2002.

Climate change will have pronounced impacts on the hydrological regime of many Alpine watersheds. The increase in temperature will result in a decrease in the amount of precipitation in the form of snow in winter. Glaciers will disappear, resulting in reduced natural water storage capacity. Changes in the seasonal distribution of precipitation with more rain in winter and less rain in summer and an increased probability of extreme precipitation events will result in a greater likelihood of extreme floods in winter and spring and a higher chance of drought and low-flow conditions in summer. Due to temperature increases the altitude of the permafrost zone will be higher, which in combination with increased extreme precipitation events will likely lead to more frequent landslides. Overall, the Alpine region will be more vulnerable to extreme weather events.

Consequently, the water sector has serious challenges ahead, in particular the management of extreme climate conditions (Schädler, 2002). In summer, water shortages are expected due to decreasing precipitation, the increased likelihood of drought periods, an increase in the probability of low-flow conditions (decline of natural buffering capacity due to retreat of glaciers and snow fields) and an intensification of water demand for irrigation. This will have undesirable consequences for water temperature and quality. Due to the increased likelihood of winter and spring floods, there will be increasing demand to use reservoir storage for flood prevention. Overall, a request from downstream areas for balancing water flows to buffer extremes (floods and droughts) is expected. Such requests will require negotiations about changing use priorities and potential trade-offs in reservoir and flood management. Given the considerable uncertainties in climate change predictions it will be important to develop appropriate adaptation strategies. This has been clearly acknowledged at the ministerial level in Switzerland and pleas for new integrated and flexible strategies have been made (Willi, 2006).

To investigate whether management practice can respond to these challenges, a major construction effort to improve flood protection in the Rhone basin is investigated more closely. The first coordinated attempt to protect the Swiss part of the Rhone valley against floods was undertaken in the 19th century after a series of heavy flooding events. Following the catastrophic floods which took place in 1860, federal founds were attributed in 1863 to the cantonal Administration to undertake a first major of the River Rhone Correction. After being completed in 1894, the first construction phase provided the conditions for the drainage and reclamation of the plain area (Colenco, 2005).

The second major correction was started in 1937 after a dike broke during a flood event in 1935. The purpose of the second correction project was to complete the works started during the first phase, and to improve the solid and bed load transport capacity of the river (Département Fédéral des Affaires Intérieurs, 1964). Another dike broke in 1948, so work continued until 1960 and improved the surface drainage of regularly flooded land.

A change in the control paradigm began in the 1990s due to extreme floods occurring in 1987 and in 1993, where observed changes indicated an imminent rupture of the protection dikes. In addition, accretion of the riverbed was still occurring in places and could not be fully controlled. Thus, doubts emerged whether dikes constituted a safe control against floods. In addition, it become progressively evident that the systematic embankment of the river initiated at the end of the 19th century had modified the river's morphology by reducing the area of the natural channel, thus diminishing most of the river's natural ecological functions. Furthermore, retention reservoirs for hydropower production constructed in the 20th century have changed the flow of alpine tributaries and the embankments of the Rhone resulting in reduced surface areas of pristine floodplains.

Today, floodplains are a remnant of the original biodiversity in the 19th century, occupying 6% of the original floodplain area. As a consequence, more than 170 flora and fauna species are endangered. In spite of intensive aquaculture the fish population of the river remains low. The geometric straightness of the river embankment is also a factor limiting both biodiversity and alluvial dynamics.

In recognition of the detrimental effects outlined above on ecosystem functions, the third Rhone River Correction (R3 Project) has three main objectives:

(i) safety, to ensure the protection against floods;

(ii) environmental, to re-establish and even strengthen the biological functions of the river;

(iii) socio-economic, to re-establish the social and economic legacies that normally take place along the river.

The R3 project aims to control potential flood damages within the plain area of the upper catchment of the Rhone river, particularly between Brig and the mouth of the river in Lake Geneva in the Canton Vallis. The project will be implemented over a period of approximately 30 years with an anticipated start of the construction work in 2008.

Analysis of the participatory process

Among the leading stakeholders (the Implementing Entities) there is a tendency to identify participation with consultation (Colenco, 2005). As a result, the public, invited to express an opinion on an already planned concept, might use its right to opposition. This might not occur in a scenario with public representatives participating in the early stages of the planning. Further, consultation processes are insufficient when profound changes in management strategies and thus in the role of different actors are envisaged (Pahl-Wostl, 2002; Pahl-Wostl et al, in press). Construction plans for the 3rd correction of the Rhone have been published for consultation for all affected stakeholder groups (Rhoneprojekt, 2005). The implementation plans reveal that economic considerations, technical considerations and the avoidance of any use conflicts dominate the overall planning process. A widening of the riverbed of up to twice the current size is foreseen whereas a 3-4 fold widening would be desirable from an ecological point of view. An accompanying research project (EAWAG, News, 2006; www.rhone-thur.eawag.ch) has provided empirical evidence that the planned construction measures and the flow regime will not lead to a significant improvement of the ecological situation despite the rhetoric in official documents conveying the impression that a balance between the competing interests of flood protection, hydropower generation and ecosystem restoration have been found. Given the dual objective of the project of flood protection and ecosystem restoration, the trade-off between flood protection and floodplain restoration could be reduced by explicitly taking into account the function of ecosystem services in flood plains. To realize such an approach would however require major changes in current and future land use in the flood plain. The consultation report mentions uncertainties and climate change only once - in parentheses. If they have been taken into account, it seems information on climate change and associated uncertainties are not a high priority to communicate to the public. Dimensions of flood protection measures are still derived from the expected magnitude of a century flood. Uncertainties are only taken into account by an increase in the safety margins. However, as shown by Aerts et al (in review) a strategy combining a portfolio of measures with different damage to discharge characteristics may be a more robust strategy than relying on measures that provide complete safety but lead to disaster in the case of failure.

Despite the stated policy goals by government to foster innovation in flood management, the suggested strategies are conservative. The situation observed in the Rhone basin is quite characteristic for many river basins as has been shown by first results from the European project NeWater exploring the need for a transition towards Adaptive Water Management in a number of river basins in Europe, Central Asia and Africa (New Approaches to Adaptive Water Management Under Uncertainty, www.newater.info). A similar lack of change at the operational level as in the Rhone basin can for example be observed in the Netherlands where on one hand the government asks for a radical rethinking of water management – more space for rivers and living with water rather than control. On the other hand management practice is very slow in adopting new strategies. Such inertia can be explained by the radical changes in the management regime that would be needed for more integrative flood management practices.

4. RADICAL CHANGE IN MANAGEMENT REGIMES AND THE IMPORTANCE OF PROCESSES OF SOCIAL LEARNING

The implementation of integrated and adaptive management strategies and the reduction of the trade-off between flood protection and floodplain restoration can be achieved by taking into account ecosystem services of flood plains and by moving towards multi-functional dynamic landscapes. As highlighted by Pahl-Wostl (2005), efficient integration requires processes of social learning since fundamental changes are needed in the governance structure as summarized in Table 1. This table also incorporates classifications according to the water management hierarchies for adaptive management as described in Section 5. This classification outlines how decisions and management of water resources are interrelated between different political levels (context, network and game levels).

Table 1: The current management regimes in regulated and controlled rivers compared with a future state that has multi-functional and dynamic landscapes.

	Current state with regulated and controlled rivers	**Potential future state with a multi-functional dynamic landscape**
Stakeholder groups and their roles **(Roles of actors at the game level - Switching)**	• Authorities as regulators in a highly regulated environment • engineers who construct and operate dams, reservoirs and levees • environmental protection groups fighting for floodplain restoration • insurance companies selling insurances against flood	• Authorities act as contributors to an adaptive management process with shared responsibilities • Neutral third parties act as facilitators of the decision making process • landscape architects • engineers who have skills in systems design and cooperate with ecologists

	damage • house owners living in floodplains • agriculture using land in the vicinity of rivers • shipping industry interested in well functioning water-ways	• environmental protection groups • insurance companies • house owners with property in a floodplain at a higher risk of being flooded • tourism industry and tourists using the floodplains for recreation
Stakeholder participation **(Roles of actors at the network level – Activating)**	Little stakeholder participation – occasional consultation where different stakeholder groups and the public at large are asked to give their opinion on a management plan or scenario that has already been prepared by experts	Stakeholders and the public are actively involved in river basin management. This can be described as co-production of knowledge and co-decision making. Involvement can range from discussions with the authorities and experts, to actively contributing to policy development (co-designing), influencing decisions (co-decision-making), or even full responsibility for (parts of) river basin management.
Paradigm of water management **(Perceptions at the network level – Reframing)**	• Management as control. Technology driven. Risk can be quantified and optimal strategies can be chosen. Zero-sum-games in closed decision space • Implementation of controllable and predictable technical infrastructure (reservoirs, dams) based on fixed regulations for acceptable risk-thresholds	• Adaptive and integrated water management. "Living with water". Acceptable decisions are negotiated. • Implementation of a multi-functional landscape and increased adaptive capacity of the system. Designed risk dialogue and cascade of adaptation measures to live with extremes. Increased importance of real time forecasting systems
Institutional setting and governance **(Institutions at the network and game level – Reforming and Arranging)**	• Institutional fragmentation • Flood protection, nature conservation, regional planning and water management are often located in different authorities. Even the European Water Framework Directive does not address flood management. But it asks to preserve and/or restore the good ecological state of freshwater ecosystems. This includes the restoration of	Polycentric governance and better institutional interplay • Better horizontal and vertical integration of formal institutional settings to overcome fragmentation which might imply new institutions such as river basin management panels with defined responsibilities and decision making capabilities • Stronger role of informal institutions and participatory approaches

	floodplains and will thus directly interfere with flood protection.	
Adaptive capacity **(Tools at the Network and Game levels – Selecting and Using)**	”Hard” approach to systems design which has aims to implement long-lasting optimal solutions. Adaptive capacity is in general quite low due to high investment in infrastructure and often inflexible legal regulations (e.g. water use rights allocated for decades, technological norms that prescribe good practice and prevent innovation and change to new management practices)	”Soft” approach to systems design allows new insights to be taken into account, including responses to changing environmental and socio-economic boundary conditions. This is more in line with the new paradigm of adaptive water management.

4.1 What is social learning?

Social learning in river basin management refers to developing and sustaining the capacity of different authorities, experts, interest groups and the public to manage river basins effectively. Collective action and the resolution of conflicts require that people recognize their interdependence and their differences and learn to deal with them constructively. The different groups need to learn and increase their awareness about their biophysical environment and about the complexity of social interactions.

4.2 Why is social learning needed to move towards and to sustain integrated, adaptive water management?

As previously mentioned, technical infrastructure (e.g. large technical infrastructure for flood protection), citizen behaviour (expectations regarding safety in floodplains, risk perception), and engineering rules of good practice are often mutually dependent and stabilize each other resulting in the blockage of new and improved resource management schemes (Pahl-Wostl, 2002). Social learning is assumed to be crucial to break through such “lock-in” situations. It is also required to implement change to sustain adaptive management practices.

A new concept for social learning in river basin management has been developed in the context of the European project, HarmoniCOP. Figure 1 shows the framework for social learning developed to account for learning processes in water resources management (Craps et al, 2003; Pahl-Wostl, 2002). The framework is structured into context, process and outcomes and has a feedback loop to account for change in cyclic and iterative processes. The context refers the governance structure and the natural environment in a river basin. To improve the state of the environment in practice most often implies a change in governance structure.

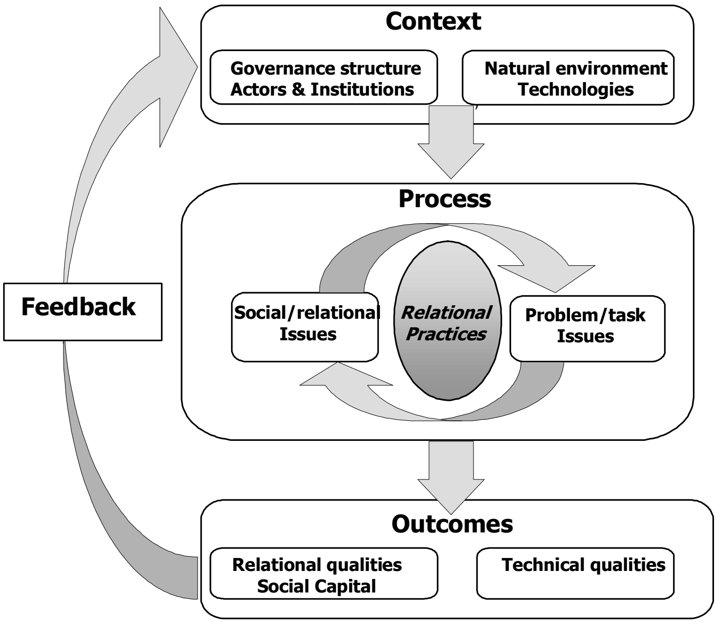

Figure 1 Conceptual framework for social learning in resources management. In the centre are multi-party processes that are influenced by the context in which they are embedded and that produce outcomes that may lead to changes in the context and thus to a cyclic and iterative long-term process of change.

The concept referring to multi-party interactions in actor networks has two pillars (Figure 1). The pillars relate to the processing of factual information on a problem (content management) and engaging in processes of social exchange (social involvement). Social involvement refers to essential elements of social processes such as the framing of the problem, the management of the boundaries between different stakeholder groups, the type of ground rules and negotiation strategies chosen or the role of leadership in the process. As one example the role of framing is explained in more detail.

During the initial stages of dealing with a problem **Framing and Reframing of a Problem Domain** determines the direction of the overall process. Frames may be derived from culture, social roles, scientific disciplines etc. Actors have frames that determine how they make sense and meaning of information and their physical and social environment. Differences in the framing of an issue are among the key reasons for problems in communication and entrenched conflicts among actors. The framing of an issue includes, for example, what is at stake, who should be included and in which role. Processes of framing and reframing are essential elements of social dynamics in a group during the negotiation of meaning of key issues such as goals to be achieved or how to measure success of management. It is important to be aware that powerful actors often impose their frames or interpretation of an issue onto a process. A relational practice may be a moderated role playing game or policy exercise where actors are willing to reflect and discuss their own perspectives as well as listen to others. This type of social learning does not necessarily lead to consensus develops the ability to deal with differences constructively.

The overall social learning process in a group leads to input on how to move the state of the environment towards desired properties (technical qualities), and to social capital such as an increase in the capacity of a stakeholder group to manage a problem.

Table 2 summarizes results from the case studies in HarmoniCOP regarding factors that constrain and support social learning (Tippett et al, 2005; Mostert, et al, in press).

Table 2: Factors that constrain and support social learning

Factors constraining Social Learning	***Factors supporting Social Learning***
STRUCTURE - CONTEXT	***STRUCTURE - CONTEXT***
▪ Centralised political and economic systems	▪ Increased decentralisation of power

▪ Privatisation and commercialisation of environment. ▪ Bureaucratic systems. ▪ Political secrecy and poor public access to information.	▪ Move away from overregulated bureaucracy ▪ Political recognition of the positive value of the public voice ▪ Greater environmental awareness by members of the public ▪ Developing a more consensus based culture
PROCESS	***PROCESS***
▪ Lack of clear objectives & process for involvement ▪ Lack of time and effort taken to build trust ▪ Lack of process to explore common ground rules and manage conflicts constructively ▪ Lack of process to link planning at different levels of scale ▪ Ineffective communication of technical issues ▪ Non-communication of supposedly shared or common knowledge or premises	▪ Provision of sufficient time and resources ▪ Opportunities for participation early enough in process ▪ Use of facilitators and process management ▪ Definition of commonly accepted ground rules ▪ Explicit recognition of different perspectives ▪ Clear formulation of interests / illustrate the framing of the respective issue

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There is a recognized need for social learning processes in the transition towards integrated and adaptive management approaches, and a requirement for the insights on the nature of such processes and factors that constrain and support social learning. This gives rise to the question - what are the appropriate approaches to facilitate change?

5. HOW TO PROMOTE CHANGE?

Decisions and management of water resources do not take place in isolation but are rather complex political processes that take shape at different political levels (cf also Figure 1).

- The **Context** level which incorporates the wider political and institutional environment which determines the governance structure.
- **Networks** (policy arenas) which determine actors and institutions, who is in and who is out of the process and thus also the boundaries and framing of the problems and solutions taken into account.
- **Games –** the level of rules, institutions that shape individual behaviour and collective negotiation, learning and decision making processes.

Understanding how at the level of context, networks and games, actors and institutions create perceptions and make use of tools is critical for an adaptive management of water resources. The coupling between the various levels shapes the outcome of water decisions and investments and hence determines the adaptive capacity of the water sector or of a specific river basin. Table 1 showed how perceptions, tools, actors and institutions can be used and applied at the network and game level in relation to managing rivers in the current state, which focuses on regulated and controlled rivers. This was then compared to a potential future state with more multifunctional and dynamic management of rivers that incorporates adaptation to change.

These ideas are worked into a coherent framework for analyzing the political context within which an adaptive capacity needs to be developed for river basin management. To do so, 12 political actions (PA) are described that actors need to consider if they wish to develop adaptive capacity for the management of a river basin. The case of the upper Rhone river is used to provide tangible examples for each of the 12 PAs. Examining the R3 project through the lens of the water management hierarchies framework demonstrates that elements of adaptive management are being used but there is considerable potential to do more through reframing and social learning. The challenge is to build further on each of the described political actions. Efficient application of adaptive management can ensure that a river basin such as the Rhone can respond to pressures such as climate change. If a river is widened sufficiently to take into account changes in flow due to climate change then the significant investment into watersheds will be worthwhile and have an effective impact.

Table 3: Water Management Hierarchies for adaptive management

Hierarachical Levels	Perceptions	Tools	Actors	Institutions
Level 1: Context level	***Shaping***	***Developing***	***Grouping***	***Creating***
Description • Applies to the national policy level • On a slow time scale of decades	→changing society wide views and ideas that shape the context within which networks are created and are functioning	→emergence of new tools relevant for policy networks and games can shift the tool options networks have at their disposal	→new groups of actors are created from which actors for the network can be selected	→setting up new (groups that that can be a driver of
Leading Example	*e.g. changing societies perception of full protection from floods (flood control) to an acceptable risk (flood risk management) changes the context and solutions space*	*e.g. advanced modelling of unguaged basins can form the basis of a series of new tools actors can choose from*	*e.g. strengthening civil society can create a group of new actors relevant for water policy and management networks*	*e.g. creating a ministry of resources that pulls togeth different strands of water r a single ministry*
Level 2: Network level	***Reframing***	***Selecting***	***Activating***	***Reforming***
Description	→changing actor's perceptions of the network, its role, goal, structure and functions	→choosing the tools or changing the tools with which the network can alter the functioning of the network	→bringing new actors or changing (network) positions of existing actors	→changing rules and reso networks that change func network's structure and fu
Leading Example	*e.g. changing the perception that a flooding problem can only be solved in the floodplain to a basin wide approach can change the flood network membership and ways of working*	*e.g. the use of facilitation tools during water meetings can alter the way that actors interact, their level participation and the quality of the discussion*	*e.g. involving a wider group of actors such as business representatives or downstream riparians can alter the functioning of the network*	*e.g. setting-up a small gra that assists civil society gr prepare for and participate water meetings*
Level 3: Game level	***Convenanting***	***Using***	***Switching***	***Arranging***
Description • Individuals and organizations • Decisions are made over months	→exploring similarities and differences in actor's perceptions and the opportunities that exist for goal convergence using the 'rules of the game'	→changing the access to and ability of actors to use tools	→(de) mobilising actors possessing resources to (un)block the game	→creating, sustaining and hoc provisions which suit g institutions
Leading Example	*e.g. using interest based negotiations to define what water users wish to achieve rather then position based negotiations that only defends a status quo*	*e.g. building the capacity of actors to use decision support systems in water management can shift the balance the game*	*e.g. temporarily working with only a sub-set of network actors that are powerful can help find a partial solution for a water allocation*	*e.g. the chairmanship of a be given to one particular particular point in time to f breakthrough*

5.1 The Context Level

The Context Level refers to the wider context within which river basin management takes shape. It refers to societal views, cultural norms, (national) constitutions and laws, the approaches and tools used for management and the existing landscape of actors and organisations. The Context Level has been formed over longer periods of time: decades or even centuries. It typically affects the management of several river basins as it constrains and determines practices at larger spatial scales - countries or (economic) regions.

Shaping & Developing

Actors at the Context Level sometimes have the possibility or can create the opportunity to change societal views which determine how a problem can be framed. They also might have the opportunity to change existing water policies at national or regional level in such a way that water problems can be framed differently. As such actors and organisations can *SHAPE* the context and discourse within which networks are managed and games being conducted.

For the management of the Upper Rhone basin, the context is, amongst others, defined by the Swiss and French constitutions and the water management organisations in both countries. Increasingly though this context is changing through the implementation of the EU Water Framework Directive, Nature 2000 directive and other EU Directives. In France for example, the established water organisations are challenged by the obligation to allow for much wider public participation in decision making (Pflieger 2006). Furthermore societal perceptions are (slowly) changing in both Switzerland and France. In Switzerland, rivers are increasingly viewed as important recreational and nature areas and not only as conduits of irrigation water or drains of storm water (ProNatura 2006). However, at the same time the opening of the European energy markets has generated interest from Swiss electricity companies to generate hydropower to service peak power demands (e.g. on Monday mornings). The generation of this power results in significant fluctuations in river levels throughout the upper Rhone river system at short time intervals impacting negatively on the Rhone river's ecology (Meile et al. 2005).

New tools or mechanism can be *DEVELOPED* that can change the way networks and policy actors find solutions for water allocation problems. For example, the 'green power tool' allows Swiss electricity companies to generate 'Green Hydropower' that can be sold for a premium price. In the upper Rhone valley, the hydropower plant 'Pont-de-la-Tine' is currently operating using the 'NatureMade' certification label (Romande Energie 2005). The plant generates electricity but also leaves residual water in the river to maintain the downstream river ecology. Though the capacity of this plant is small, it is still significant as it demonstrates that hydropower generation can be combined with ecological objectives. It also shows that a new tool can change the way water is managed and even create a 'win-win' situation, in this case at the local level.

Grouping & Creating

Stakeholders in river basins and at national levels often cluster in different *GROUPS* that hold similar views or interests. Creating or (re-)grouping actors either at national levels or within a river basin can help to change the way a policy network is managed or functions. This type of grouping has been done to an extent in the Rhone river basin where stakeholders at the internal and external levels. At the internal level, the heads of government departments are grouped into the Steering Council (described further below) and are in charge of strategy and project implementation. At the external level, there are thematic and local/regional groups. The thematic group consists of various sub groups of actors that represent different sectors of interest (tourism and leisure, the environment, the economy, agriculture, land and safety). The local/regional groups represent local/regional interests of communities or municipalities, which are represented by regional Steering Committees (HarmoniCOP, 2005).

While different actors can cluster in different ways, another option is to *CREATE* new (groups of) institutions. This often happens at the national level when a new water policy is developed and the existing institutional set-up needs to be brought in-line with the policy. A typical mechanism in water management is the creation of a national level coordinating body. This body then includes representatives from different ministries that each has responsibilities for some aspects of water management, such as water quality monitoring, operation and maintenance of river infrastructure, hydropower generation, irrigation and drainage development and maintenance etc. The State council of the Canton Valais created a number of institutional bodies to direct the implementation of R3. The Steering Council or the Conseil de Pilotage (COPIL) consists of representatives from various federal offices including the Office of Water and Geology, the Department of Transport, Infrastructure and the environment, as well as external stakeholders in the form of association of municipalities and organisations (Canton du Valais, 2005; HarmoniCOP, 2005). Although this group was specifically created for the R3 project, it could be useful to create more dynamic groups that fully incorporates external stakeholders from the very beginning of the planning process.

5.2 The Network Level

The Network Level refers to the provincial context of river basin management. It includes interactions between actors across organizations at the basin level, and is influenced by the context level. The network level refers to the relationships established between interdependent organisations, and how they cooperate (or don't cooperate). The context level determines how the network level will be formed and how it will function, and in turn the network level will determine how organizations will play the game (i.e. their approach to decision making, their attitudes to new tools for river basin management). The Network Level is formed over years and usually applies to the management of a regional river basin.

Reframing and Selecting

As previously mentioned, social learning includes reframing of problems to make sense of available information and how it can be used in adaptive river basin management. *REFRAMING* changes the perception of the network's role, goal, structure and functions. Problems can be redefined and possibly solved using different approaches derived from reframing. However, reframing can be a long process, as perceptions are rooted in mental constructs derived from past experiences (Kickert et al., 1999). Often actors within a network will need to go through a learning process to understand how reframing occurred and why. In addition, the network can also be used as a tool to bring forward ideas and redefine river management problems into a more manageable form. In the case of the R3 project, reframing should occur around the main project goals (ensuring safety from floods), changes in the river landscape and its use to change the view from flood management to watershed management. The impacts of climate changes and uncertainties need to be incorporated so that the management plan is adaptive and flexible to changing events.

Traditional instruments such as existing regulations used for river basin management may not be very effective within a network; instead instruments must be *SELECTED* and altered to fit the frame of reference of the network. Legal, economic and communicative tools within a network must be able to be deployed at a horizontal level across the network as opposed to the vertical top-down approach. Although tools are what enable networks to function, they need to fit into the network structure within which they are used. The tools selected and adapted for the network depend on the actors that make up the network and the relationships that exist between the actors (Kickert et al., 1999). Tools introduced to the R3 project such as the www.rhone.vs site were implemented to facilitate social learning in the general public but had limited outreach to stakeholders (HarmoniCOP, 2005: Canton du Valais, 2005). The use of geographical information systems and other computer graphic displays such as Auto Cad and Power Point were found to have some success in facilitating dialogue and understanding of the R3 project (Luyet, 2005). The Canton of Valais has produced a report on the structural plan for the third correction, as well as maps for each commune displaying land use and flood prone areas along the Rhone (Canton du Valais, 2005). These types of visual tools can aid in understanding the problems and help stakeholders in the network with reframing their understanding of the extent of the ecological and social issues to be tackled in the Rhone floodplain.

Activating and Reforming

Sometimes new actors are *ACTIVATED*, created or brought into a network to carry out functions needed to manage the network. The introduction of new actors can occur by setting up or reorganizing a commission, recruitment, and bringing in an advisor (Kickert et al., 1999). For example, an association of business owners could be created to take part in public participation discussions on flood plain management in order to ensure the interests of the business community are represented. Introducing a new party into a network does not automatically solve problems and create new ideas; rather they develop through the course of interaction. Including organizations in public discussions is only useful and representative if they are actively involved in the network and their input is considered important to the decision making process. In the Rhone example, new actors were brought into thematic working groups within the R3 project by the State Council of the Canton Valais to ensure representation of interests outside government. The stakeholders include five municipalities, the Sierre region association and six different regional associations representing agriculture, ecology, environment and nature protection (HarmoniCOP, 2005). It would be useful to also bring in new actors with specific knowledge on climate change and ideas on adaptation within the river basin.

Reframing problems in discussions will lead to actual reformation through action. For example, institutions that are created or activated can be part of the *REFORMING* process in a network. Policy processes in networks can be unpredictable and complex. There are often a variety of actors whose preferences can change during the course of interactions. Consequently, rules and resources within networks can change leading to structural and functional shifts. However, networks do not function without management, which can be seen as promoting the mutual adjustment of the diverse objectives of actors, and ensuring a cooperative strategy with regard to tackling problems (Kickert et al., 1999). Network management steers the process of reforming as perceptions shift and actors enter and leave the network. In the R3 project, new actors brought into the river basin network in the Canton of Valais can be a mechanism to reform project organization and ensure the participation and perspective of external stakeholders.

5.3. <u>The Game Level</u>

Networks, which are the relation patterns between actors, are the context in which games take place. At the same time, the games change and influence the shape of networks. Actors within networks choose game strategies (i.e. policy making processes) that seem rational according to the network they interact with, their individual goals, and the overall context of the policy making process. Furthermore, actors driving river basin management at the game level are influenced by other forms of management (i.e. agricultural management) and the relationships developed in the network through present and past interactions. A characteristic feature of a game is that the result derives from the interaction between the strategies of all actors involved (Kickert et al., 1999). The rules of the game put constraints on actors but are at the same time the product of their interactions (Kickert et al., 1999).

The Game Level includes individuals and organizations which are making decisions over periods of several months. These decisions are steered by context and network structure, but also have an upward impact that can shape interactions within the network level, leading to shifts in the context level. Actors perceptions undergo incremental change during games due to interaction or confrontation with other actors' perceptions (Kickert et al., 1999).

Convenanting and Using

CONVENANTING refers to a management strategy aimed at improving the consistency of decisions made in the game by exploring and consolidating perceptions of actors (Klijn and Teisman, 1997). Consistency is improved through social knowledge and learning, which involves changes in norms, practices and behaviour as well as changes in perception and understanding among stakeholders. This management strategy uses the informal rules that exist in a meeting, committee or organization to manage the participants. The convenanting concept is used to emphasize that specialized actors (i.e. network managers) have potential for enriching new initiatives. An effective network manager will interlink specialized initiatives in order to improve the policy initiative around which a game is constructed (Klijn and Teisman, 1997). Convenanting in the R3 project occurred to an extent as the Regional Steering Committee was involved in workshops where actors representing various interests learned and discussed the advantages, disadvantages and consequences of implementing the plans of the 3rd correction, as well as ensured that participants understood the rules of the game (i.e. the boundaries in which they have to make decisions). Workshops and discussions promote social learning, allow actors to make informed decisions and work towards goal convergence using the rules of the game.

For a management strategy to achieve its goals a process of social knowledge and learning progression is undertaken by actors involved in a game. Actors may need to be trained to *USE* the tools they need to be effective in playing a game. For example, a toolkit for environmental flows can be developed to guide river basin management but it may be of little use unless the actors are trained in how to apply the knowledge from the toolkit. This learning can evolve over time through interactions with other actors or through active training courses. The result is that the actors can shift the balance of the game as their perceptions change. As previously mentioned, a few visual tools were selected to help stakeholders in facilitating constructive dialogue. Taking photographs was a tool employed to help stakeholders identify their objectives in the participatory process in the R3 project. Participants were asked to take pictures of what they thought was beautiful, ugly, unsustainable and attractive to tourists in the river basin, then elaborate why they took each picture. This approach was used to get stakeholders to think about how to transform their theoretical knowledge into concrete pictures (Luyet et al., 2004). This approach is a good start but application of tools and training should be taken further and incorporate adaptive management to climate change and uncertainties.

Switching and Arranging

Policy making processes can be improved by *SWITCHING* on specific participants. Selective activation demands that managers assess which actors are essential at given moments in a policy process, whether and how to involve them. Success of activating and deactivating depends on choosing the appropriate actors, as well as the willingness of actors to invest time and resources in a policy process. The R3 project involves internal and externals actors at the federal, canton and municipal levels, as well as independent organisations concerned with ecology, agriculture, business and land ownership. R3 depends on activating or deactivating the different stakeholders at the appropriate levels to determine solutions to problems such as water allocation. There is no point in engaging actors in a game if they do not possess the necessary resources to actively participate. If the input of a set of actors is considered essential to the policy process then tools must be used to ensure that they have the needed capacity to participate,

ARRANGING refers to the capacity of the participants involved to develop platforms on which games can be played and to the capability of the participants to develop or use rules for interaction (Kickert, 1999). Arranging includes creating, sustaining and changing ad hoc provisions to suit various situations or games (Klijn and Teisman, 1997). Arrangement as a management activity is the art of linking interdependent actors in such a way that the arrangement costs are low and do not result in high transaction costs (Kickert, 1999). Arrangement in the R3 project can refer to the evolution of the structure of the project and relationships between stakeholders. Different actors may be brought in or new relationships forged in order to change the status quo and move forward on an issue.

6. Requirements and challenges for the implementation of adaptive management in upland riversheds

The analysis in the previous section provides evidence that there have been opportunities to engage in a dialogue that could influence a change in management practices in the Rhone case but further development in all political actions is needed to implement effective adaptive management practices. Undergoing reframing and the process of social learning can open up discussions to alternative perspectives, solutions and other stakeholders. Social learning leading to change requires leadership and clear commitment from those designing and coordinating the process. Developing adaptive capacity with a long term vision would be a wise strategy rather than responding to disaster and escalating conflicts.

Currently, adaptive management in relation to climate change is limited in prevailing designs, practices and ideas surrounding river basin management. Therefore, reframing issues of river basin management to include climate change scenarios may aid in shifting the focus from flood management to a wider basin management view that includes storage and buffering of flow and capacity upstream (Dyson et al, 2003). Another example of the importance of adaptive management pertains to ecological restoration. If ecological restoration of a watershed is narrowly defined (i.e. – one section of a river) then the results are unlikely to be sufficient to significantly justify investment, as other sections of the river will not be restored and benefits will be minimal.

Drawing on the conceptual and empirical analyses it is possible to make a number of recommendations for policy making to develop, implement and sustain adaptive management practices in upland riversheds facing increased uncertainty due to global and climate change:

- The complex socio-ecological nature of river basin environments and the inherent uncertainties associated with their management have to be taken into account in policy development and implementation.
- Selected management strategies should be robust and perform well under a range of possible, but initially uncertain, future developments.
- The design of transparent and open social learning processes is a key requirement of sustainable water management regimes.
- Effort has to be devoted to building trust and social capital for problem solving and collaborative governance.
- An increase in, and maintenance of, the flexibility and adaptive capacity of water management regimes should be a primary management goal

- Trust in a collaborative process is a more robust strategy in conditions of uncertainty then any belief in prediction and control.
- Entrenched perceptions and beliefs block innovation and change. Space has to be provided for creative and out-of-the-box thinking
- There is a significant need to train a new generation of water management practitioners skilled in participatory system design and implementation.

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