NeWater

The role of adaptive and integrated water management (AIWM) in developing climate change adaptation strategies for dealing with floods or droughts

A formal comparative analysis of eight water management regimes in Europe, Asia, and Africa

Task 1.7.9b

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Executive Summary

This Deliverable 1.7.9b contains an assessment and formal comparative analysis of the role of adaptive and integrated water management (AIWM) in developing climate change adaptation strategies in eight case-studies in Europe, Asia and Africa. The analysis comprises several regime elements considered to be important in adaptive and integrated water management: agency, awareness raising and education, type of governance and cooperation structures, information management and –exchange, policy development and –implementation, risk management, and finances and cost recovery. This comparative study has an explorative character intended to identify general patterns in adaptive and integrated water management, and to determine its role in developing climate change adaptation strategies to deal with either floods or droughts.

This Deliverable 1.7.9b builds on the research carried out in the EU NeWater Project. The data was collected through 81 interviews with stakeholders representing national (ministries, water authorities, planners, academic institutions) and local organizations (NGOs, water boards, municipalities, farmers), and analysis of documents on water policies and other project plans.

The results show that there is a strong interdependence of the elements within a water management regime, and as such this interdependence is a stabilizing factor in current management regimes. For example, this research provides evidence that a lack of joint/participative knowledge production is an important obstacle for cooperation.

For large-scale, complex multiple-use systems, such as river basins, this research suggests that bottom-up governance and decentralization is not a straight forward solution to water management problems. There will probably always be the need for a certain degree of top-down governance (or centralization), for example in the area of transboundary issues, capacity building, setting of standards and conflict resolution. All the case-studies in this research seem to be in a process of finding a balance between bottom-up and top-down governance. In other words, this research has found evidence that the NeWater working hypothesis of bottom-up governance as an appropriate approach for river basin management needs to be adjusted, since the case-study with the highest level of AIWM (= Rivierenland) is characterized by a combination of top-down and bottom-up processes. This is supported by the majority of experts in this research, indicating that there is a certain need for top-down governance in river basin management.

Nevertheless, we can also conclude that management regimes characterized by a high level of top-down governance are dominated by lower levels of learning (= single loop learning / ad-hoc problem solving), such as the management regimes in the Alentejo Region, AmuDarya and Kagera Basin. This lower level of learning is being reflected and/or consolidated in less advanced adaptation strategies. Also the Hungarian part of the Tisza is characterized by top-down

governance, although they have managed to develop an advanced adaptation strategy (new Vásárhelyi Plan (VTT), 2003), probably caused by the existence of a shadow network in this specific case-study. The VTT is an excellent example of double loop learning and a modified flood defence strategy by local actors and research institutions. However, the current implementation of this plan is seriously hampered, since the centralized management system has not managed to find agreement between different Ministeries on allocation of the necessary (financial) resources. In other words, a high degree of top-down governance seems to be a serious limiting factor in this case-study as well.

By analysing the relationship (by using mvQCA) between the level of AIWM and the levels of learning (being reflected in their adaptation stragegies) we can conclude that a relatively high score on **cooperation structures** or **information management** are causal conditions leading to at least double loop learning in Rivierenland, Ohre Basin, and Upper Vaal. In the case-studies were these conditions are less developed - like the Alentejo Region, AmuDarya and Kagera Basin - the strategies are characterized by single loop learning (ad-hoc problem solving). In other words, better integrated cooperation structures (including non-governmental stakeholders, governments from different sectors and different hierarchical levels), and advanced information management (including joint/participative information production, consideration of uncertainties, and broad communication) are the key factors leading towards higher levels of learning, being reflected and/or consolidated in more advanced adaptation strategies for dealing with either floods or droughts.

Finally, this research shows that in a basin where one type of extreme is dominant – like droughts in the Alentejo (Portugal) and floods in Rivierenland (Netherlands) - the potential impacts of other extremes are somehow ignored or not perceived with the urgency they might deserve.

Key words: *formal comparative analysis, adaptive and integrated water management (AIWM), water management regime, river basin management, adaptation strategies, climate change, floods, and droughts, levels of learning, double loop learning, triple loop learning.*

Contents

Chapter 1 Introduction

The challenges posed by climate-related extreme events to river basins are manifold, especially since water resource issues interact with a wide range of environmental and socio-economic sectors including health, public safety, agriculture, biodiversity, industry, navigation, and tourism. According to the Intergovernmental Panel on Climate Change (IPCC, 2007) an increase in the surface temperature of water, and changes in the hydrological cycle could result in changing rainfall patterns. Some areas may experience intense rainfall resulting in heavy floods, while other areas may witness less rainfall, and also frequent droughts.

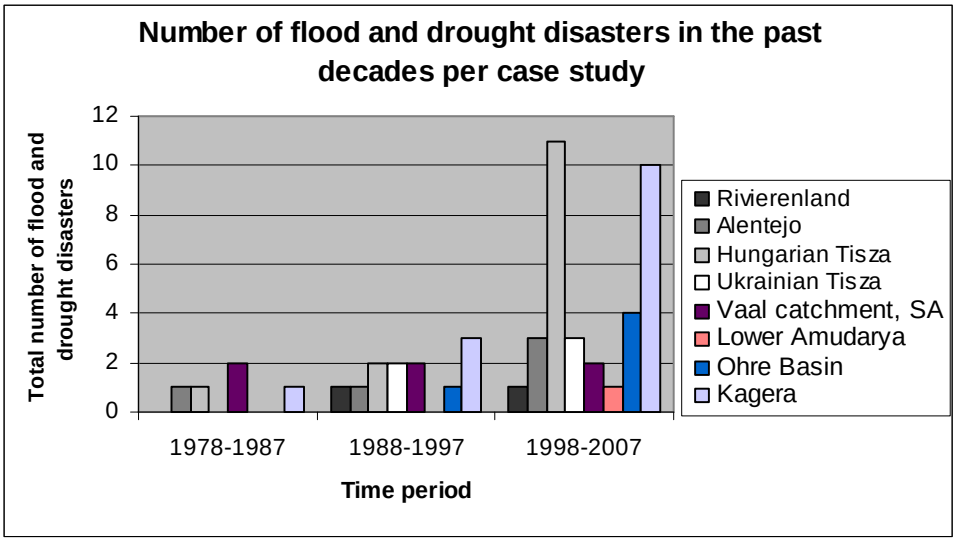

Figure 1 – Number of reported flood and drought disasters in the past decades in eight sub basins under investigation. Based on data from EM-DAT: The OFDA/CRED International Disaster Database, 2008

On a global scale the number of disasters caused by weather-related phenomena such as storms, floods and droughts has more than doubled over the past decade, from 175 in 1996 to 391 in 2005 (IFRC, 2007). The same trend (Figure 1) is being observed in the case-studies under investigation. The case-studies in this paper include eight sub-basins in Africa, Asia, and Europe:

- Rivierenland in the Netherlands, as a sub basin of the Rhine River Basin
- Alentejo region in Portugal, as a sub basin of the Guadiana River Basin;
- Hungarian part of the Upper Tisza;
- Ukrainian part of the Upper Tisza (also called the Zacarpathian Tisza);
- Ohre Basin in Czech Republic, as a sub basin of the Elbe River Basin;
- Kagera Basin in Uganda, Rwanda, Burundi and Tanzania, as a sub basin of the Nile River Basin;
- Lower AmuDarya in Uzbekistan, as a sub basin of the AmuDarya River Basin;

- Upper Vaal catchment in South Africa, as a sub basin of the Orange River Basin

The increasing frequency and intensity of floods and droughts is also being confirmed by the latest report of the Intergovernmental Panel on Climate Change (IPCC, Fourth Assessment Report, 2007), which argues that "there are multiple lines of evidence that climate change is happening now, and the impacts are being seen now". Given the expected increase of climate related extreme events, water management capabilities in the case-studies, and on a global scale, will be tested to their limits by the effects of climate change. This requires innovative and adaptive ways of managing water, which can be referred to as "Adaptive and Integrated Water Management" (AIWM). This paper addresses the role of AIWM in developing climate change adaptation strategies to deal with impacts of climate change on floods and droughts.

The characteristics (see next paragraphs) of AIWM are to be regarded as working hypotheses, since the change towards more adaptive management regimes is yet slow and empirical data and practical experience thus limited – in particular regarding the interdependence of elements of the management regime. The strong interdependence of the factors stabilizing current management regimes is also one possible reason for this lack of innovation. One cannot, for example, move easily from top-down to participatory management practices without changing the whole approach to information and risk management. Hence, research is urgently needed to better understand the interdependence of key elements of water management regimes and the dynamics of transition processes in order to be able to compare and evaluate alternative management regimes and to implement and support transition processes if required.

This article also adresses the question whether a higher level of AIWM is showing a different response in coping with floods and droughts than case-studies with a lower level of AIWM. This will be done by looking at levels of learning, being reflected and/or consolidated in the adaptation strategies to deal with floods or droughts.

This paper is focusing on conditions and processes at the sub-basin level (e.g. water boards), but being embedded in a wider context (e.g. institutional setting at different levels). The sub basin level is conceived as the level where all elements of a water management regime are at play. At the same time this level is influencing, or is being influenced by, higher and lower levels of management. This central position also allows for assessing the outcomes of a water management regime at the operational level, since the management on the sub-basin level (e.g. water board or regional water authority) is influenced by international or national regulation, while implementing at the operational/local level.

A calibrated approach (standardized questionnaires and interviews, expert judgement and reinterpretation of outcomes by means of relevant literature) was used to compare the state of affairs in water management in the selected case-studies.

1.1 Adaptive and Integrated Water Management

Despite the fact that the concept of Integrated Water Resources Management (IWRM)[1] is widely accepted as the appropriate framework to deal with complex water

1 One of the most often referred to definitions of IWRM is the one by the Global Water Partnership (GWP) defining IWRM as 'a process which promotes the co-ordinated development and management of water, land and related resources in order to maximise

resources management issues, the scientific base for IWRM is not yet fully developed. It lacks both empirical knowledge and concepts that allow effective transfer of successful experiences across basins and frontiers. More flexible approaches, such as adaptive water management, have been advocated as an essential and timely extension of the IWRM approach to improve the conceptual and methodological base to realize the goals of IWRM (Pahl-Wostl and Sendzimir, 2005; Moberg and Galaz, 2005; Pahl-Wostl 2007).

To deal with existing and new complexities water resources management must be able to respond to changes in the natural and social environment and to anticipate associated uncertainties (Folke et al., 2005; Pahl-Wostl et al., 2007). Adaptation to climate change and management of related risks should therefore be built into water resources management plans and programmes. Adaptive and integrated management is considered to be an appropriate approach for doing so. Adaptive and integrated management can be defined as a structured process for improving systemic management policies and practices by learning from the outcomes of implemented management strategies (Pahl-Wostl et al, 2007a). By re-evaluating goals, objectives and means how to achieve them as new information and insights become available, adaptive management is more responsive to changing conditions of and demands on ecosystems as compared to traditional approaches to water resource management.

AIWM requires different capabilities than traditional forms of water management, particularly when it comes to creating forms of collaboration between water managers and stakeholders, the relation between science and policy, the importance of participatory learning processes, dealing with uncertainty, and assessing a wide variety of possible measures and future scenario's. It requires many instances of social learning to implement and sustain innovative management approaches (Pahl-Wostl, et al, 2007). As e.g. Folke et al. (2005) have pointed out, social learning is needed to build up experience for coping with uncertainty and change. They emphasize that "knowledge generation in itself is not sufficient for building adaptive capacity in social-ecological systems to meet the challenge of navigating nature's dynamics" and conclude that "learning how to sustain social-ecological systems in a world of continuous change needs an institutional and social context within which to develop and act". Knowledge and the ability to act upon new insights are continuously enacted in social processes. The social network of stakeholders is an invaluable asset for dealing with change. Since social learning is an important prerequisite for AIWM the variables in the analytical framework for AIWM (see table 2) incorporate a range of indicators for stakeholder involvement and the existence of a social network in different elements of the management regime, such as in existing cooperation structures, information management, policy development and -implementation, and risk management.

In technology dominated water management practice, design and structure of governance regimes has not played a prominent role. Adaptive and integrated water management implies a real paradigm shift in water management from what can be described as a prediction and control to a management as learning approach. Such change aims at increasing the adaptive capacity of river basins at different scales and implies a change in the whole water management regime (Pahl-Wostl, 2007). Some structural requirements for a water management regime to be adaptive are

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the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.' (GWP-TEC, 2000).

summarized in table 1. Two different regimes characterized by two different management paradigms – management as control versus management as learning - are contrasted as the extreme, opposing ends of six axes.

Table 1: Different regimes and their characteristics (From: Pahl-Wostl *et al.*, 2007a)

Dimension	Prediction, Control Regime	Integrated, Adaptive Regime
Governance	Centralized, hierarchical, narrow stakeholder participation	Polycentric, horizontal, broad stakeholder participation
Sectoral Integration	Sectors separately analysed resulting in policy conflicts and emergent chronic problems	Cross-sectoral analysis identifies emergent problems and integrates policy implementation
Scale of Analysis and Operation	Transboundary problems emerge when river sub-basins are the exclusive scale of analysis and management	Transboundary issues addressed by multiple scales of analysis and management
Information Management	Understanding fragmented by gaps and lack of integration of information sources that are proprietary	Comprehensive understanding achieved by open, shared information sources that fill gaps and facilitate integration
Infra-structure	Massive, centralized infrastructure, single sources of design, power delivery	Appropriate scale, decentralized, diverse sources of design, power delivery
Finances and Risk	Financial resources concentrated in structural protection (sunk costs)	Financial resources diversified using a broad set of private and public financial instruments

Chapter 2 Analytical framework

2.1 Analytical framework for AIWM

The green box in the analytical framework (figure 2) for comparative analysis incorporates the key elements of AIWM as being described above.

The factors which are considered important in Adaptive and Integrated Water Management (AIWM) are predominantly based on working hypotheses (see table 1) on the characteristics of management regimes developed in the context of the European project NeWater[2] (Pahl-Wostl et al., 2005). Moreover, additional variables were included based on related literature. This resulted in an analytical (sub) framework for AIWM (see green box in figure 2), consisting of nine different categories of variables: 1) Agency, 2) Awareness Raising & Education, 3) Type of governance, 4) Cooperation structures, 5) Policy development & implementation, 6) Information management & sharing, 7) Finances and cost recovery, 8) Risk management, and 9) Effectiveness of (international) regulation.

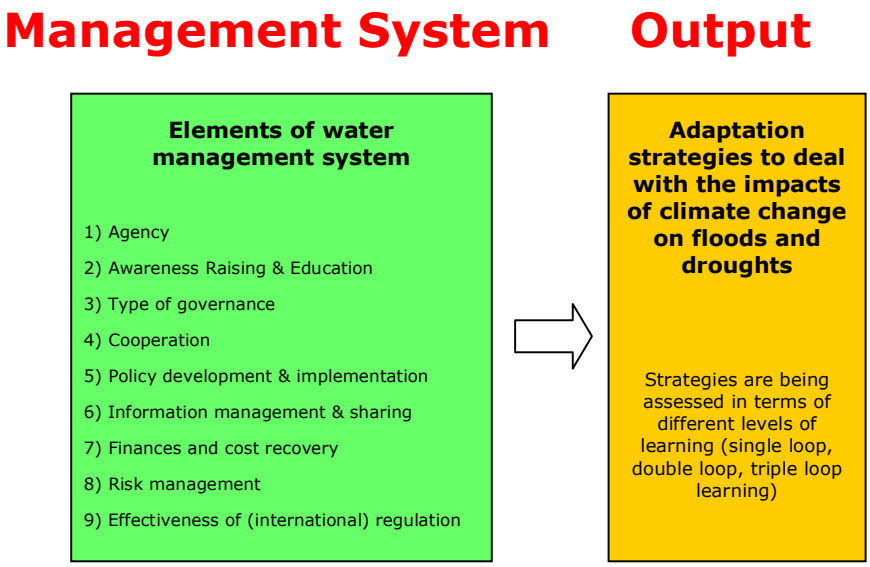

Figure 2 – Analytical framework for explorative research in order to identify general patterns in the characteristics of Adaptive and Integrated Water Management (AIWM). The elements of the management regime (in green box) are based on working hypotheses (see table 1) on the characteristics of management regimes developed in the context of the European project NeWater (Pahl-Wostl et al., 2005), and additional variables have been included based on related literature (presented in previous paragraphs and in table 2).

[2] The NeWater (New approaches for adaptive water management under uncertainty) project is a large European project funded under the 6th Framework Programme of the EU. URL: www.newater.info

Based on relevant literature each category was operationalised into specific variables, including single or multiple indicators for each variable. The operationalisation resulted in 33 variables; comprising 62 indicators (see Table 2). Each category in table 2 provides references to relevant literature being used.

An important assumption in the analytical framework is that effective AIWM is able to facilitate a change in strategy, as being an adaptation to climate change. As such, there is a reciprocal relationship between AIWM and the development of adaptation strategies. Moreover, our assumption is that this relationship is reciprocal only in a situation of bottom-up governance, including real participation of non-governmental stakeholders, but also from different government sectors, lower levels of government, and downstream stakeholders. This bottom-up process is emerging from partnerships and networks (Geels et al., 2004).

Table 2 – Overview of variables and indicators for AIWM

Category	Criteria	Indicator
1) Agency[1]	A. Type of leadership (in dealing with climate-related extreme events)	Mobilization of allies
		Taking advantage of exogenous factors (e.g. taking action when political climate is right)
		Barriers are dealt with effectively, causing no serious delays or problems
		Leadership is proactive; anticipates on problems
	B. Level of cohesion	Leadership is able to formulate and articulate internally consistent policy preferences
	C. Level of authority	Leadership has authority to act externally, in particular the legal competence in given subject matter
2) Awareness raising & education[2]	A. Public awareness programs	Public awareness programs for / on water management are regularly implemented in collaboration with civil society organizations + media
	B. Water education in school programs	IWRM is regularly introduced in school programs; and with potential to be an integral part of school curricula
	C. Water education for water professionals	IWRM is regularly introduced in educational/capacity building programs
3) Governance[3]	A. Type of governance	Consensual (bottom-up) governance vs top-down governance (governance by government)
4) Cooperation (Formal and informal actor networks)[4]	A. Level of, or provisions for, stakeholder participation	Legal provisions concerning access to information, participation in decision-making (e.g. consultation requirements) + access to courts
		Co-operation structures include non-governmental stakeholders
		Non-governmental stakeholders actually contribute to agenda setting, analysing problems, developing solutions and taking decisions ("coproduction")
		Non-governmental stakeholders undertake parts of river basin management themselves, e.g. though water users' associations
	B. cross-sectoral cooperation	Sectoral governments actively involve other government sectors
		Co-operation structures include government bodies from different sectors; many contacts generally
		Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed
	C. cooperation between administration levels	Lower level governments are involved in decision-making by higher level goverrments.
		Co-operation structures include government bodies from different hierarchical levels; many contacts generally

		Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed
	D. cooperation across administrative boundaries	Downstream governments are involved in decision-making by upstream governments
		International/ transboundary co-operation structures exist (e.g. river basin commissions); many contacts generally
		Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed
5) Policy development and implementation[4]	A. time horizon	Solutions for short term problems do not cause more problems in the (far) future (20 years or more)
		Already now preparations are taken for the (far) future (> 20 years)
	B. flexible measures, keeping options open	Measures taken now or proposed for the near future do not limit the range of possible measures that can be taken in the far future and are preferably reversible.
	C. experimentation	Small-scale policy experiments take place/are financially supported.
	D. consideration of possible measures	Several alternatives and scenario's are discussed
		Alternatives include small and large-scale and structural and nonstructural measures
	E. Actual implementation of policies	Plans and policies are actually implemented
		Policies are not dogmatically stuck to when there are good reasons not to implement policies, such as new / unforeseen circumstances and new insights
		Formation and documentation of high-level steering committee meetings for project preparation and implementation
	F. Monitoring & Evaluation	Adoption of an M&E plan during project preparation that includes establishment of process indicators, stress reduction indicators, and environmental status indicators.
6) Information management and sharing[4]	A. Joint/participative information production	Different government bodies are involved in setting the TORs and supervising the search, or at least consulted (in interviews surveys)
		Idem for non-governmental stakeholders
	B. Interdisciplinarity	Different disciplines are involved in defining and executing the research: in addition to technical and engineering sciences also for instance ecology and the social sciences
	C. Elicitation of mental models/ critical selfreflection about assumptions	Researchers allow their research to be challenged by stakeholders and present own assumptions in as far as they are aware of them
		Research results are not presented in an authoritative way, but in a facilitative way, to stimulate reflection by the stakeholders about what is possible and what it is they want
	D. Consideration of uncertainty	Uncertainties are not glossed over but communicated (in final reports, orally)
		Researchers are willing to talk with stakeholders about uncertainties
	E. Broad communication	Governments exchange information/data with other governments
		Governments actively disseminate information and data to the public: on the Internet, but also by producing leaflets, though the media, etc.
	F. Utilization of information	New information is used in public debates (and is not distorted)
		New information influences policy
	G. Decision support	River basin information systems (DSS) are up to standards
7) Finances and cost recovery[4]	A. Resources	Sufficient (public and private) resources are available
	B. Cost recovery	Costs are recovered from the 'users' by public and private financial instruments (charges, prices, insurance etc.)
	C. Allocation of resources	Authorities can take loans and depreciate their assets, to facilitate efficient use of resources and replacement of assets
		Financial resources diversified using a broad set of private and public financial instruments
	D. private-public RBM	Wide-spread private sector participation in river basin management

8) Risk management[5]	A. Risk perception	Both formal expert judgment and risk perceptions by the stakeholders
	B. Decision-making on acceptable risks	Non-governmental stakeholders are involved in decisions on what are acceptable risks
	C. insurance against risk	Insurance against housing and property damage is available > non-adaptive
		Harvest insurance mechanisms are available > non-adaptive
9) Effectiveness of (international) regulation*	A. Level of compliance	To which extent are coercive sanctions used as legitimate means of generating compliance in hierarchical context?
		To which extent are coercive sanctions used as legitimate means of generating compliance in institutionalized horizontal setting, in other words, does compliance with regulations vary with the availability of information, institutionalized horizontal coercion, shaming, and adjudication, among other things?
		Are there any softer paths to compliance in place (e.g. capacity building, legitimacy building, and the voluntary internalization of law)?
	B. Adoption of international regulation	Country adoption of specific water, environment, or sector related legal reforms, policies, institutions, standards, and programs necessary to address the transboundary priority issues, including stakeholder participation programs
		County ratification of the regional or global conventions and protocols
		High-level political commitment to follow up joint action as signified by, among other things, ministerial level declarations or adoption of a joint legal/institutional framework
		Country commitments to report progress in achieving stress reduction indicators as well as environmental status data to the regional/joint institution
		Incorporation of country assistance strategies (CAS) in the World Bank or regional development bank or UNDP country-level strategic results framework

[1] Based on Giddens (1986), Wendt (1995), Jupille and Caporaso (1998), Grin *et al*., 2004, Voß and Kemp (2005), and Folke *et al*. (2005), Bos & Grin (2008).

[2] Based on Savenije and van der Zaag (2000).

[3] Based on Pahl-Wostl *et al.* (2005), Ostrom (2005), and Olsson *et al*. (2006).

[4] Categories 4, 5, 6 and 7 are for a large part derived from the River Basin Assessment-framework being developed by Raadgever and Mostert (2005).

[5] Based on Pahl-Wostl *et al.* (2006)

* Based on Ostrom *et al*. (1994), Weiss and Jacobson (1998), Weinstein (2000), Tietenberg *et al*. (2001), Nash (2002), Dietz, *et al,* (2003), Lamy (2005), and Young and Zürn (2006).

2.2 Analytical framework for levels of learning

Next to the elements of AIWM the analytical framework also describes the outputs of management regimes, being defined as the adaptation strategies to deal with either floods or droughts (see orange box in figure 2). It should be taken into account that the management regimes may be currently in the process of developing climate change adaptation strategies to deal with floods and/or droughts. In other words, even when a new management regime has been established it may not have achieved its projected outputs (and/or outcomes) yet. Hence, the outcomes of these adaptation strategies are largely unknown at present. Most of them have only recently been introduced and there has not been enough time to test their appropriateness and effectiveness.

The adaptation strategies curently in place are being assessed in terms of different levels of learning. It is important to take into account that learning may have different levels of intensity (Pahl-Wostl et al 2007, 2008). These levels are addressed in the concept of double loop learning (Argyris, 1999) or even triple loop learning (Hargrove, 2002), an extension of the double loop concept represented below.

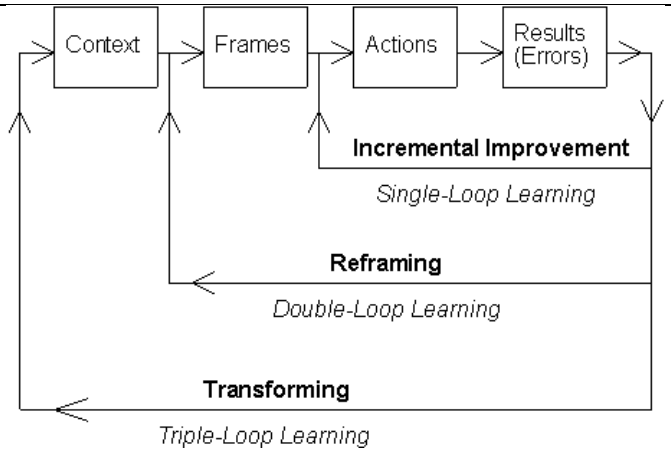

Figure from Hargrove Masterful Coaching, 2002.

In order to distinguish different learning processes and how to classify them according to the triple loop concept it is useful to start with some definitions:

- **Single loop learning (SLL)** – refine established actions to improve performance without changing guiding assumptions or without taking entirely alternative actions into account (e.g. increase height of dikes to improve flood protection).
- **Double loop learning (DLL)** – change frame of reference and guiding assumptions (e.g. increase boundaries for flood management and encourage collaboration across national boundaries in large river basins).
- **Triple loop learning (TLL)** – transformation of context to change factors that determine the frame of reference. This kind of learning refers to transitions of the whole regime. Values and norms are shaped and stabilized by the structural context.

Below paragraphs intend to make the concepts of single, double, and triple loop learning more tangible (based on relevant literature), for the purpose of developing an operational framework to distinguish between different levels of learning.

Types of Complexity—Why Double and Triple-Loop Learning Are Needed

When there are low levels of complexity, single-loop learning often will be enough to stay on track (Kahane, 2004). Simple problems can be solved using processes that:

- focus on the parts of a problem in isolation,
- rely heavily on what has worked in the past or elsewhere ("best practices"), and
- are open to solutions proposed by leaders or experts.

When the levels of complexity in our work and the issues we are working with are high, it becomes more critical for us to be able to also use double- and triple-loop learning to:

- succeed in new contexts,

- make learning an integral activity, and
- ultimately to achieve results.

According to Kahane (2004:31) problems of high social complexity cannot be peacefully solved by authorities from a top-down perspective; the people involved must participate in creating and implement solutions. As we focus on lasting change in the community, we are dealing with increasingly high levels of three types of complexity where success only comes through using processes that (based on Kahane, 2004):

- focus on working with all the parts as a single system,
- accept that solutions emerge as situations unfold, and
- involve the concerned people in developing the solutions.

Type Of Complexity	Low	High
Dynamic Focus is on various parts or the whole system?	Cause and effect are close together in space and time. Solutions can be found by testing and fixing one part at a time.	Cause and effect are far apart in space and time. Solution can be found only when situation is understood systemically, taking account of the interrelationships among the parts and the functioning of the system as whole.
Generative Solutions are planned or emergent?	Future is familiar and predictable. Solutions from the past or other places can be repeated or replicated.	Future is unfamiliar and unpredictable. Solutions cannot be calculated in advance based on what has worked in the past. Emergent solutions have to worked out as situations unfold.
Social Solutions come from leaders or from participants?	People involved have common assumptions, values, rationales and objectives. A leader or expert can propose a solution with which everyone agrees.	People involved look at things very differently. Solutions cannot be given by authorities; the people involved must participate in creating and implementing solutions.

Adapted from Adam Kahane: *Solving Tough Problems*, San Francisco: Berrett-Koehler, 2004.

Single loop learning (SLL): For Argyris and Schön (1978: 2) learning involves the detection and correction of error. Where something goes wrong, it is suggested, an initial port of call for many people is to look for another strategy that will address and work within the governing variables. In other words, given or chosen goals, values, plans and rules are operationalized rather than questioned. According to Argyris and Schön (1974), this is single-loop learning.

According to Adam Kahane (2004) single-loop learning assumes that problems and their solutions are close to each other in time and space (though they often aren't). In this form of learning, we are primarily considering our actions. Small changes are made to specific practices or behaviors, based on what has or has not worked in the past. This involves doing things better without necessarily examining or challenging our underlying beliefs and assumptions. The goal is improvements and fixes that often take the form of procedures or rules. Single-loop learning leads to making minor fixes or adjustments, like using a thermostat to regulate temperature.

> **SLL > Single-loop learning seems to be present when goals, values, frameworks and, to a significant extent, strategies are taken for granted. The emphasis is on 'techniques and making techniques more efficient' (Usher and Bryant: 1989: 87)**

Below paragraphs will elaborate on the concepts of double loop and triple loop learning, although it is not always easy to distinguish them in practice. Nevertheless, the conceptual distinction is useful, especially since the triple loop learning concept (Hargrove, 2002) is a refinement of the original double loop learning concept by Argyris (1999), and as such it allows for a more detailed operationalization when assessing the water management regimes in this paper. Despite the fact that there is a conceptual difference between double loop and triple loop learning, this paper will make an operational distinction between single loop learning and 'at least double loop learning', for the purpose of obtaining a dichotomous outcome necessary for conducting a formal comparative analysis (see chapter 6). The latter category may include (elements of) triple loop learning, althought chapter 5 will show the difficulties in making an operational distinction between double loop and triple loop learning based on empirical data collected for this specific research.

Double loop learning (DLL): According to Adam Kahane (2004) double-loop learning leads to insights about why a solution works. In this form of learning, we are considering our actions in the framework of our operating assumptions. This is the level of process analysis where people become observers of themselves, asking, "What is going on here? What are the patterns?" We need this insight to understand the pattern. We change the way we make decisions and deepen understanding of our assumptions. Double-loop learning works with major fixes or changes, like redesigning an organizational function or structure. According to Argyris & Schon (1978, p.3) double-loop learning occurs when error is detected and corrected in ways that involve the modification of an organization's underlying norms, policies and objectives. They contend that organizations need to engage in both single- and double-loop learning; that is to say, deuterolearning. When an organization engages in deutero-learning its members learn about the previous context for learning. They reflect on and inquire into previous episodes of organizational learning, or failure to learn. They discover what they did that facilitated or inhibited learning, they invent new strategies for learning, they produce these strategies, and they evaluate and generalize what they have produced (Argyris & Schon, 1978, p. 4). M. Leann Brown (2000) concludes in a study on environmental policy making in the European Union that the EU exhibits both single-loop (acquiring new information including policy feedback and new causal understandings) and double-loop learning (promulgating more effective policies and evidencing enhanced goal achievement), i.e., deutero-learning. Brown (2000, p. 3) shows that clear indicators that organizational learning is occurring or has occurred are modifications in personnel, programs, and legal and organizational structures that incorporate new information (including policy feedback) and causal understandings that yield more intellectually perceptive processes, a wider range of capabilities, and more effective policy.

> **DLL > modifications in personnel, programs, and legal and organizational structures that incorporate new information (including policy feedback) and causal understandings that yield more intellectually perceptive processes, a wider range of capabilities, and more effective policy (Brown, 2000, p. 3)**

Knowledge and the ability to act upon new insights are continuously enacted in social processes (Folke *et al*., 2005). Hence, the social network of stakeholders is an invaluable asset for learning and dealing with change. This bottom-up process is emerging from partnerships and networks (Geels *et al*., 2004).

> **DLL > When actor networks are being changed by including new and different stakeholders, supporting reflection on own assumptions and showing new possibilities.**

Uncertainty: Assessing and handling uncertainties is an increasingly important issue in adaptive water management and adaptive governance (Campolongo, *et al*., 2000; Dewulf, *et al*., 2008). Frequently, uncertainty is considered an attribute associated only with the quality of technical information used to characterize or understand a system. However, this description is limited when dealing with river basin management issues, where the conflicting views about how the system operates, the diversity of stakeholder's expectations and value systems may provoke disagreement about how the river basin should be managed (Dewulf, *et al*., 2008). Uncertainties in water management can take different forms. Therefore, identifying what sorts of uncertainty are present is the first step that is needed to find solutions.

> **DLL > Dealing with uncertainties starts with identifying what sorts of uncertainty are present (e.g. either in the nature of uncertainty (related to variability, incomplete knowledge, or multiple knowledge frames), or in the object of uncertainty (related to the natural, technical, or social system)) (Brugnach, *et al*., 2008)**

In this paper we use a broad definition of uncertainty, trying to cover different theoretical approaches to the concept: Uncertainty refers to the situation in which there is not a unique and complete understanding of the system to be managed (Brugnach, *et al*., 2008). For example, in this paper we are focusing on how strategies are dealing with issue of climate change impacts. Hence, the incorporation of climate change scenarios in current policy-making is an important parameter for assessing whether uncertainties have been taken into account.

> **DLL > When uncertainties have been taken into account in current policy-making (e.g. adaptation strategies based on climate change scenarios)**

Triple loop learning (TLL): As being mentioned before, triple loop learning is a refinement of the original double loop learning concept by Argyris (1999), and as such it allows for a more detailed operationalization when assessing the water management regimes in this paper. Triple loop learning (also called transformational learning) will help to bring about fundamental shifts in thinking and attitude (Hargrove, 2002:60). It starts with declaring powerful new possibilities for water management and then translating them into goals that take people and organizations beyond what they already think and know based on their own or organizational orthodoxies or experience (Hargrove, 2002: 115), or to take them beyond their old management styles. Learning means correcting mistakes and

producing intended results for the first time. This requires feedback that removes the blinders from people's eyes, but also in making new distinctions that open up new possibilities for them or allows them to think differently (DLL) (Hargrove, 2002: 115-116).

The concept of triple loop learning also relates to the work of Anthony Giddens (1984), who argues that social structure is both the medium and outcome of action. According to Anthony Giddens (1984) and Alexander Wendt (1987) actors have preferences which they cannot realize without collective action; based on these preferences they shape and re-shape social structures; once these social structures are in place, they shape and re-shape the actors themselves and their preferences. In other words, the constitution of agents and structures are not two independently sets of phenomena, meaning that structures should not be treated as external to individuals. This is what Voß and Kemp (2005) call second-order reflexivity, which is about self-critical and self-conscious reflection on processes of modernity, particularly instrumental rationality. It evokes a sense of agency, intention and change. Here actors reflect on and confront not only the self-induced problems of modernity, but also the approaches, structures and systems that reproduce them (Stirling, 2006; Grin et al., 2004). In other words, agents have the ability to look at actions to judge their effectiveness in achieving their objectives. This means that if agents can reproduce structure through action, they can also transform it.

According to Hargrove (2002:116-117), transformation (triple loop learning) is about intervening in the context so as to produce a profound alteration. Hargrove defines context as the background against which people are standing that determines their perceptions of reality. This background determines what they see is possible and achievable, and from it they draw their identity and formulate their thinking and attitudes. Important questions are: What is the context from which the management regime draws its identity that results in its coping strategies; How does the management regime intervene in the context in order to improve its strategies?

According to Hargrove (2002:118) context involves goals and aspirations that are being shaped by history, norms and values that shape social behavior or community behavior, and history of successes and failures. And important element of context is horizon of possibility (set by personal or cultural history). Triple loop learning is about expanding horizons of possibility (Hargrove, 2002:118). This involves making powerful declarations and dismantling limiting beliefs and assumptions.

> **TLL > When horizons of possibility are being expanded (e.g. by entirely new management measures or entirely new physical interventions in the river basin)**

Context also involves automatic responses to deal with risk, disagreement, conflict, and automatic ways of thinking based on management orthodoxies (e.g. 'fight against floods' versus 'living with floods' or 'room for rivers').

> **TLL > When automatic responses to deal with risk are being altered**

Paradigms: as human being or society as a whole we inherit certain master paradigms that tend to shape, limit, and define our thinking and behavior, or define our governance system in case of a society (Hargrove, 2002:119). A water management paradigm refers to a set of basic assumptions about the nature of the system to be managed, the goals of management and the ways in which these management goals can be achieved (Pahl-Wostl *et al.*, 2006). The paradigm is shared by what can be called an epistemic community of the actors involved in water management. The paradigm is manifested in artefacts such as technical infrastructure, planning approaches, regulations, engineering practices, models etc.

A paradigm shift involves major structural changes in infrastructure and regulatory frameworks. But it involves first of all learning processes which have to start at the level of mental models. It is needed to engage in a critical reflection on innovative management approaches based on sound and unbiased deliberations. (Pahl-Wostl *et al.*, 2006).

> **TLL > When a paradigm shift takes place, that alters our way of thinking and behaviour**
>
> **TLL > When a major structural change has been taking place in the regulatory framework for dealing with floods or droughts**

The fact is that automatic responses, horizon of possibility, and paradigms are like a box, and once inside the box it becomes very difficult to act outside of it. The only way to break out of the box is transformation, or triple loop learning.

According to Hargrove (2002: 119) there are only two ways to alter the context, and both are valid. One way is to make a powerful declaration of possibility that moves beyond history, horizon of possibility, and than standing inside that possibility. The other way to intervene in the context has to do with shifting the perspectives, beliefs, and assumptions that constitute the context - that is, reframing of the mind-set. This is not easy, since people don't just have their perspective; they become their perspective. They don't just have their beliefs; they become their beliefs. They don't just have their winning strategy; they become their winning strategy. Intervening in these, even with the best intentions, is likely to produce defensive reactions.

Parameters for assessing levels of learning

The above paragraphs have been operationalised into key characteristics of adaptation strategies related to different levels of learning:

- Strategy's name, including references to policy document(s)
- Current status in strategy development (which policy phases have been finalized)?
- Strategy's objectives
- Most important driver(s) to initiate strategy development
- How does **new information** / innovations enter the policy-making process (e.g. via informal (shadow) networks, formal commissions etc)?
- Planned actions: Entirely **new management measures**?
- Planned actions: Entirely **new physical interventions** in river basin?
- Are **structural constraints** (e.g. political, economical, technical, etc.) being recognized? and how are they being addressed? For example, was there a **change in the regulatory framework**? or an adjustment in the property rights system? Or in the implementation of cost-recovery mechanisms?
- Are **uncertainties** being recognized? If yes, how are they perceived and addressed?
- Changes in the **actor network**? Was there a change in mandates/positions/interests? Did entirely new actors become involved?
- Are there any **new norms and values** which have influenced the policy-making?

Chapter 3 Methods of data collection

A calibrated approach, using a standardized questionnaire for the elements of AIWM (see table 3), and a questionnaire for determining key characteristics of adaptation strategies (see table 5), expert judgment for both questionnaires, and reinterpretation of outcomes by means of relevant literature) was used to compare the water management regimes in the selected case-studies. A complete outlay of the questionnaires being used for data collection can be found in NeWater Deliverable 1.7.9a (Huntjens *et al.*, 2007).

By combining in-depth case studies with more extensive and formal comparative analysis we can to some extent use the strengths of one method to compensate for limitations inherent in the other. This explorative research has taken the research problem, rather than a favorite methodology, to determine the research approach, and both the quantitative and qualitative aspects have been and can be used in a consonant manner (Leon, P. de, 1998). As such it is possible to combine the qualities of the case-oriented approach with the qualities of the variable-oriented approach (Berg-Schlosser, *et al*., 2008). In this research, expert judgment has been used as method for knowledge elicitation on regime elements and internal processes. The list of potential respondents for each case-study was developed in cooperation with the case-study teams of NeWater, with the objective of selecting a group of respondents with enough knowledge on the case-study under consideration, and the ability to answer the whole questionnaire, or at least a major part of it. Moreover, with the objective of including all relevant perspectives and experiences in the case-study the respondents group was selected as a reflection of the most important stakeholders, policymakers, water practitioners, involved scientists, private sector and civil society. This resulted in a consultation round involving a minimum of ten experts in each case-study, reflecting perspectives from different categories (see table 3).

	Case-studies	**Academia**	**Government**	**Non-Government**	*Total no. of experts*
1	Lower Guadiana - Alentejo, Portugal	**4**	**2**	**4**	10
2	Ukrainian part of Upper Tisza	**3**	**6**	**3**	12
3	Hungarian part of Upper Tisza	**3**	**4**	**3**	10
4	Lower Rhine - Rivierenland, Netherlands	**2**	**6**	**2**	10
5	Upper Elbe - Ohre, Czech Republic	**4**	**4**	**2**	10
6	Lower AmuDarya - Uzbekistan	**5**	**4**	**4**	13
7	Upper Nile - Kagera, Uga/Tan/Rwa/Bur	**1**	**5**	**4**	10
8	Upper Orange - Upper Vaal, S-Africa	**2**	**2**	**2**	6
	Total	24	32	24	**81**
	Percentage	30%	40%	30%	

Table 3 – Overview of the number of experts (per category) consulted in each case-study

By using standardized questionnaires, or using these questionnaires for standardized interviews, qualitative data was being collected in such a way that it was possible to compare weighted averages on each seperate indicator. The weighted average has been calculated by multiplying each individual score by the weight which respondents assigned to it; the total sum of all respondents in one case-study was then divided by the total assigned weight (by adding up all weights assigned to this specific indicator). Furthermore, the level of inconsistency (standard deviation) for each variable has been calculated, next to 'Independent Samples T Tests', in order to test for significant differences between the case-studies.

The reason for developing standardized answering options in the questionnaire is that it supports a formal comparative analysis of the results. Furthermore, the questionnaire allows for assigning weights to each indicator. In this way it is possible to aggregate multiple indicators, resulting in a score for one variable, or for aggregated variables, resulting in a score for one meta-variable (e.g. category of variables).

Not much work is available on comparative analyses of river basins including full range of a water management regime's complexity (Myint 2005; Wolf 1997). Many studies on IWRM are descriptive and limited to recording success or failure of single cases. The initial comparisons in this research will help develop and test protocols (cf. Breitmeier et al. 1996) that open the way for efforts at broader generalizations about options for institutional designs and procedures with a special emphasis on assessing what does and doesn't work well with respect to adaptive and integrated water management.

Chapter 6 will describe in more details the methods used for running a formal comparative analysis (which is multi-value QCA), in order to identify specific configurations of conditions in Adaptive and Integrated Water Management (AIWM) that lead to higher levels of learning in river basin management (being reflected and/or consolidated by CC adaptation strategies to deal with either floods or droughts).

Chapter 4 Comparitive assessment of the management systems

An essential step in the procedure of a formal comparitive analysis using Boolean minimization techniques (by QCA) is the reduction of (qualitative and/or quantitative) data into a set of binary variables. A normal QCA would require the dichotomization of every variable in absence/presence or low/high, respectively leading to 0's and 1's. However, for an appropriate description of the conditions in the case-studies this would be too simplistic and valuable information would be lost, especially since many of the conditions are classified in between 'non-adaptive (traditional) regime' and 'integrated, adaptive regime'. Hence, it is more appropriate to use mvQCA (multi-value QCA). One of the major consequences of using mvQCA is the loss of parsimony; however in this case the preservation of valuable and essential information, related to the focus on the transition from non-adaptive towards adaptive regimes, is regarded as more important. Therefore, below results are presenting weigthed averages between a range of 0 and 2 (with '0' as non-adaptive and non-integrated regime; and '2' as adaptive and integrated regime).

Table 4 – Complete overview of the results (weighted averages) of expert judgement on each indicator

		Rivierenland	Alentejo	Ohre	Ukraine	Hungary	AmuDarya	Kagera	Upper Vaal
Agency	Leadership does mobilize allies	1.9	0.8	1.8	1.2	1.4	1.4	1.3	1.4
	Leadership takes advantage of exogenous factors (e.g. when political climate is right)	1.6	1.0	1.4	1.0	1.3	0.8	1.6	1.4
	Barriers are dealt with effectively, causing no serious delays or problems	1.2	0.6	1.4	0.2	0.8	1.0	0.6	0.6
	Leadership is proactive; anticipates on problems	1.5	0.3	1.1	0.8	1.0	0.7	0.6	0.6
	Leadership is able to formulate and articulate internally consistent policy preferences	1.7	1.0	1.3	1.2	0.8	1.0	1.1	0.8
	Leadership has authority to act externally, in particular the legal competence in given subject matter	1.6	1.4	1.7	1.0	0.3	1.8	1.5	1.0
overall		**1.6**	**0.8**	**1.5**	**0.9**	**0.9**	**1.1**	**1.1**	**1.0**
Awarenes Raising & Education	Public awareness programs for water management are regularly implemented in collaboration with civil society organizations and the media	1.8	0.8	1.3	0.9	0.4	1.2	1.2	1.6
	IWRM is regularly introduced in school programs; and with potential to be an integral part of school curricula	0.7	0.3	0.8	0.1	0.0	0	0.1	1.5
	IWRM is regularly introduced in educational/capacity building programs	1.4	1.0	1.2	0.8	0.7	1	1.6	1.5
overall		**1.3**	**0.7**	**1.1**	**0.6**	**0.4**	**0.8**	**1.0**	**1.5**
Gov erna nce	Top-down (=0) versus Consensual (bottom-up) governance (=2)	0.9	0.0	0.4	0.4	0.2	0.1	0.2	0.4
overall		**0.9**	**0.0**	**0.4**	**0.4**	**0.2**	**0.1**	**0.2**	**0.4**
Cooperation	Legal provisions concerning access to information, participation in decision-making (e.g. consultation requirements) and access to courts	2.0	1.5	1.7	1.3	1.4	0.7	1.2	2.0
	Co-operation structures include non-governmental stakeholders	1.5	0.7	1.0	0.9	0.7	0.3	0.8	1.5
	Non-governmental stakeholders actually contribute to agenda setting, analyzing pro-blems, developing solu-tions and taking decisions ("co-production")	1.3	0.4	1.0	0.8	1.0	0.3	1.1	1.3
	Non-governmental stakeholders undertake parts of river basin management themselves, e.g. though water users' associations	1.3	0.7	0.7	0.3	0.8	0.8	1.0	1.3
	Sectoral governments actively involve other government sectors	1.8	0.9	1.6	1.1	0.3	1.4	0.5	1.2
	Co-operation structures include government bodies from different sectors; many contacts generally	1.7	1.0	1.4	1.6	0.5	1.3	0.9	1.6
	Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed	1.4	1.3	1.0	1.3	0.2	1.1	1.0	1.0
	Lower level governments are involved in decision-making by higher level governments	2.0	0.4	1.4	1.3	0.5	0.6	1.1	1.0
	Co-operation structures include government bodies from different hierarchical levels; many contacts generally	1.9	1.0	1.2	1.2	1.0	0.6	1.1	1.4
	Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed	1.8	1.0	1.2	1.0	0.8	1.6	1.1	1.0
	Downstream governments are involved in decision-making by upstream governments	1.6	1.1	1.6	1.2	1.0	1.1	1.3	1.3
	International/ transboundary co-operation structures exist (e.g. river basin commissions); many contacts generally	1.9	1.3	1.9	1.4	1.2	1.3	1.6	2.0
	Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed	1.6	1.3	1.2	1.2	0.8	1	1.3	1.3
overall		**1.7**	**1.0**	**1.3**	**1.1**	**0.8**	**0.9**	**1.1**	**1.4**
Policy Development & Implementation	Solutions for short term problems do not cause more problems in the (far) future (20 years or more)	1.1	0.8	0.8	0.6	0.3	0.3	0.3	0.6
	Already now preparations are taken for the (far) future (20 years or more)	1.8	1.0	1.2	0.7	0.9	0.1	1.0	1.4
	Measures taken now or proposed for the near future, do not limit the range of possible measures that can be taken in the far future and are preferably reversible.	1.3	1.2	1.1	0.8	0.7	0.8	0.9	0.6
	Small-scale policy experiments take place/ are financially supported	1.3	0.3	1.2	0.8	1.0	1.2	0.6	1.0
	Several alternatives and scenario's are discussed	1.8	1.3	1.7	1.2	1.0	0.8	1.4	1.8
	Alternatives include small and large-scale and structural and nonstructural measures	1.8	0.3	1.2	0.7	1.0	0.1	1.0	1.4
	Plans and policies are actually implemented	1.5	1.2	1.3	1.3	1.0	1	0.6	1.0
	When there are good reasons not to implement policies, such as new and unforeseen circumstances and new insights, appropriate changes to policies are being made	1.3	1.0	0.8	0.7	1.0	0.4	1.3	0.8
	Formation and documentation of high-level steering committee meetings for project preparation and implementation	1.7	0.6	1.7	1.3	1.5	0.3	1.6	1.4
	Adoption of an M&E plan during project preparation that includes establishment of process indicators, stress reduction indicators, and environmental status indicators.	1.6	0.8	1.6	1.3	0.7	1.2	1.9	1.6
overall		**1.5**	**0.9**	**1.3**	**0.9**	**0.9**	**0.6**	**1.1**	**1.2**

		Rivierenland	Alentejo	Ohre	Ukraine	Hungary	AmuDarya	Kagera	Upper Vaal
Information Management & Sharing	Different government bodies are involved in setting the TORs and supervising the search, or at least consulted (interviews, surveys etc.)	1.7	0.9	1.9	1.0	0.3	1	1.0	1.0
	Non-governmental stakeholders are involved in setting the TORs and supervising the search, or at least consulted (interviews, surveys etc.)	1.6	0.5	1.3	0.7	0.6	0.4	0.6	1.2
	In addition to technical and engineering sciences also for instance ecology and the social sciences are involved in defining and executing the research	2.0	1.1	1.4	1.3	0.8	1.1	1.6	1.6
	Researchers allow their research to be challenged by stakeholders and present their own assumption in as far as they are aware of them	1.6	0.5	1.3	1.0	0.5	1	1.8	1.2
	Research results are presented in a facilitative way, to stimulate reflection by the stakeholders about what is possible and what it is they want	1.9	0.4	1.7	1.1	0.4	1	1.6	1.4
	Uncertainties are not glossed over but communicated (in final reports, orally)	1.3	0.4	1.4	0.6	0.2	0.4	0.8	1.2
	Researchers are willing to talk with stakeholders about uncertainties	2.0	1.0	1.4	1.2	0.5	0.1	0.9	1.4
	Governments exchange information and data with other governments	1.9	1.1	1.7	1.3	1.0	1	0.9	1.6
	Governments actively disseminate information and data to the public: on the Internet, but also by producing leaflets, though the media, etc.	1.9	0.9	1.4	1.2	0.6	1.1	0.9	1.8
	New information is used in public debates (and is not distorted)	1.9	1.0	1.6	0.6	0.5	0.2	1.0	1.5
	New information influences policy (not specifically related to CC)	1.8	1.0	1.3	1.0	1.0	0.7	0.7	1.4
	River basin information systems are up to standards	2.0	0.8	1.7	0.8	0.9	0.4	0.1	1.8
overall		**1.8**	**0.8**	**1.5**	**1.0**	**0.6**	**0.7**	**1.0**	**1.4**
Finances and cost recovery	Sufficient (public and private) resources are available	1.2	0.7	0.9	0.0	0.4	0.8	0.0	0.8
	Costs are recovered from the 'users' by public and private financial instruments (charges, prices, insurance etc.)	1.4	1.0	1.7	0.8	1.0	0	0.9	1.8
	Authorities can take loans and depreciate their assets, to facilitate efficient use of resources and replacement of assets	1.5	1.6	0.9	0.3	1.3	0.3	1.4	1.5
	Financial resources diversified using a broad set of private and public financial instruments	1.0	0.7	1.2	0.4	0.3	0	0.8	1.0
	Wide-spread private sector participation in river basin management	0.8	0.2	1.0	0.0	0.3	0	0.3	1.4
overall		**1.2**	**0.8**	**1.1**	**0.3**	**0.6**	**0.2**	**0.6**	**1.3**
Risk Management	Uncertainties are not glossed over but communicated (in final reports, orally)	1.3	0.4	1.4	0.6	0.2	0.4	0.8	1.2
	Both formal expert judgment and risk perceptions by the stakeholders	1.1	0.7	1.1	0.8	1.3	0.1	0.9	1.5
	Non-governmental stakeholders are involved in decisions on what are acceptable risks	1.2	0.5	0.8	0.8	0.3	0	0.9	1.8
	Insurance against housing and property damage is available (= 2) (seen as a measure of AIWRM,in order to reduce vulnerability)	1.1	1.5	2.0	0.6	0.8	1	0.3	1.8
	Harvest insurance mechanisms are available (= 2) (seen as a measure of AIWRM,in order to reduce vulnerability)	1.3	1.8	1.8	0.3	1.7	1.6	0.1	2.0
overall		**1.2**	**1.0**	**1.4**	**0.6**	**0.8**	**0.6**	**0.6**	**1.6**
Effectiveness of (international) regulation	Coercive sanctions are used as legitimate means of generating compliance in hierarchical context	1.4	1.2	1.3	0.8	1.3	1.5	1.5	0.7
	Coercive sanctions are used as legitimate means of generating compliance in institutionalized horizontal setting, e.g. with institutionalized horizontal coercion,	1.5	0.8	1.0	0.8	0.7	1.3	0.9	0.7
	Soft paths to compliance are in place (e.g. capacity building, legitimacy building, and the voluntary internalization of law)	1.5	0.7	1.6	0.5	0.0	1	0.9	1.3
	Country adoption of specific water, environment, or sector related legal reforms, policies, institutions, standards, and programs necessary to address the transboundary priority issues, including stakeholder participation programs	1.5	1.7	1.7	1.6	1.5	1.3	1.9	1.8
	County ratification of the regional or global conventions and protocols	1.9	1.8	1.4	1.8	2.0	1.8	1.6	1.8
	High-level political commitment to follow up joint action as signified by, among other things, ministerial level declarations or adoption of a joint legal/institutional	1.5	1.8	1.7	1.6	1.0	1.5	1.3	1.0
	Country commitments to report progress in achieving stress reduction indicators as well as environmental status data to the regional or joint institution	2.0	1.5	1.6	1.8	1.3	1.8	1.9	1.0
	Incorporation of country assistance strategies (CAS) in the World Bank or regional development bank or UNDP country-level strategic results framework (SRF)				0.6	1.5	1.8	1.9	1.0
overall		**1.6**	**1.3**	**1.5**	**1.2**	**1.2**	**1.5**	**1.5**	**1.2**

4.1 Correlations between variables

This paragraph will identify the presence or absence of significant correlations between the variables presented in table 2. The variables are aggregates of indicators presented in table 4. The correlations have been assessed by calculating correlation coefficients between all variables. For a complete overview of correlation coefficients see Appendix IV.

The following significant correlations were identified:

- Joint/participative information production is positively correlated with vertical cooperation (p=0.91), transboundary cooperation (p=0.95), consideration of uncertainties (p=0.95), and broad communication (p=0.90).
- Levels of, and provisions for, stakeholder participation is positively correlated with consideration of possible measures (p=0.96), and risk perception (p=0.95)
- Vertical cooperation is positively correlated with joint/participative information production (0.91) and consideration of uncertainties (p=0.90)
- Transboundary cooperation is positively correlated with joint/participative information production (0.95) and consideration of uncertainties (p=0.93)
- Besides the correlations already mentioned, consideration of uncertainty is also positively correlated with time horizon in policy development (0.90), consideration of possible measures (0.90), broad communication (p=0.90), and utilization of information (p=0.94).
- Monitoring and evaluation is positively correlated with elicitation of mental models/ critical selfreflection about assumptions (p=0.95)
- Risk perception is positively correlated with consideration of possible measures (p=0.95)
- Type of governance is positively correlated with vertical cooperation (p=0.97)
- Vertical conflict resolution is positively correlated with the level of compliance to (inter)national regulation (p=0.91)
- Utilization of information is positively correlated with time horizon in policy development (p=0.96) and consideration of possible measures (p=0.91)

4.2 Relative strengths and weaknesses per case-study

Below paragraphs will describe the relative strengths and weaknesses of each management system, based on the weighted averages shown in table 4.

Indicators with a weighted average belonging to the two lowest weighted averages of all case-studies have been selected as a relative weakness. Indicators with a weighted average belonging to the two highest weighted averages of all case-studies have been selected as a relative strength.

Additionally, indicators which show a weighted average more than 0.4 (in table 4) lower than the average score of its category (e.g. information management is one category) than this indicator is (also) selected as a relative weakness. Indicators which show a weighted average which is more than 0.4 (in table 4) higher than the average score of its category is selected as a relative strength.

Rivierenland in the Netherlands (Lower Rhine Basin)

Relative Strengths:

- Leadership does mobilize allies
- Public awareness programs for water management are regularly implemented in collaboration with civil society organizations and the media
- Balance between topdown and bottom up governance, although water authorities state that *'public and civil society are still not adequately mobilised, despite substantial investments'* (Directorate General Water, 2006), it still shows a relatively high score on bottom-up governance compared to other case-studies.
- Good Legal provisions concerning access to information, participation in decision-making (e.g. consultation requirements) and access to courts
- Horizontal cooperation
- Vertical cooperation
- Transboundary cooperation
- Already now preparations are taken for the (far) future (20 years or more)
- Several alternatives and scenario's are discussed
- Alternatives include small and large-scale and structural and nonstructural measures
- In general, good information management, meaning joint (consensual) knowledge production, interdisciplinarity, consideration of uncertainties, utilization of information, broad communication

Relative Weaknesses:

- Limited private sector participation in river basin management
- Financial resources for water management are dominated by public financial instruments, while private financial instruments are limited.
- Limited introduction of water management and related issues into school programs of primary and secondary schools

Alentejo region in Portugal (Lower Guadiana)

Relative Strengths:

- Leadership has authority to act externally, in particular the legal competence in given subject matter
- Insurance mechanisms are available for harvest, housing and property damage

Relative Weaknesses:

- Very limited bottom-up governance, although civil society involvement is slowly growing
- Leadership is mainly reactive; in general, problems must first occur before taking action
- Leadership's mobilization of allies is limited
- Limited introduction of water management and related issues into school programs of primary and secondary schools
- Limited contribution of non-governmental stakeholders to agenda setting, analyzing problems, developing solutions and taking decisions ("co-production"), mainly due to limited resources for civil society in general
- Limited vertical integration (cooperation between hierarchical levels in government) and limited conflict resolution between hierarchical levels in government
- Limited support to small-scale policy experiments
- In general, alternatives do not include small and nonstructural measures in river basin management
- Limited adoption of an M&E plan during project preparation that includes establishment of

process indicators, stress reduction indicators, and environmental status indicators.

- In general, non-governmental stakeholders are not involved in setting the TORs and supervising the search for information, or at least consulted (interviews, surveys etc.)
- In general, researchers do not allow their research to be challenged by stakeholders and present their own assumption in as far as they are aware of them
- In general, research results are not presented in a facilitative way, to stimulate reflection by the stakeholders about what is possible and what it is they want
- In general, uncertainties are glossed over and not communicated (in final reports, orally)
- Limited private sector participation in river basin management
- Limited involvement of non-governmental stakeholders in risk perceptions and in decisions on what are acceptable risks
- Limited use of coercive sanctions as legitimate means of generating compliance in institutionalized horizontal setting, e.g. with institutionalized horizontal coercion, shaming, and adjudication
- Soft paths to compliance are very limited (e.g. capacity building, legitimacy building, and the voluntary internalization of law)

Ohre Basin in Czech Republic (Upper Elbe)

Relative Strengths:

- Leadership does mobilize allies
- Leadership has authority to act externally, in particular the legal competence in given subject matter
- Sectoral governments actively involve other government sectors
- Transboundary cooperation
- Several alternatives and scenario's are discussed
- Different government bodies are involved in project preparation and supervising the search for information, or at least consulted (interviews, surveys etc.)
- In general a fairly good information management, especially broad communication, consideration of uncertainties, although involvement of civil society could be improved
- Costs are recovered from the 'users' by public and private financial instruments (charges, prices, insurance etc.)
- Insurance mechanisms are available for harvest, housing and property damage

Relative Weaknesses:

- Solutions for short term problems are running a risk of causing more problems in the (far) future (20 years or more)
- Policies remain often unchanged, even when there are good reasons not to implement policies, such as new and unforeseen circumstances and new insights
- Limited involvement of non-governmental stakeholders in decisions on what are acceptable risks
- Limited use of coercive sanctions as legitimate means of generating compliance in institutionalized horizontal setting, e.g. with institutionalized horizontal coercion, shaming, and adjudication

Tisza Basin in Ukraine (also called Zacarpathian Tisza)

Relative Strengths:

- Co-operation structures include government bodies from different sectors; many contacts in general

Relative Weaknesses:

- Limited introduction of water management and related issues into school programs of primary and secondary schools
- No water users' associations in place, in other words, non-governmental stakeholders do not undertake parts of river basin management themselves
- Policies remain often unchanged, even when there are good reasons not to implement policies, such as new and unforeseen circumstances and new insights
- Uncertainties are normally glossed over and not communicated (in final reports, orally)
- In general, new information is distorted and not used in public debates
- Limited (public and private) resources for river basin management
- Authorities have limited ability to take loans and depreciate their assets, to facilitate efficient use of resources and replacement of assets
- Financial resources for water management are dominated by public financial instruments, while private financial instruments are limited.
- Limited private sector participation in river basin management
- Insurance mechanisms against harvest, housing and property damage are in general not available
- Soft paths to compliance are limited (e.g. capacity building, legitimacy building, and the voluntary internalization of law)

Upper Tisza in Hungary

Relative Strengths:

- Leadership does mobilize allies
- Leadership takes advantage of exogenous factors (e.g. when political climate is right)
- International/ transboundary co-operation structures exist (e.g. river basin commissions); many contacts generally
- Non-governmental stakeholders contribute to agenda setting, analyzing problems, developing solutions (co-production)".
- Both formal expert judgment and risk perceptions by the stakeholders
- Harvest insurance mechanisms are available (seen as a measure to reduce vulnerability), although not many people can afford to pay for it.

Relative weaknesses:

- Limited awareness raising and education on water resources management and related issues
- Limited horizontal integration (cooperation between different government sectors) and limited conflict resolution between sectoral governments
- Limited vertical integration (cooperation between hierarchical levels in government) and limited conflict resolution between hierarchical levels in government
- Solutions for short term problems are running a risk of causing more problems in the (far) future (20 years or more)
- Limited discussion on alternatives and scenario's
- Limited adoption of an M&E plan during project preparation that includes establishment of process indicators, stress reduction indicators, and environmental status indicators.
- Different government bodies are not always involved in setting the TORs and supervising the search, or at least consulted (interviews, surveys etc.)
- Limited elicitation of mental models / critical self-reflection on guiding assumptions
- Limited consideration of uncertainty: 1) Uncertainties are glossed and not communicated (in final reports, orally); 2) Researchers are reluctant to talk with stakeholders about uncertainties
- Limited communication: 1) Governments are reluctant in exchanging information and data with

other governments; 2) Limited dissemination of information and data to the public: on the Internet, but also by producing leaflets, though the media, etc.

- Limited utilization of information (not specifically related to climate change): New information is distorted and not used in public debates
- Financial resources for water management are dominated by public financial instruments, while private financial instruments are limited.
- Limited private sector participation in river basin management
- Limited involvement of non-governmental stakeholders in decisions on what are acceptable risks
- Limited use of coercive sanctions as legitimate means of generating compliance in institutionalized horizontal setting, e.g. with institutionalized horizontal coercion, shaming, and adjudication
- Limited high-level political commitment to follow up joint action as signified by, among other things, ministerial level declarations or adoption of a joint legal/institutional framework

Lower AmuDarya Basin in Uzbekistan

Relative Strengths:

- Top level leadership has authority to act, in particular the legal competence in water resources management
- Horizontal integration: Sectoral governments (e.g. water and agriculture) actively involve other government sectors, although agricultural sector dictates water management in general. Nevertheless, existing cooperation structures include government bodies from different sectors; many contacts generally.
- Conflicts between higher and lower levels of government are dealt with constructively, normally forced by topdown decisions/agreements
- Insurance mechanisms are available for harvest, housing and property damage. However, not everybody can afford to pay for insurance, and insurances for crop loss (failure of germination) are forced upon the farmers, i.e. the amount is taken by the government from their bank accounts

Relative Weaknesses:

- Leadership does not always take advantage of exogenous factors (e.g. when political climate is right)
- In general, leadership is reactive; problems must first occur before taking action
- Limited introduction of water management and related issues into school programs of primary and secondary schools
- Limited involvement of non-governmental stakeholders/civil society in agenda setting, knowledge production and decisionmaking, partly due to limited legal provisions for stakeholder participation (e.g no consultation requirements), limited access to information, and access to courts is difficult
- Co-operation structures do not include non-governmental stakeholders, and they are not involved in perception of risks and in decisions on what are acceptable risks
- Limited involvement of lower level governments in decision-making by higher level governments
- Solutions for short term problems are running a risk of causing more problems in the (far) future (20 years or more)
- Preparations for the (far) future (20 years or more) are not on the agenda
- In general, limited discussion on several alternatives and scenarios, and alternatives rarely include small and nonstructural measures in river basin management
- Policies often remain unchanged, even when there are good reasons not to implement policies, such as new and unforeseen circumstances and new insights
- In general, uncertainties are glossed over and not communicated (in final reports, orally), and researchers are reluctant to talk with stakeholders about uncertainties
- In general, new information on climate change impacts is distorted and not used in public

debates

- River basin information systems are not up to standards
- In general, indicators on finances and cost recovery are showing lowest averages of all case-studies

Kagera Basin in Uganda/Rwanda/Burundi/Tanzania (Upper Nile Basin)

Relative Strengths:

- Leadership takes advantage of exogenous factors (e.g. when political climate is right)
- Leadership has authority to act externally, in particular the legal competence in given subject matter
- IWRM is regularly introduced in educational/capacity building programs
- Transboundary cooperation
- In addition to technical and engineering sciences also for instance ecology and the social sciences are involved in defining and executing the research
- Researchers allow their research to be challenged by stakeholders and present their own assumption in as far as they are aware of them
- Research results are presented in a facilitative way, to stimulate reflection by the stakeholders about what is possible and what it is they want
- Adoption of an M&E plan during project preparation, mainly due to requirements for international funding
- Authorities can take loans and depreciate their assets, to facilitate efficient use of resources and replacement of assets

Relative Weaknesses:

- In general, leadership is reactive; problems must first occur before taking action
- Limited introduction of water management and related issues into school programs of primary and secondary schools
- Limited involvement of non-governmental stakeholders, although influence of civil society is slowly growing
- Limited horizontal integration (cooperation between different government sectors) and limited conflict resolution between sectoral governments
- Solutions for short term problems are running a risk of causing more problems in the (far) future (20 years or more)
- Limited political support and financial resources for small-scale policy experiments
- Implementation of water resources management plans is limited, mainly due to capacity problems and political priorities on economic development and povery alleviation.
- Insufficient (public and private) resources for river basin management in general
- Limited exchange of information between different government
- River basin information systems are not up to standards
- Limited private sector participation in river basin management
- Limited availability of insurance mechanisms for harvest, housing and property damage, even when available, most people cannot afford to pay for insurance.

Vaal catchment in South Africa (Upper Orange Basin)

Relative Strengths:

- Leadership does mobilize allies
- Leadership takes advantage of exogenous factors (e.g. when political climate is right)

- Good legal provisions concerning access to information, participation in decision-making (e.g. consultation requirements) and access to courts - Involvement of civil society is growing stronger - Transboundary cooperation is getting more consolidated (in ORASECOM) - Several alternatives and scenario's are discussed - Adoption of an M&E plan during project preparation - In addition to technical and engineering sciences also for instance ecology and the social sciences are involved in defining and executing the research - Broad communication (between governments and towards public) - River basin information systems are up to standards - Costs are recovered from the 'users' by public and private financial instruments (charges, prices, insurance etc.) - Private sector participation in river basin management - Insurance mechanisms are available for harvest, housing and property damage, although not everybody can afford to pay for insurance
Relative Weaknesses: - In general, leadership is reactive; problems must first occur before taking action - Capacity building programs are high on the agenda of DEAT and DWAF, but it is not enough for compensating the continuing loss of skills - Implementation of water resources management plans is limited, mainly due to capacity problems and political priorities on economic development and povery alleviation. - Solutions for short term problems are running a risk of causing more problems in the (far) future (20 years or more) - Level of compliance to existing regulation is relatively low, mainly due to limited use of coercive sanctions as legitimate means of generating compliance in hierarchical context, neither in an institutionalized horizontal setting, e.g. with institutionalized horizontal coercion, shaming, and adjudication

4.3 Intermediate conclusions

Intermediate conclusions based on the results presented in table 4 are as follows:

- There are many positive correlations between variables from different elements in the management system, for example, joint/participative information production is positively correlated with vertical cooperation (p=0.91), transboundary cooperation (p=0.95), consideration of uncertainties (p=0.95), and broad communication (p=0.90). These correlations lead to the conclusion that a lack of consensual knowledge is an important obstacle for cooperation and dealing with uncertainty and change, which is also being suggested by other researchers (Olsson et al., 2006; Stubbs and Lemon, 2001; Tompkins and Adger, 2004)
- The above correlations suggest a strong interdependence of the elements within a water management regime, and as such this interdependence is a stabilizing factor in current management regimes.
- Although the conceptual foundations of AIWM may suggest that bottom-up governance is a straight forward solution to water management problems, the weighted averages on governance suggest otherwise. For example, the weighted average on governance in Rivierenland (0.9 on a scale of 0.0 to 2.0, with 0.0 as top-down governance and 2.0 als bottom-up governance) indicates that there is much more topdown governance than could be

expected from consensus-based decision-making, particularly since the Netherlands is well-known for its consensus-based decision-making (also called the 'Poldermodel'). The fact that Rivierenland also shows a substantial degree of top-down governance is reflected in the framework for flood management (PKB Room for Rivers) in the Netherlands, which was initiated by the national government (Berenschot, 2007). Nevertheless, after initiation by the national government the framework was being further developed, and this process was much more characterized by bottom-up governance (idem, 2007). This bottom-up process was, amongst others, reflected in the document called "Advice to the parliament as regard the PKB Room for Rivers by nine civil society organisations" (LIRR, 2003).

- In summary, for large-scale, complex multiple-use systems, such as river basins, this research suggests that bottom-up governance and decentralization is not a straight forward solution to water management problems. There will probably always be the need for a certain degree of top-down governance (or centralization), for example in the area of transboundary issues, capacity building, setting of standards and conflict resolution. All the case-studies in this research seem to be in a process of finding a balance between bottom-up and top-down governance.

Chapter 5 - Analyzing the levels of learning being reflected in the adaptation strategies

The next step in this study is an assessment of the outputs of the management systems under consideration. The outputs are being defined in (paragraph 3.2) as the levels of learning in river basin management (being reflected and/or consolidated by CC adaptation strategies to deal with either floods or droughts). This paragraph will present the results from literature review and expert judgement on the parameters defined in paragraph 2.2. The results are presented in an overview table shown below (Table 5). A more detailed description of the key characteristics of each strategy can be found in the appendices I to VIII.

Adjustment of an operational indicator

All the case-studies being analysed do have existing international/transboundary cooperation structures, even the case-studies which are now being characterized by single loop learning (AmuDarya, Kagera, and Alentejo). An operational distinction based on this specific element would only be possible when being able to assess the extent (e.g. number of contacts) and effectiveness (e.g. inclusive agreements to which the parties are committed) of transboundary cooperation. However, based on the results of expert judgement in this study the weighted averages on these specific indicators are all relatively high (see table 4 in previous chapter), and these averages do not show any significant differences between the case-studies, at least in terms of the extent and effectiveness of transboundary cooperation. In other words, an operational distinction between different levels of learning, based on this specific element, is not possible.

Table 5 - Key characteristics of climate change adaptation strategies to deal with floods or droughts in eight case-studies. Dark blue indicates an element of triple loop learning (TLL); Light blue indicates an element of double loop learning (DLL); Yellow indicates single loop learning (SLL) (ad-hoc problem solving). The outcomes of these adaptation strategies are largely unknown at present. Most of them have only recently been introduced and there has not been enough time to test their appropriateness and effectiveness.

Variable	Rivierenland	Alentejo	Ohre	Tisza in Ukraine	Tisza in Hungary	AmuDarya	Kagera	Upper Vaal
Strategy's name	Room for Rivers	No strategy	Plan of Main Basins (Period 2007-2012) + Nat Progr. Reduction of CC Impacts (2004)	Program of Integrated Anti-Flood Protection in Zacarpathian Tisza (2006)	National CC Strategy (2004) + new Vásárhelyi Plan (VTT, 2003)	No strategy	No strategy	National Climate Change Response Strategy (DEAT, 2004)
Current status in strategy development	Fully developed flood strategy (PKB RvdR 2006), based on CC scenarios	Problem identification (droughts) in Albufeira Convention	Ratified in 2007	Fully developed flood strategy for period 2007-2015	Strategic goal setting (approved by Governm.)	Problem identification (developed CC scenarios)	Problem identification only by academics	Translation of strategy into operational policy has not occurred yet
Strategy's objectives	1) Capacity of 16,000 m3/s in 2015 2) Environmental quality 3) Reservation of space for 18:000 m3/s in 2050	N.A. at this stage	1) Flood protection 2) Increase storage cap. of reservoirs 3) Nature conservation	Flood protection for period 2007-2015, but not based on CC scenarios	Nat. CCS is a guideline for mitigation and adaptation for different sectors (2008-2025); VTT > flood protection, rural development, nature conservation	N.A. at this stage	N.A. at this stage	Offset vulnerability to climate change, amongst others by WRM and contingency planning
Allocated budget	2.1 Billion euro for 2015 objectives	N.A. at this stage	Unknown	300 M Euro	Unknown	N.A. at this stage	N.A. at this stage	Unknown
Most important driver(s) to initiate strategy development	Floods in 1993 and 1995	Drought and water shortages	Floods in 1997 and 2002, drought in 2003, institut. and land use changes, EU funding	Floods (1998/2001)	Floods (1998/2001) and droughts, EU policies and funding	Drought and water shortages, institutional changes, ext. funding, pop. dynamics	Drought and water shortages	Threat of extreme climate changes, food security, cap. problems, ext funding
Entirely new management measures?	Yes	No	Partly	Spatial river basin planning with respect to appropriate land use change	Plans for National Drought Committee and a Drought Fund	No	No	New measures being proposed, but not implemented yet
Entirely new physical interventions in river basin?	Yes: retention areas, bypasses, dyke replacements	No	No	No	Replacement of dykes, retention areas	No	No	No, so ar only optimizing existing measures
Structural constraints being recognized/addressed?	Partly	No	Partly	Not specifically	Partly, e.g. changes in regulatory framework	No	No	Minimal > First steps to adress major capacity constraints
Uncertainties being recognized/addressed?	Yes, strategy based on CC scenarios	No	Partly, recognized by CC scenarios, but not addressed in policy	No agreement on CC scenarios and no shared vision on CC adaptation strategy	Partly, but no agreement on CC scenarios	Uncertainties in projections being mentioned as major barrier to adaptation	CC uncertainty only addressed by academics	Partly: recognized by CC scenarios, but not addressed in policy
Changes in the actor network?	To some extent	No	To some extent	To some extent	To some extent	No	To some extent	No
Change in the regulatory framework?	Yes	No	Partly	No	Yes	No	No	No
How does new information enter the policy-making process?	Formal Cie. / informal network	Formal network	Mainly formal, some informal	Only via formal networks	Formal network + informal network	Formal network	Only via formal networks	Mainly formal, some informal
New norms and values?	Yes, paradigm shift from 'fighting against water' to 'living with water', besides more dominant EU norms (WFD, RBM)	EU norms have become more dominant: WFD, RBM planning, stronger involvement of civil society	EU norms have become more dominant: WFD, RBM planning, stronger involvement of civil society	EU norms have become more dominant: WFD, RBM planning, stronger involvement of civil society	EU norms have become more dominant: WFD, RBM planning, stronger involvement of civil society	No	Increasing involvement of civil society	More concern on CC and its impacts + increasing involvement of civil society
Type of learning	Double loop learning + some elements of triple loop learning	SSL (ad-hoc problem solving)	SLL & DLL	SSL (ad-hoc problem solving)	SLL & DLL	SSL (ad-hoc problem solving)	SSL (ad-hoc problem solving)	SLL & DLL
Binary outcome (1 = DLL/TLL)	1	0	1	0	1	0	0	1

5.1 Intermediate conclusions

Below paragraphs will give a brief summary of the adaptation strategies currently in place in all case-studies, and will analyze these strategies in terms of single loop learning (= ad-hoc problem solving), double loop learning (= reframing) and triple loop learning (= regime transition / paradigm shift). The conclusions have been based on the overview table of key characteristics of CC adaptation strategies (Table 5). A more detailed description of the key characteristics of each strategy can be found in the appendices I to VIII.

CC Adaptation in the Netherlands

The Room for Rivers-policy in the Netherlands (see appendix I) is predominantly characterized by double loop learning, although elements of triple loop learning have been observed as well. As a matter of fact, the Room for Rivers-policy appears to be the only strategy in this comparative study which clearly shows some elements of triple loop learning, such as a change in the regulatory framework (PKB, 2006), strong involvement of civil society, taking into account uncertainties, and last but not least, a change in paradigm from "fighting against water" towards "living with water". As a matter fact, Rivierenland is one of the few cases (next to the Hungarian Tisza) where there is a clear influence from civil society on policy making, being reflected, for example, in the "*Advice to the parliament as regard the PKB Room for Rivers by nine civil society organisations*"[3]. This advice was for a large part incorporated in the final plan. Moreover, the Room for Rivers-policy involves entirely new management measures and new phyiscal interventions (see appendix I). Also structural constraints and uncertainties are specifically being addressed and dealt with. Although the latter leaves room for improvement (see appendix I). For example, the rigidity of related policy (WFD and Natura 2000) – by focusing on objectives – may be a limiting factor to other solutions. Moreover, there are continuous tensions between safety and nature. For example, the Ministry of Agriculture, Nature, and Environment (LNV) is very ambitous as regards nature development in floodplains, while research reports (e.g. Alterra report 1624) show that floodplains and nature development are difficult to combine.

CC Adaptation in the Alentejo region in Portugal

The Alentejo region in Portugal does not have a climate change adaptation strategy in place, neither at the national scale. The only strategy in place for dealing with droughts is the National Program for Water Use Efficiency, but this program is not related to climate change issues. In general, the strategies are dominated by single loop learning, meaning that all efforts are focused on improvement of existing measures, such as building larger reservoirs (e.g. Alqueva Reservoir). The general perception is that improvement of irrigation will solve all problems. However, the current irrigation system is seriously threatened because reservoirs (e.g. Alqueva Reservoir) are suffering from an increasing salinity, which will even become worse because temperatures will increase due to climate change. Next to the fact that more

[3] Landelijke Initiatiefgroep Ruimte voor de Rivier, 2003, Meer waarden met een robuuste rivierruimte - Veiligheid, Ruimtelijke Kwaliteit en sociaal-economische vitaliteit

water is needed for agriculture due to increasing temperatures. Hence, increasing irrigation with saline water will eventually destroy soils, and thus, agricultural production. Even though environmental impacts assessments of the Alqueva Dam in 1992 have already been stressing that the situation in this region is unsustainable, the current management system has not been taking appropriate action up until today. Moreover, experts in the Alentejo region indicate that much faith has been put in the water transfers of the EMFA-project[4], a project seen as a solution to all water shortages. However, these water transfers are expected to lead to serious negative environmental impacts, and even to violations of the EU Habitat Directive (Platform for Sustainable Alentejo, 2005).

CC Adaptation in the Ohre Basin, Czech Republic

In the period after accession of the Czech Republic to the EU the Water Framework Directive represents the main tool for enforcing the water management policy, and as a result new water management planning has been launched in 2003. Climate change issues are being addressed in the Plan of Main River Basins of the Czech Republic (2007) - National Conception for Period 2007 – 2012. In general, the adaptation strategies in the Ohre Basin are dominated by double loop learning, although ad-hoc problem solving (single loop learning) may still be conceived as common sense in some instances. Nevertheless, spatial river basin planning with respect to appropriate land use change is a new management objective which reflects double loop learning, since it increases the boundaries for flood management. Additionally, the National Programme for the Reduction of Climate Change Impacts in the Czech Republic (by Ministry of the Environment, 2004), is explicitly considering climate change scenarios, and emphasizes the need to develop and implement appropriate adaptation measures in the relevant sectors including the water resource management sector. However, the translation into operational policy has not been taking place yet.

CC Adaptation in the Ukrainian part of the Tisza

The strategies in the Ukraine (see appendix IV), specifically addressing the Tisza Basin, are predominantly characterized by single loop learning, which means that coping strategies are mainly defined by enhancement of existing measures, such as "classic" extensive structural measures (e.g. dyke strengthening). Additionally, some elements of double loop learning have been observed as well (e.g. increase boundaries for flood management by replacement of dykes and natural retention areas to reduce flood run-off). Nevertheless, entirely new management measures are scarce, and no signs of influence of a shadow network have been observed in the strategies of the Ukrainian part of the Tisza. The revised State Program for Flood Protection in the Ukraine has been planning new flood protection measures in the period 2002-2010, and after re-assessment of what is effective (which allows at the same time for reallocation of resources) there will be a new implementation plan for the period 2010-2015. However, the revised State Program for Flood Protection does not include any climate change scenarios. In other words, there is a serious risk that the implemented and planned flood protection measures are not effective enough for dealing with increased frequency and intensity of floods in the coming decades.

[4] Empreendimento de Fins Múltiplos de Alqueva (EFMA): a plan for multiple uses of the Alqueva reservoir), a project which has been partially financed by the European Investment Bank (EIB) with loans totalling EUR 135 million

CC Adaptation in the Hungarian part of the Tisza

The strategies in Hungary (see appendix V), specifically addressing the Tisza, are quite unique compared to the other case-studies. Despite the fact that the management system in this part of the Tisza is showing relative low scores on all regime elements, the strategies in place include a number of elements related to double loop learning or even triple loop learning, such as changes in the actor network and changes in the regulatory framework. The discrepancy between the current management system, which is a rather traditional, centralized regime, and its outputs (an advanced flood defense strategy) is probably caused by the existence of a shadow network in this specific case-study. The VTT is an excellent example of double loop learning and a modified flood defence strategy by local actors and research institutions. The VTT in Hungary is formulated in light of the possible impacts of climate change, having in mind the potential uncertainties. The importance of shadow networks has been highlighted by researchers in Hungary - namely in flood protection, in flexible land and property management and in the formulation of the VTT as a flood defence strategy (Matczak et al, 2008). Nevertheless, the implementation of new Vásárhelyi Plan (2003) is seriously hampered, since the centralized management system has not managed to find agreement between different Ministeries on allocation of the necessary resources. Moreover, Jolankai *et al*. (2005) concludes that, based on the analysis of climate-change and precipitation scenarios, that higher floods than observed so far may occur, needing upgraded flood-control strategies (with the meaning that presently contemplated strategies, such as the VTT in Hungary, may not be sufficient to cope with floods). In conclusion, even though the Hungarian Tisza is an interesting example of the influence of an informal shadow network, it is especially this case-study were the expected outcomes of its adaptation strategies are largely unknown at present.

CC Adaptation in the Lower AmuDarya, Uzbekistan

The adaptation strategies in the Lower Amudarya are characterized by ad-hoc problem solving, meaning single loop learning. The debate on climate change has largely remained confined to the scientific establishments and has hardly involved the common people who are possibly least aware of the gravity of the impact that this phenomenon will have in their lives. Adaptation to extreme events (e.g. droughts) does not take into account climate change scenarios, but merely involves short term weather forecasting by UZHydromet, and improvement of existing measures, such as enlargement of the storage capacity of delta floodplains, construction of polders (e.g. Mezhdureche reservoir), leakage reduction, more efficient irrigation, upgrading of the drainage systems, plans for increasing capacity of pumps, and on a local scale the main solution for dealing with droughts is to apply more organic fertilizers to increase humidity, and using hand pumps to get groundwater. In general, stakeholder participation in policy-making is very limited, and Kay Wegerich (2007) shows that since independence in Uzbekistan, the state's influence on decision making over water allocation has grown rather than been reduced, while civil society is highly underdeveloped.

CC Adaptation in the Kagera Basin (Uganda, Rwanda, Burundi, Tanzania)

Although all countries in the Kagera Basin have ratified the UNFCC and have been developing National Action Programme for Adaptation (NAPA's), the NAPA strategies lack a clearly defined climate change vision. There are no clear actions at national and regional level except reforestation campaigns and river basin management and development under NBI. Adaptation strategies have to be improved and a strategy for resource mobilization developed. The debate on climate change has largely remained confined to the scientific establishments and has hardly involved the common people who are possibly least aware of the gravity of the impact that this phenomenon will have in their lives. Also some experts in the field, such as water managers and policy makers, are not yet aware of the problem or do not acknowledge the link of climate change to water management.

The current policy-making in the countries of the Kagera Basin is predominantly characterized by ad-hoc problem solving, meaning single loop learning. Politicians seem to have other political priorities than climate change, although scientists expect serious negative consequences for food security. So far, current river basin management mainly consist of improvement of existing measures, such as early warning systems for droughts, maintenance and enhancement of water storage, adjustment of planting dates and crop varieties, terracing and contouring is widely done in the catchment, reforestation campaigns (especially at hill tops), and expanded use of rainwater harvesting (e.g. by Rwanda Rainwater Harvesting Association).

Nevertheless, there are some promising initiatives as regards transboundary cooperation, since the Nile Basin Initiative (NBI) is bringing countries together for development of sustainable resource management for the Kagera Basin (By NELSAP - Kagera Transboundary Integrated Water Resources Management & Development Project). However, a Common Framework Agreement (CFA) between the countries has not been approved yet. At the same time, Uganda has started some experimentation on IWRM, and GEF funded Rwanda for Integrated Management of Critical Ecosystems (IMCE). Additionally, involvement of civil society is slowly increasing, for example by means of the Nile Basin Discourse Forum (NBDF) in each separate country of the Kagera Basin (www.nilebasindiscourse.org), although a clear influence of an informal network on policy-making has not been observed yet.

CC Adaptation in South Africa

The current strategies in South Africa (see appendix II) are partly characterized by single loop learning, which means that coping strategies are defined by enhancement of existing measures, such as optimising the current system of large storage dams and interbasin water transfer schemes and related infrastructure. However, in the strategies you can also find some elements of double loop learning (e.g. contingency planning for extreme events such as floods and droughts, flexibility in water use allocations, water demand and conservation mechanisms, and collaboration across national boundaries in the Orange Basin). However, at this moment strategies in SA do not take into account climate change scenarios in current policy-making, although good CC scenarios are available (IPCC downscaled). Moreover, although the National Climate Response Strategy (2004) is opting for a wide range of possible adaptation measures the translation of this strategy into operational policy has not occurred yet, mainly due to current institutional arrangements, extreme lack of skills and human capacity, and the traditional notion of water management which hampers

implementation. In general, current research in SA suggests that the political and planning response is lagging behind compared to the understanding of climate change (Mukheibir, 2007).

Table 6 - A summarized overview of outcomes being used for mvQCA (see chapter 6).

Case ID	Type of learning which is dominant	Binary outcomes
Rivierenland (Netherlands)	Double/triple loop learning	1
Alentejo (Portugal)	Single (ad-hoc problem solving)	0
Ohre (Czech Republic)	Single/Double loop learning	1
Tisza in Ukraine	Single (ad-hoc problem solving)	0
Tisza in Hungary	Single/Double loop learning	1
Kagera (Ug/Tan/Rwa/Bur)	Single (ad-hoc problem solving)	0
AmuDarya (Uzbekistan)	Single (ad-hoc problem solving)	0
Upper Vaal (South Africa)	Single/Double loop learning	1

Chapter 6 Relationship between the management systems and levels of learning in the adaptation strategies

Qualitative Comparative Analysis (QCA) – is particularly suitable for bringing out the full range of causal conditions associated with a particular outcome, and for identifying conjunctures of such conditions. The specific objective for using mvQCA in this paper is to identify specific configurations of conditions in Adaptive and Integrated Water Management (AIWM) that lead to higher levels of learning in river basin management (being reflected and/or consolidated by CC adaptation strategies to deal with either floods or droughts). Our method allows different causal models leading to a particular outcome, meaning that we are not looking for a blueprint in water management systems.

Table 6 shows the Raw Data Table after drawing data from table 4 and 5. The first nine columns show data based on table 4, while the last column shows data based on table 5. Hence, the last column shows the output of each management system (level of learning), but it is NOT a summary or synthesis of the first nine columns, since the outputs have been independently assessed. For the first nine columns, '0' indicates a condition variable belonging to a non-adaptive (traditional) regime, '1' indicates a condition variable in between non-adaptive and adaptive, '2' indicates a condition variable belonging to an integrated adaptive regime. For the last column, '0' indicates an output (= adaptation strategy) dominated by single loop learning, '1' indicates on output dominted by double/triple loop learning.

Table 6a - Raw Data Table (based on synthesis of table 4 and 6).

	Agency	Awareness raising & Education	Type of Governance	Cooperation structures	Policy development & implementation	Information Management	Finance and Cost Recovery	Risk Management	Effectiveness Internat. Regulation	**Outcome** (0=dominated by single loop learning)
Rivierenland	1.6	1.3	0.9	1.7	1.5	1.8	1.2	1.2	1.6	**1**
Alentejo	0.8	0.7	0.0	1.0	0.9	0.8	0.8	1.0	1.3	**0**
Ohre	1.5	1.1	0.4	1.3	1.3	1.5	1.1	1.4	1.5	**1**
Tisza Ukraine	0.9	0.6	0.4	1.1	0.9	1.0	0.3	0.6	1.2	**0**
Tisza Hungary	0.9	0.4	0.2	0.8	0.9	0.6	0.6	0.8	1.2	**1**
AmuDarya	1.1	0.8	0.1	0.9	0.6	0.7	0.2	0.6	1.5	**0**
Kagera	1.1	1.0	0.2	1.1	1.1	1.0	0.6	0.6	1.5	**0**
Upper Vaal	1.0	1.5	0.4	1.4	1.2	1.4	1.3	1.6	1.2	**1**

Table 6 shows a contradiction in the outputs: while the adaptation strategies in the Hungarian Tisza are dominated by double loop learning (output = '1'), the scores on the causal conditions of the management system in the Hungarian Tisza belong to the (relatively) lowest of all case-studies. In other words, one would expect a '0' output for this case-study, since other management systems (e.g. Alentejo, AmuDarya, and Kagera) with similar or even better scores on the causal conditions are also showing a '0' output (= dominated by single loop learning). Hence, including the Hungarian Tisza in the mvQCA would propably lead to contradictions in the truth table (see paragraph 6.1). When a truth table shows such a contradiction it is not valid for conducting a Boolean minimization. Therefore this specific contradiction needs to be resolved. A logical explanation for such a contradiction is the presence or absence of an additional causal condition. For example, the importance of informal (shadow) networks has been highlighted by researchers in Hungary - namely in flood protection, in flexible land and property management and in the formulation of the VTT as a flood defence strategy (Matczak *et al*, 2008). At the same time, literature indicates that the influence of such an informal (shadow) network is lacking in the Alentejo Region in Portugal (Videira, *et* al., 2005). Also regarding Uzbekistan, Kay Wegerich (2007) shows that since independence in Uzbekistan, the state's influence on decision making over water allocation has grown rather than been reduced, while civil society is highly underdeveloped. According to Wegerich a new comanagement arrangement is not so likely in such circumstances. Also in the Kagera Basin the influence of informal shadow networks on current policy making is very limited.

For the purpose of this comparative analysis it is important to acknowledge the fact that the Hungarian Tisza is an exceptional case due to an additional causal condition (e.g. the influence of a shadow network). Assessing which causal condition(s) could explain the output of this case-study is beyond the scope of this paper, although a likely explanation as been given in above paragraph. Nevertheless, for this specifc mvQCA the Hungarian Tisza will be left out in order to avoid contradictions in the Truth Table. This resulted in the raw data table shown below (table 6b).

Table 6b - Raw Data Table (without Hungarian Tisza).

	Agency	Awareness raising & Education	Type of Governance	Cooperation structures	Policy development & implementation	Information Management	Finance and Cost Recovery	Risk Management	Effectiveness Internat. Regulation	**Outcome** (0=dominated by single loop learning)
Rivierenland	1.6	1.3	0.9	1.7	1.5	1.8	1.2	1.2	1.6	**1**
Alentejo	0.8	0.7	0.0	1.0	0.9	0.8	0.8	1.0	1.3	**0**
Ohre	1.5	1.1	0.4	1.3	1.3	1.5	1.1	1.4	1.5	**1**
Tisza Ukraine	0.9	0.6	0.4	1.1	0.9	1.0	0.3	0.6	1.2	**0**
AmuDarya	1.1	0.8	0.1	0.9	0.6	0.7	0.2	0.6	1.5	**0**
Kagera	1.1	1.0	0.2	1.1	1.1	1.0	0.6	0.6	1.5	**0**
Upper Vaal	1.0	1.5	0.4	1.4	1.2	1.4	1.3	1.6	1.2	**1**

6.1 Data reduction

The next step in conducting a formal comparative analysis (using mvQCA) is threshold setting. Threshold-setting is necessary for distinguishing between clusters on one condition variable, leading to dichotomous or trichotomous variables. This type of data reduction is necessary for developing models (= combinations of condition variables leading to a particular outcome) to be tested with mvQCA. In order to ensure transparency in the analysis (= QCA good practice) this paragraph represents the steps taken to obtain the best model possible.

In order to obtain the best model possible it is necessary to conduct a series of exploratory analyses, depending on various ways of operationalizing the conditions. For this purpose we have used different strategies for setting thresholds on each condition variable: 1) Threshold setting by modeller's judgement; 2) Threshold setting on median; 3) Systematic threshold setting; and 4) Multiple modelling between two extreme opposite models. Each strategy resulted in different models being used for boolean minimization. The purpose of these successive analyses is to obtain the best model possible (meaningful in terms of cases, theory, devoid of contradictory configurations and, at the same time, sufficiently "short" (not too many conditions, because it is a "small N" design). Of course, these last 2 goals are somewhat "in tension" : the shorter the model, the more you run the risk of obtaining contradictory configurations.

Data reduction strategy 1 – Threshold setting by modeller's judgement

The first strategy is to determine the thresholds on each condition variable by means of modeller's judgement. Thresholds have been set by distinguishing between clusters of average scores. In other words, clusters haven been separated by setting

one threshold in between them. If possible, condition variables have been clustered into two groups, leading to a dichotomous variable, for others three clusters were more appropriate, leading to a trichotomous variable. Table 7a shows mvQCA data based on this strategy.

On the conditon variable *Agency* ('Lead') there are two distinct clusters of weighted averages. One cluster is including the Ohre Basin and Rivierenland with relatively high scores on this condition variable. The other case-studies belong to the cluster including relatively low scores. Hence, one threshold (on 1.2) has been set between these two distinct clusters.

For the condition variable *Awareness Raising and Capacity building* ('Cap') three distinct clusters can be recognized, hence, two thresholds have been set in order to distinguish between them.

On the condition variable *Type of governance* ('Gov') two thresholds have been chosen (resulting in three clusters), since the role or influence of civil society and lower level governments in Rivierenland is clearly more visible than in case-studies which show limited bottom-up governance (e.g. Tisza Ukraine, Ohre Basin, and Upper Vaal), while some case-studies are cleary dominated by top-down governance (e.g. Alentejo, AmuDarya and Kagera).

On the condition variable C*ooperation structures* ('Coop') two distinct clusters can be recognized, and one exceptional high score for Rivierenland. Hence, to distinguish between these scores two thresholds have been set.

The condition variable *Information Management* ('Inf') shows the largest difference, of all variables, between the lowest (0.7) and highest average (1.8). Because of this relatively large difference, plus the clear presence of three distinct clusters, two thresholds have been set.

For the condition variables *Policy development and implementation* ('Pol'), *Finances and Cost Recovery* ('Fin'), *Risk Management* ('Ris'), and *Effectiveness of International regulation* ('Eff'), two distinct clusters on each variables were recognized. Hence, one threshold has been set on each one of them, leading to dichotomous variables.

Boolean minimization (explaining 1 outcomes, including logical remainders) shows that when **Coop** is 1 or 2, **or Inf** is 2 it will lead to a positive outcome. Boolean minimization (explaining 0 outcomes, including logical remainders) shows that when Coop is 0 or Inf is 0 or 1 it will lead to a negative outcome.

Table 7a – mvQCA data based on strategy 1

Data | MVQCA Data

	Case ID	Lead 1.2	Cap 0.9; 1.2	Gov 0.3; 0.6	Coop 1.2; 1.55	Pol 1	Inf 0.93; 1.25	Fin 0.75	Ris 0.9	Ef 1.4	Output
▶	Rivierenland	1 (1.6)	2 (1.3)	2 (0.9)	2 (1.7)	1 (1.5)	2 (1.8)	1 (1.2)	1 (1.2)	1 (1.6)	1
	Alentejo	0 (0.8)	0 (0.7)	0 (0)	0 (1)	0 (0.9)	0 (0.8)	1 (0.8)	1 (1)	0 (1.3)	0
	Ohre	1 (1.5)	1 (1.1)	1 (0.4)	1 (1.3)	1 (1.3)	2 (1.5)	1 (1.1)	1 (1.4)	1 (1.5)	1
	Ukraine	0 (0.9)	0 (0.6)	1 (0.4)	0 (1.1)	0 (0.9)	1 (1)	0 (0.3)	0 (0.6)	0 (1.2)	0
	AmuDarya	0 (1.1)	0 (0.8)	0 (0.1)	0 (0.9)	0 (0.6)	0 (0.7)	0 (0.2)	0 (0.6)	1 (1.5)	0
	Kagera	0 (1.1)	1 (1)	0 (0.2)	0 (1.1)	1 (1.1)	1 (1.1)	0 (0.6)	0 (0.6)	1 (1.5)	0
	Upper Vaal	0 (1)	2 (1.5)	1 (0.4)	1 (1.4)	1 (1.2)	2 (1.4)	1 (1.3)	1 (1.6)	0 (1.2)	1
*											

Data reduction strategy 2 – Threshold setting on median

The second strategy involves a less arbitrary mode of setting thresholds, although this stategy runs the risk of distinguishing between scores which are very close to each other. Hence, distinctions between case-studies may be exaggerated. This strategy is setting one threshold on each condition variable on the same position as the median of each distribution of scores. The median is the middle of a distribution: half of the scores are above the median and half are below the median. Table 7b shows mvQCA data based on this strategy. Boolean minimization (explaining 1 outcomes, including logical remainders) shows that when **Cap, Coop, Pol, Inf, Fin, or Risk** are 1 it will lead to a positive outcome. Boolean minimization (explaining 0 outcomes, including logical remainders) shows that when Cap, Coop, Pol, Inf, Fin, or Risk are 0 it will lead to a negative outcome. Table 7b shows mvQCA data based on this strategy.

Table 7b - mvQCA data based on strategy 2

Data | MVQCA Data

Case ID	Lead 1.1	Cap 1	Gov 0.4	Coop 1.1	Pol 1.1	Inf 1.1	Fin 0.8	Ris 1	Ef 1.5	Output
Rivierenland	1 (1.6)	1 (1.3)	1 (0.9)	1 (1.7)	1 (1.5)	1 (1.8)	1 (1.2)	1 (1.2)	1 (1.6)	1
Ohre	1 (1.5)	1 (1.1)	0 (0.4)	1 (1.3)	1 (1.3)	1 (1.5)	1 (1.1)	1 (1.4)	0 (1.5)	1
Kagera	0 (1.1)	0 (1)	0 (0.2)	0 (1.1)	0 (1.1)	0 (1.1)	0 (0.6)	0 (0.6)	0 (1.5)	0
AmuDarya	0 (1.1)	0 (0.8)	0 (0.1)	0 (0.9)	0 (0.6)	0 (0.7)	0 (0.2)	0 (0.6)	0 (1.5)	0
Upper Vaal	0 (1)	1 (1.5)	0 (0.4)	1 (1.4)	1 (1.2)	1 (1.4)	1 (1.3)	1 (1.6)	0 (1.2)	1
Ukraine	0 (0.9)	0 (0.6)	0 (0.4)	0 (1.1)	0 (0.9)	0 (1)	0 (0.3)	0 (0.6)	0 (1.2)	0
Alentejo	0 (0.8)	0 (0.7)	0 (0)	0 (1)	0 (0.9)	0 (0.8)	0 (0.8)	0 (1)	0 (1.3)	0

Data reduction strategy 3 – Systematic threshold setting

The third strategy is setting the threshold exactly in between the lowest and highest score on each condition variable. Table 7c shows mvQCA data based on this strategy. Boolean minimization (explaining 1 outcomes, including logical remainders) shows that when **Cap, Inf, or Risk** are 1 it will lead to a positive outcome. Boolean minimization (explaining 0 outcomes, including logical remainders) shows that when Cap, Inf, or Risk are 0 it will lead to a negative outcome.

Table 7c - mvQCA data based on strategy 3

Data | MVQCA Data

Case ID	Lead 1.2	Cap 1.05	Gov 0.45	Coop 1.3	Pol 1.05	Inf 1.25	Fin 0.7	Ris 1.1	Ef 1.4	Output
Rivierenland	1,6	1,3	0,9	1,7	1,5	1,8	1,2	1,2	1,6	1
Ohre	1,5	1,1	0,4	1,3	1,3	1,5	1,1	1,4	1,5	1
Kagera	1,1	1	0,2	1,1	1,1	1,1	0,6	0,6	1,5	0
AmuDarya	1,1	0,8	0,1	0,9	0,6	0,7	0,2	0,6	1,5	0
Upper Vaal	1	1,5	0,4	1,4	1,2	1,4	1,3	1,6	1,2	1
Ukraine	0,9	0,6	0,4	1,1	0,9	1,0	0,3	0,6	1,2	0
Alentejo	0,8	0,7	0	1	0,9	0,8	0,8	1	1,3	0

Data reduction strategy 4 - Multiple modelling between two extreme opposite models

In this strategy the range between the lowest and highest score on each condition variable is divided by three, resulting in three different categories: high, medium and low. For example, when the range between the lowest and highest score is 0.9 (see for example 'Cap' and 'Gov') then each category has a range of 0.3. Then the categorie 'low' is defined by the range starting from the lowest category plus 0.3. For the condition variable 'Cap' this method results in the following categories: low = 0.6-0.9; medium = 0.9-1.2; high = 1.2-1.5. After dividing all condition variables in three categories the next step is to deduct extreme models. For the first extreme model (Model A) all condition variables are being scored according to the principle: low = 0 and medium and high = 1. The second extreme, and opposite, model (Model B) is scored according to the principle: low and medium = 0; high = 1. This strategy is resulting in two extreme opposite models with one threshold on each condition variable (see table 7d and 7e).

For model A Boolean minimization (explaining 1 outcomes, including logical remainders) shows that when **Coop** is 1 it will lead to a positive outcome. Boolean minimization (explaining 0 outcomes, including logical remainders) shows that when Coop is 0 it will lead to a negative outcome.

For model B Boolean minimization (explaining 1 outcomes, including logical remainders) shows that when **Fin** is 1 it will lead to a positive outcome. Boolean minimization (explaining 0 outcomes, including logical remainders) shows that when Fin is 0 it will lead to a negative outcome.

The next step is developing models which are located in between Model A and B. This has been done by taking Model A as a starting point, and setting each threshold 0.1 higher (Model C). Another model has been developed by taking Model B as a starting point, and setting each threshold 0.1 lower (Model D).

For model C Boolean minimization (explaining 1 outcomes, including logical remainders) shows that when **Cap, Coop, Inf or Ris** are 1 it will lead to a positive outcome. Boolean minimization (explaining 0 outcomes, including logical remainders) shows that when Cap, Coop, Inf or Ris are 0 it will lead to a negative outcome.

For model D Boolean minimization (explaining 1 outcomes, including logical remainders) shows that when **Pol, Inf, Fin or Ris** are 1 it will lead to a positive outcome. Boolean minimization (explaining 0 outcomes, including logical remainders) shows that when Pol, Inf, Fin or Ris are 0 it will lead to a negative outcome.

Table 7d - mvQCA data based on strategy 4, and showing model A variant for each condition variable

Data | MVQCA Data

	Case ID	Lead 1.07	Cap 0.9	Gov 0.3	Coop 1.17	Pol 0.9	Inf 1.07	Fin 0.57	Ris 0.93	Ef 1.33	Output
▶	Rivierenland	1,6	1,3	0,9	1,7	1,5	1,8	1,2	1,2	1,6	1
	Alentejo	0,8	0,7	0	1	0,9	0,8	0,8	1	1,3	0
	Ohre	1,5	1,1	0,4	1,3	1,3	1,5	1,1	1,4	1,5	1
	Ukraine	0,9	0,6	0,4	1,1	0,9	1,0	0,3	0,6	1,2	0
	AmuDarya	1,1	0,8	0,1	0,9	0,6	0,7	0,2	0,6	1,5	0
	Kagera	1,1	1	0,2	1,1	1,1	1,1	0,6	0,6	1,5	0
	Upper Vaal	1	1,5	0,4	1,4	1,2	1,4	1,3	1,6	1,2	1

Table 7e - mvQCA data based on strategy 4, and showing model B variant for each condition variable.

	Case ID	Lead 1.33	Cap 1.2	Gov 0.6	Coop 1.43	Pol 1.2	Inf 1.43	Fin 0.93	Ris 1.27	Ef 1.47	Output
▶	Rivierenland	1,6	1,3	0,9	1,7	1,5	1,8	1,2	1,2	1,6	1
	Alentejo	0,8	0,7	0	1	0,9	0,8	0,8	1	1,3	0
	Ohre	1,5	1,1	0,4	1,3	1,3	1,5	1,1	1,4	1,5	1
	Ukraine	0,9	0,6	0,4	1,1	0,9	1,0	0,3	0,6	1,2	0
	AmuDarya	1,1	0,8	0,1	0,9	0,6	0,7	0,2	0,6	1,5	0
	Kagera	1,1	1	0,2	1,1	1,1	1,1	0,6	0,6	1,5	0
	Upper Vaal	1	1,5	0,4	1,4	1,2	1,4	1,3	1,6	1,2	1

Intermediate conclusion

Based on the above strategies for data reduction 7 different models have been tested with Boolean minimization. The first observation is that the condition variables *Agency* ('Lead'), *Governance* ('Gov') and *Effectiveness of International Regulation* ('Eff') are not mentioned in any of the minimal formulas, meaning that these condition variables are not relevant in explaining the outcomes. Hence, these specific condition variables are being left out in in the following Boolean minimizations, in order to reduce the number of simplifying assumptions.

Furthermore, the scores on the condition variable *Awareness Raising and Capacity Building* do not allow for a valid comparison between the case-studies, since the weighted averages are not representative for the current status of human capital. For example, while the Upper Vaal case-study is having a high score on this variable, literature indicates that South African water management is suffering from an extreme lack of skills and human capacity (Mukheibir, 2007). In other words, capacity building is high on the agenda (explaing the high scores on this variable), while the capacity itself is quite problematic. At the same time, Rivierenland is also showing high scores on this variable, but in this case the human capital is not problematic. Hence, there cannot be a valid comparison of scores on this specific variable, and for this reason it will be left out in the mvQCA.

6.2 Truth Table

The Truth Table shows a summary of both the different combinations of input values (independent variables) and their associated output values (the dependent variable). Based on the results of paragraph 6.1 four condition variables have been left out in order to reduce the number of simplifying assumptions, resulting in a truth table with five causal condtions. Table 8 show the truth table based on strategy 1.

Table 8 – Representative Truth Table (based on strategy 1) with five causal conditions.

Case ID	Coop	Pol	Inf	Fin	Ris	Output
Rivierenland	2	1	2	1	1	1
Alentejo	0	0	0	1	1	0
Ohre,Upper Vaal	1	1	2	1	1	1
Ukraine	0	0	1	0	0	0
AmuDarya	0	0	0	0	0	0
Kagera	0	1	1	0	0	0

The most important observation at this point is that there seems to be some "logic" in the data shown in the truth table. For example, when the output is "1" there is a higher density of "1" and "2" condition values, while there is a higher density of "0" condition values when the output is "0". This observation is consistent with our working hypothesis stating that a higher level of AIWM is showing a different response in coping with floods and droughts than case-studies with a lower level of AIWM. The response in the case-studies with a higher level of AIWM is different in terms of higher levels of learning, being reflected and/or consolidated in the adaptation strategies to deal with floods or droughts.

6.3 Boolean Minimization

The analyses shown below are based on truth table 8. Since no contradicting simplifying assumptions (CSA's) have been identified, it means that the Boolean minimization was valid, and the minimal formula provides a justified identification of specific configurations of conditions in Adaptive and Integrated Water Management (AIWM) that lead to higher levels of learning in river basin management (being reflected and/or consolidated by CC adaptation strategies to deal with either floods or droughts).

The analysis, explaining the '0' outcomes (without logical remainders), is producing the following minimal formula:

[formula 1]

Coop{0} * Inf{1} * Fin{0} * Ris{0} +	Coop{0} * Pol{0} * Inf{0} * Fin{1} * Ris{1} +	Coop{0} * Pol{0} * Inf{0} * Fin{0} * Ris{0}	→ Output {0}

(Ukraine+Kagera)	(Alentejo)	(AmuDarya)	

Translation of formula 1 into verbal statements:

"In the case-studies Ukrainian Tisza and Kagera Basin, single loop learning is dominant when the conditions cooperation structures, finances and cost recovery and risk management show a "0" value, and information management shows a "1'' value."

Or

"In the case-study Alentejo, single loop learning is dominant when the conditions cooperation structures, policy development and -implementation, information management show a "0" value, and the conditions finances and cost recovery and risk management show a "1" value."

Or

"In the case-study AmuDarya, single loop learning is dominant when all conditions show a "0" value."

Not much parimony is gained with formula 1, except that the condition policy development and -implementation does not play a role in explaining the outcome in the case-studies Ukrainian Tisza and Kagera Basin. For the other two case-studies (Alentejo and AmuDarya) the formula merely represents what already could be observed from data in the truth table, in other words, no parsimony could be gained. When no, or only limited, parsimony can be gained it is useful to include logical remainders (see following paragraph).

The analysis, explaining the '0' outcomes (including logical remainders), is producing the following two (alternative) minimal formulas:

[formula 2]

Coop{0}	→ Output {0}
(Alentejo+Ukraine+AmuDarya+Kagera)	
Number of Simplifying Assumptions: 20	

Translation of formula 2 into a verbal statement:

"In the case-studies Alentejo, Ukrainian Tisza, AmuDarya and Kagera Basin, single loop learning is dominant when the condition **cooperation structures** shows a "0'' value."

[formula 3]

Inf{0,1}	→ Output {0}
(Alentejo+Ukraine+AmuDarya+Kagera)	
Number of Simplifying Assumptions: 22	

Translation of formula 3 into a verbal statement:

"In the case-studies Alentejo, Ukrainian Tisza, AmuDarya and Kagera Basin, single loop learning is dominant when the condition **information management** shows a "0'' or "1" value."

By including logical remainders the boolean minimization produces two alternative formulas. Each one of them may tell a coherent story, and they will be used both for deriving conclusions.

Intermediate conclusion: All case-studies with a relatively low score on cooperation structures or information management are characterized by single loop learning or ad-hoc problem solving (as being reflected in their strategies to deal with either floods or droughts).

The analysis, explaining the '1' outcomes (without logical remainders), is producing the following minimal formula:

[formula 4]

Coop{2} * Pol{1} * Inf{2} * Fin{1} * Ris{1} +	Coop{1} * Pol{1} * Inf{2} * Fin{1} * Ris{1}	→ Output {1}
(Rivierenland)	(Ohre,Upper Vaal)	

Translation of formula 4 into verbal statements:

"In the case-study Rivierenland at least double loop learning occurs when the conditions cooperation structures and information management show a "2" value, and the conditions policy development, finances and cost recovery and risk management show a "1" value."

Or

"In the case-studies Ohre Basin and Upper Vaal at least double loop learning occurs when the conditions cooperation structures, policy development, finances and cost recovery and risk management show a "1" value, and the condition information management shows a "1" value."

Again, not much parsimony can be gained by excluding the logical remainders (in formula 4). When no, or only limited, parsimony can be gained it is useful to include logical remainders (see following paragraph).

The analysis, explaining the '1' outcomes (including logical remainders), is producing the following two (alternative) minimal formulas:

[formula 5]

Coop{1,2}	→ Output {1}
(Rivierenland+Ohre,Upper Vaal)	
Number of Simplifying Assumptions: 23	

Translation of formula 5 into a verbal statement:

"In the case-studies Rivierenland, Ohre Basin, and Upper Vaal at least double loop learning occurs when the condition **cooperation structures** shows a "1" or "2" value."

[formula 6]

Inf{2}	→ Output {1}
(Rivierenland+Ohre,Upper Vaal)	
Number of Simplifying Assumptions: 22	

Translation of formula 6 into a verbal statement:

"In the case-studies Rivierenland, Ohre Basin, and Upper Vaal at least double loop learning occurs when the condition information management shows a "2" value."

We have checked for the presence of possible contradictory simplifying assumptions[5] and have established that no such contradictory simplifying assumptions are present when we "cross" minimal formulas numbers 2 & 3 with minimal formulas numbers 5 & 6. Therefore, we can proceed with the interpretation of the minimal formulas.

6.4 Interpretation of the minimal formulas

Based on the short minimal formula's (formulas 3 & 4 and 5 & 6) we can conclude that everything boils down to 2 core factors: **cooperation structures** and **information management**. In other words, a relatively high score on cooperation structures or information management is a necessary and sufficient condition leading to at least double loop learning in Rivierenland, Ohre Basin, and Upper Vaal. All case-studies with a relatively low score on cooperation structures or information management are characterized by single loop learning or ad-hoc problem solving (as being reflected in their strategies to deal with either floods or droughts).

As e.g. Folke et al. (2005) have pointed out, social learning is needed to build up experience for coping with uncertainty and change. They emphasize that "knowledge generation in itself is not sufficient for building adaptive capacity in social-ecological systems to meet the challenge of navigating nature's dynamics" and conclude that "learning how to sustain social-ecological systems in a world of continuous change needs an institutional and social context within which to develop and act". Knowledge and the ability to act upon new insights are continuously enacted in social processes. Our research presented in this paper provides strong empirical evidence that the social network of stakeholders is an invaluable asset for dealing with change.

Moreover, above conclusions support our initial assumption that effective AIWM is able to facilitate a change in strategy, as being an adaptation to climate change. As such, there is a reciprocal relationship between AIWM and the development of adaptation strategies. Moreover, our assumption is confirmed that this relationship is reciprocal only in a situation of bottom-up governance, including real participation of non-governmental stakeholders, but also from different government sectors, lower levels of government, and downstream stakeholders. This bottom-up process is emerging from partnerships and networks (Geels et al., 2004).

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[5] *Checking that some of the same logical remainders are not used both for the minimization of the {1} outcome configurations and for the minimization of the {0} outcome configurations, which would produce some contradictory assumptions regarding the outcome value of that logical remainder (Rihoux and Ragin, 2008: 182)*

What is also important is that the conditions policy development and –implementation, finances and cost recovery, and risk management are not in the minimal formulas, and thus do not play the most central „causal" role here. This observation could suggest to further investigate whether these conditions may be considered as outcomes of an adaptation strategy. In that case it would support our assumption that the relationship between the management systems and its adaptation strategy is reciprocal, since the strategy itself is influencing the management system on its turn. This means that there could be many nonlinear feedback loops within the management regime itself, and the regime is in that sense creating its own enabling environment. Especially in regimes with a higher level of AIWM the formal institutional setting is being altered by the demand for governance as regards (new developments in) water related problems, such as the impacts of climate change. Examples include the Dutch National Water Agreement (Bestuursakkoord Water, 2002), leading towards the start of implementing the Room for Rivers-policy (PKB Ruimte voor de Rivier, 2006), and the Hungarian National Drought Strategy (2004). Nevertheless, the complex interdependency as described above is only addressed to a limited extent in this research, but is very important to be taken into account by future research activities. Especially for analyzing dynamic or transitional systems it is crucial to conduct longitudinal research.

Chapter 7 Overall Conclusions

Based on the results of the analyses presented in the previous chapters we can derive the following overall conclusions:

1. There are many positive correlations between variables from different elements in the management system, for example, joint/participative information production is positively correlated with vertical cooperation (p=0.91), transboundary cooperation (p=0.95), consideration of uncertainties (p=0.95), and broad communication (p=0.90). These correlations lead to the conclusion that a lack of joint/participative knowledge (production) is an important obstacle for cooperation and dealing with uncertainty and change, which is also being suggested by other researchers (Olsson et al., 2006; Stubbs and Lemon, 2001; Tompkins and Adger, 2004).
2. Additionally, the above correlations suggest a strong interdependence of the elements within a water management regime, and as such this interdependence is a stabilizing factor in current management regimes. One cannot, for example, move easily from top-down to participatory management practices without changing the whole approach to information and risk management.
3. A relatively high score on cooperation structures or information management are causal conditions leading to at least double loop learning in Rivierenland, Ohre Basin, and Upper Vaal. In the case-studies were these conditions are less developed - like the Alentejo Region, AmuDarya and Kagera Basin - the strategies are dominated by single loop learning (ad-hoc problem solving). In other words, better integrated cooperation structures (including non-governmental stakeholders, governments from different sectors and different hierarchical levels), and advanced information management (including joint/participative information production, consideration of uncertainties, and broad communication) are the key factors leading towards higher levels of learning, being reflected and/or consolidated in more advanced adaptation strategies for dealing with floods or droughts.
4. Although the conceptual foundations of AIWM may suggest that bottom-up governance is a straight forward solution to water management problems, the weighted averages on governance suggest otherwise. For example, the weighted average on governance in Rivierenland (0.9 on a scale of 0.0 to 2.0, with 0.0 as top-down governance and 2.0 als bottom-up governance) indicates that there is much more topdown governance than could be expected from consensus-based decision-making, particularly since the Netherlands is well-known for its consensus-based decision-making (also called the 'Poldermodel'). The fact that Rivierenland also shows a substantial degree of top-down governance is reflected in the framework for flood management (PKB Room for Rivers) in the Netherlands, which was initiated by the national government (Berenschot, 2007). Nevertheless, after initiation by the national government the framework was being further developed, and this process was much more characterized by bottom-up governance (idem, 2007). This bottom-up process was, amongst others, reflected in the document called "Advice to the parliament as regard the PKB Room for Rivers by nine civil society organisations" (LIRR, 2003).

5. In summary, for large-scale, complex multiple-use systems, such as river basins, this research suggests that bottom-up governance and decentralization is not a straight forward solution to water management problems. There will probably always be the need for a certain degree of top-down governance (or centralization), for example in the area of transboundary issues, capacity building, setting of standards and conflict resolution. All the case-studies in this research seem to be in a process of finding a balance between bottom-up and top-down governance.
6. Nevertheless, we can also conclude that management regimes characterized by a high level of top-down governance are dominated by lower levels of learning (= single loop learning / ad-hoc problem solving), such as the management regimes in the Alentejo Region, AmuDarya and Kagera Basin. This lower level of learning is being reflected and/or consolidated in less advanced adaptation strategies. Also the Hungarian part of the Tisza is characterized by top-down governance, although they have managed to develop an advanced adaptation strategy (new Vásárhelyi Plan (VTT), 2003), probably caused by the existence of a shadow network in this specific case-study. The VTT is an excellent example of double loop learning and a modified flood defence strategy by local actors and research institutions. However, the current implementation of this plan is seriously hampered, since the centralized management system has not managed to find agreement between different Ministeries on allocation of the necessary (financial) resources. In other words, a high degree of top-down governance seems to be a serious limiting factor in this case-study as well.
7. Different responses to drought and flood events: case-studies which are recently confronted with floods have most advanced strategies, while drought response/adaptation seems to be much slower > possibly explained by different risk perceptions and differences in the availability of solutions.
8. Additionally, this research shows that in a basin where one type of extreme is dominant – like droughts in the Alentejo (Portugal) and floods in Rivierenland (Netherlands) - the potential impacts of other extremes are somehow ignored or not perceived with the urgency they might deserve.

Contextual differences

It is important to recognize that the ability to adapt in the individual countries may depend on the availability of financial resources, technologies, levels of education, available information, suitable planning and the overall infrastructure. It holds in general that the economically and socially more developed countries have disproportionately greater potential for adaptation compared to developing countries. The regional differences in technical progress, natural circumstances and financial resources determine the potential for development and implementation of adaptation measures.

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Appendix I: Adaptation strategies in Rivierenland, The Netherlands

Introduction

This questionnaire is focussing on the development/implementation of an adaptation strategy to deal with the (expected increase in frequency and intensity of) floods in the Netherlands, more specifically related to Water Board Rivierenland (as part of the Lower Rhine Basin)

A strategy is being defined as a policy document and/or plan which describes the objective(s), means to achieve this objective (plan of measures), and a time schedule for implementation.

Questions and Answers

Based on interviews in the Netherlands by Patrick Huntjens and based on relevant literature.

1) Strategy currently in place (or being developed) to deal with floods and/or droughts:

- Room for Rivers Program

2) Current status of strategy:

Fully developed flood strategy including plan of measures: In 2006 the Cabinet drew up the Spatial Planning Key Decision Room for the River (Planologische Kernbeslissing Ruimte voor de Rivier), which can be considered the final stage (centerpiece) of a fully developed CC adaptation strategy for dealing with floods; strategy implementation is ongoing.

3) Strategy's objectives

The Room for Rivers Program has three objectives:

- In 2015 the Rhine branches will safely cope with an outlet capacity of 16,000 cubic metres of water per second; Additionally all measures should fit into long term objectives (18.000 m3/s at Lobith, 4600 m3/s for Meuse)
- The measures implemented to achieve the above will also improve the quality of the environment of the river basin;
- The extra space the rivers will need throughout the coming decades, subsequent to expected climate changes, will remain available.

4) Most important driver(s) to initiate strategy development (high-low ranking)

- Floods in 1993 and 1995. Although no dyke breaches have occurred there was a preventive evacuation of 150.000 people.
- National and international policies

5) Understanding of CLIMATE CHANGE in the region: is it happening?

In the Netherlands there is a recognition of climate related problems for water management, and a high level of awareness about the impacts of climate change among population, scientists and policy makers.

In the Netherlands the climate scenarios of KNMI are the bases for adaptation within the water sector (From national to water board level). Agreement on this is formalized in the so-called Bestuursakkoord Water in 2003 (Management Agreement on Water). This also means that regional scenarios are present, however there is a need for improvement seen from the point of science. For policy making the present scenarios are sufficient. Constantly changing scenarios make policy making difficult.

6) How does new CC information / innovations enter the policy-making process (e.g. via informal (shadow) networks, formal commissions, etc.?

By means of consultative groups (=klankbordgroepen), management teams (=stuurgroepen), local stakeholders groups, etcetera; for example Natuurmonumenten, Utrechts Landschap, Gelders Landschap, Staatsbosbeheer (semi-overheid), Stichting Ark, etc

By means of a shadow network: for example civil society involvement is being reflected in "Advice to the parliament as regard the PKB Room for Rivers by nine civil society organisations" (Landelijke Initiatiefgroep Ruimte voor de Rivier, 2003, Meer waarden met een robuuste rivierruimte - Veiligheid, Ruimtelijke Kwaliteit en sociaal-economische vitaliteit).

Formal commissions, such as Luteijn, FiKa, etc. However, FiKA was an ad-hoc commission established during the process, after identifying financial contraints for strategy implementation.

Near Avelingen a management experiment has been initiated to test how the proces for developing flood management plans can be designed alternatively.

In the proces of developing the Room for Rivers-policy the so-called Blokkendoos (report on alternative measures, its effects and cost efficiency) was an important tool for knowledge transfer to decision makers.

7a) Implemented or Planned Actions: Entirely new management measures?

Yes, for example the decision by Parliament, prior to initiating strategy development, to combine central and decentral interests during development of the strategy, was one of the succes factors of the Room for Rivers-policy (Berenschot, 2007). This decision contributed to consensual decision-making. A decentral development of the strategy was coordinated by provinces, and being consolidated in a regional advice. In some cases the provinces, water boards, and municipalites are already initiating the implementation of measures being defined in the strategy. Additionally, the Spatial Planning Decision (PKB) offers the flexibility to include new initiatives when they apply to the boundary conditions.

Also pilot projects and a programmatic approach have contributred to a succesful proces (Berenschot, 2007). The pilot projects which have already been initiated during the proces of strategy development provided stimuli to move certain measures forward. Moreover, the programmatic approach made it possible that specific projects could be adjusted or replaced by better alternatives in a later stage

of the proces. This approach provided more leverage for decision-making (Berenschot, 2007).

However, the rigidity of related policy (WFD and Natura 2000) – by focusing on objectives – may be a limiting factor to other solutions. Moreover, there are continuous tensions between safety and nature. The Ministry of Agriculture, Nature, and Environment (LNV) is very ambitous as regards nature development in floodplains, while research reports (e.g. Alterra report 1624) show that floodplains and nature development are difficult to combine.

7b) Implemented or planned actions: Entirely new physical interventions in river basin?

Approxmately 100 Million Euro will be used for dike reinforcements, while approximately 90% of the total budget (= 2.1 Billion euro) will be used for entirely new spatial measures:

- Retention areas (e.g. Overdiepsche Polder is a measure developed by local stakeholders)
- Bypasses and peak flow channels
- Dyke replacements
- Removal of hydraulic obstacles

8) Are structural constraints (e.g. political, economical, technical, etc.) being recognized? Which ones, and how are they being addressed?

- Yes, financial constraints are being addressed by: 1) establishing an ad-hoc task force (FiKa) to assess possible solutions, and 2) Van Lith-Boelhouwer proposal to Parliament for increasing budget for implementation of proposed measures in the Room for Rivers Program (which has been approved in January 2005)
- Yes, political constraints are being addressed by trust building between responsible politicians, and between politicians and local stakeholder groups.

9) Are uncertainties being recognized? If yes, how are they perceived and addressed?

- See chapter specifically dedicated to uncertainties (in Report on Planning proces RvdR)
- An example of political uncertainty is related to (the effects of) measures in upstream areas of the Rhine (in Germany). This uncertainty is being adressed by transboundary cooperation in the Arbeitsgruppe. However, because of politics and/or extreme events there may be new measures on top of the agenda, but this is highly uncertain. Also the level of compliance of Germany to the EU Flood Directive is uncertain.
- Another political uncertainty is caused by political opportunism: never sure who will vote for what. Politicians try to cope by mobilation of allies.
- An example of technical uncertainty is the effect of lowering of the groynes (kribverlaging) on water levels. An experiment is taking place near Beuningen.

- Another example of technical uncertainty is the issue of polluted soil: how serious is the problem, and how to deal with?
- Also external effects is a major uncertainty: for example, the effects of certain meausres on the goose population are not clear.

10) Changes in the actor network? (E.g. Change in Mandates/Positions/Interests? New actors?

- Strong involvement of civil society, amongst others reflected in the document called "Advice to the parliament as regard the PKB Room for Rivers by nine civil society organisations" (LIRR, 2003).
- Strong involvement of local stakeholders (e.g. Overdiepsche Polder is a plan developed by local stakeholders)
- Private eneterprises are getting more involved, such as projectdevelopers, and companies related to exploitation of gravel and sand. Moreover, pProvinces are looking for spatial planning opportunites besides rivers (e.g. Waalweelde), living with water (e.g. beaches, floating houses), and improvement of (public) transport.
- The project Huussensche Waarden is run by a private enterprise, which means that implementation is not the exclusive domain anymore of water authorities (Rijkswaterstaat).
- Also organisations like VNO, ANWB, and LTO are involved, although authorities need to be convinced as regards the added value of such consultative groups. That is the reason why authorities ask NGO's: what is your expertise and technical input? The added value of stakeholder participation is consensusbuilding, not only by providing consensus, but also by looking for consensus.

11) Change in regulatory framework?

- Yes, in 2006 the Cabinet drew up the Spatial Planning Key Decision Room for the River (PKB RvdR)

12) New norms and values?

- Generally the public accent to environmental protection, natural conservation and sustainable development is rising.

- EU norms are becoming more dominant: WFD and RBM planning, stronger involvement of civil society.

Appendix II: Adaptation strategies in the Alentejo Region, Portugal

Introduction

This questionnaire is focussing on the development/implementation of an adaptation strategy to deal with the (expected increase in frequency and intensity of) floods or droughts in Portugal, more specifically related to the Alentejo Region (Lower Guadiana)

A strategy is being defined as a policy document and/or plan which describes the objective(s), means to achieve this objective (plan of measures), and a time schedule for implementation.

Questions and Answers

1) Strategy currently in place (or being developed) to deal with floods and/or droughts:

There is no strategy or plan; the only initiative created under the extreme climatic phenomena 'droughts' have been in form of a 'Working Group', by the Government and under the frame of Albufeira Convention (see: http://www.cadc-albufeira.org/pt/comision/actividades.html) – under this some documents have been produced mainly with objective of analizing extreme situation and base negotiation between portugal and spain, and eventually support some finantial help for agriculture uses after recognition of effects on production by natural disasters, when proclaimed 'catastrophic situation' in some more severe years

2) Current status of strategy:

Not applicable.

3) Strategy's objectives

Not applicable.

4) Most important driver(s) to initiate strategy development (high-low ranking)

Although no strategy development is currently taking place, there are strong drivers to do so:

- Drought and water shortages at local scale (Alentejo in particular)
- Floods in 1997 and 2006
- Institutional changes, like the stablishment of River Basin Authority for the Alentejo Region (ARH)
- Implementation of national and international policies (e.g. WFD)
- Funding opportunities (e.g EU funds)

5) Understanding of CLIMATE CHANGE in the region: is it happening?

Awareness on climate change is only slowly starting, although climate change issues are not yet integrated in a regional or national strategy and no new measures have been identified.

Quoting from Eugenio Sequeira, President of LPN (Liga Para a Protecao da Naturae):

"General perception is that improvement of irrigation will solve all problems. However, there is a serious risk that more irrigation will eventually destroy the soils. Because water at bottom of Alqueva reservoir is saline, top is good quality. Outlets are on top of the dam, so the salinity of the reservoirs is increasing, while irrigation needs twice as much because of raising temperatures in the coming decades. Evenually, irrigation with bad water will destroy soils. The Environmental Impact Assessment (EIA) of the Alqueva dam (in 1992) has already addressed this unsustainable situation. At the same time, the WFD does not provide a good framework for dealing with irrigation problems and salinity."

6) How does new CC information / innovations enter the policy-making process (e.g. via informal (shadow) networks, formal commissions, etc.?

In general, authorities give limited or no information to civil society. Data is not being available, neither by Spanish nor Portugese authorities. This is also casued by capacity problems in government. As a result NGO's are forced to collect information themselves, although they have capacity problems themselves. In other words, without sufficient data, money, experience, and people the NGO's are not in a good position to make complaints or develop alternative solutions/ideas, or to participate in decision-making in general.

7a) Implemented or Planned Actions: Entirely new management measures?

Not applicable.

7b) Implemented or planned actions: Entirely new physical interventions in river basin?

Not applicable.

8) Are structural constraints (e.g. political, economical, technical, etc.) being recognized? Which ones, and how are they being addressed?

Not applicable.

9) Are uncertainties being recognized? If yes, how are they perceived and addressed?

Awareness on climate change is only slowly starting. General perception is that improvement of irrigation will solve all problems.

10) Changes in the actor network? (E.g. Change in Mandates/Positions/Interests? New actors?

- No substantial changes.
- For sure the ARH (Alentejo) will act as a new actor in this process.

- Civil society is having a lot problems, Aarhus Convention only exists on paper. In general authories give limited or no information to civil society. Data not made available, neither from Spanish nor Portugese authorities.

11) Change in regulatory framework?

- The new Water Frame Law (2005), but not due to expected impacts of climate change.

12) New norms and values?

- Yes. International agreements in the policy point of view. Generally the public accent to environmental protection, natural conservation and sustainable development is rising.

- EU norms are becoming more dominant: WFD and RBM planning.

Appendix III: Adaptation strategies in Ohre Basin, Czech Republic

Introduction

This questionnaire is focussing on the development/implementation of an adaptation strategy to deal with the (expected increase in frequency and intensity of) floods or droughts in the Czech Republic, more specifically in the Ohre Basin.

A strategy is being defined as a policy document and/or plan which describes the objective(s), means to achieve this objective (plan of measures), and a time schedule for implementation.

Water planning system in the Czech Republic (Based on: Novicky et al., 2008)

Long tradition of water management planning in the Czech Republic has been reflected in the fact that planning for meeting the requirements of WFD involves not only protection of water as a component of the environment but also flood protection and water use (supply) issues. New water management planning has been launched in 2003. It is coordinated by Ministry of Agriculture in co-operation with the Ministry of Environment, Ministry of Health, Ministry of Transport, Ministry of Defence (central water authorities) and with the Ministry of Interior and Ministry of Regional Development. All these ministries have to meet the principles of the EU Water Framework Directive. In the period after accession of the Czech Republic to the EU it represents the main tool for enforcing the water management policy, whose aims are to improve the quality and quantity of water, to support the sustainable use of water, to resolve the problems of transboundary rivers, to protect the aquatic and connected terrestrial ecosystems and wetlands and to ensure protection against floods and other harmful impacts of water.

Questions and Answers

1) Strategy currently in place (or being developed) to deal with floods and/or droughts:

- Specific action plan for climate change issues in the Ohre Basin does not exist.
- However, some aspects are reflected in the Plan of Main River Basins of the Czech Republic - National Conception for Period 2007 – 2012. This Plan was adopted by government resolution on 23 Mai 2007, N. 562
- Also relevant is the government document National Politics of Environmental conditions in Czech Rep. - issued 17.3.2004
- The National Programme for the Reduction of Climate Change Impacts in the Czech Republic (by Ministry of the Environment) was approved in 2004, which, among others, emphasizes the need to develop and implement appropriate adaptation measures in the relevant sectors including the water resource management sector.

2) Current status of strategy:

- The Plan of Main River Basins of the Czech Republic - National Conception for Period 2007 – 2012. This Plan was adopted by government resolution on 23 Mai 2007, N. 562
- The National Programme for the Reduction of Climate Change Impacts in the Czech Republic was approved in 2004

3) Strategy's objectives

The Plan of Main River Basins of the Czech Republic (2007):

- protection against floods
- increase of the storage capacity of the artificial or natural reservoirs of water
- nature conservation

The River Basin Management Plan (RBMP) of the Czech Republic 2007 - 2012 for the main river basins, which will be revised every six years, represents the long-term approach to water management and sets the framework for goals and programme measures. Then, individual Regional River Basin Management Plans provide specific goals and programme measures. The purpose of the Regional River Basin Management Plans is to compare the current status of surface water and groundwater to the target status, and resolution proposals for water management problems in regional river basins.

4) Most important driver(s) to initiate strategy development (high-low ranking)

- Disastrous floods in 1997 (Moravia) and 2002 (Vltava and Elbe basins)
- Drought in 2003
- Institutional changes (e.g. New Water Acts (from 2002)
- Implementation of national and international policies
- Land use change
- Funding opportunities (e.g EU funds)

5) Understanding of CLIMATE CHANGE in the region: is it happening?

- Yes, recognition amongst researchers and policy makers
- The results of scientific research during the last few years show that climate change in Czech Republic could have significant impacts on agriculture, forestry, and water resources. There will be an increasing risk of floods and periods of drought (MoE, 2004).
- Scenarios of climate change and assessments of its effects on agriculture, human health, and water and forest resource management in the Czech Republic were prepared in the framework of the National Climate Programme (NKP)

6) How does new CC information / innovations enter the policy-making process (e.g. via informal (shadow) networks, formal commissions, etc.?

- Both ways are used. Sometimes the media and public provide the stimulus for the innovations.
- Generally as a result of negotiation process during the Kyoto protocol ratification
- Particularly after two disastrous floods in 1997 and 2002
- Continuation has been motivated and connected to the implementation of the EU legislation during the country EU entering process.
- Small local activities are connected to the propagation of CC in the media

The Czech Hydrometerological Institute is responsible for the National Climate Programme. Studies of climate models and scenarios of climate change are also conducted by the Department of Meteorology and Environment Protection of the Charles University in Prague, Faculty of Mathematics and Physics , which cooperates closely with the Institute of Atmospheric Physics and the Institute of Thermomechanics of the Academy of Sciences of the Czech Republic.

The study of the relationship between climate change and the water regime is conducted by the T. G. Masaryk Water Research Institute. The decline in water run-off, especially the decline in the average long-term run-off elevation in the river basins, cannot be resolved without the use of simulation models and current (IPCC) climate change scenarios. In the Czech Republic to date, the effect of climate change on water reserves and compensation and adaptation options of climate change impacts by means of water reservoirs have been assessed.

7a) Implemented or Planned Actions: Entirely new management measures?

- New management strategies are incorporated into wider plans against CC impacts.
- Spatial river basin planning with respect to appropriate land use change;
- Transboundary cooperation with Germany
- Flood forecasting for the tributaries of the Upper Elbe is provided by the Czech Hydrometerological Institute in cooperation with the State Flood Centre in the Saxon State Agency for the Environment and Geology (LfUG).

7b) Implemented or planned actions: Entirely new physical interventions in river basin?

- New physical interventions are planned as a part of the adaptation strategies.

The National Programme for the Reduction of Climate Change Impacts (2004) suggests measures leading to an increase in the water retention abilities of the landscape, restoration of partial flood control systems, reduction of affecting of water quality by contamination, the security of dams against overflowing, a change in the controllable retention space, an increase in the capacity of safety overflows, an increase in the effectiveness of management of reservoirs and dams under nonstationary conditions and of the decision-making process in dangerous and uncertain situations. Suitably selected measures, respecting the technical and

natural conditions in the individual reservoirs and dams can reduce the risk following from flood situations.

8) Are structural constraints (e.g. political, economical, technical, etc.) being recognized? Which ones, and how are they being addressed?

- Yes, political – connected to implementation needs of EU legislation and international agreements
- Economical – taxes and insurance regulations

9) Are uncertainties being recognized? If yes, how are they perceived and addressed?

- Yes. Mainly by creation of several project variants or adaptation of range of limits. The risk is usually calculated during the evaluation process.

10) Changes in the actor network? (E.g. Change in Mandates/Positions/Interests? New actors?

- No substantial changes.
- Involvement of NGO's is very limited, but slowly increasing

11) Change in regulatory framework?

- Yes. New Water Act into the CR legislation

12) New norms and values?

- Yes. International agreements in the policy point of view. Generally the public involvement into environmental protection, natural conservation and sustainable development is rising.

- EU norms have become more dominant: WFD and RBM planning, strong involvement of public , protocol being developed for ensuring public participation

Appendix IV: Adaptation strategies in Ukrainian Tisza

Introduction

This questionnaire is focussing on the development/implementation of an adaptation strategy to deal with the (expected increase in frequency and intensity of) floods or droughts in the Ukraine, more specifically in the Zacarpathian Tisza.

A strategy is being defined as a policy document and/or plan which describes the objective(s), means to achieve this objective (plan of measures), and a time schedule for implementation.

Questions and Answers
Based on interviews in Ukraine by Patrick Huntjens and based on relevant literature. Validated by Dr. Alexei Iaroshevitch, Ukrainian Center of Environmental and Water Projects.

1) Strategy currently in place (or being developed) to deal with floods and/or droughts:

- The revised State Program for Flood Protection in the Ukraine has been planning new flood protection measures in the period 2002-2010, and after re-assessment of what is effective (which allows at the same time for reallocation of resources) there will be a new implementation plan for the period 2010-2015.
- The most important project initiated in this regard is the "Program of Integrated Anti-Flood Protection in the Tysa River Basin of Zakarpatska Oblast for 2002-2006 and Forecast till 2015" (Decision of the Cabinet of Ministers of October 24, 2001)
- There also exists an Integrated Anti-Landslide Program in the Zakarpatska Oblast from 1999 to 2010, which mainly consists of forest protection as well as anti-erosive and mudflow protection measures in the mountainous area and was prepared and approved by the Cabinet of Ministers; however, its implementation proceeds slowly.

2) Current status of strategy:

- The revised State Program for Flood Protection in the Ukraine has been planning new flood protection measures in the period 2002-2010, and after re-assessment of what is effective (which allows at the same time for reallocation of resources) there will be a new implementation plan for the period 2010-2015.
- Program of Integrated Anti-Flood Protection in the Tysa River Basin of Zakarpatska Oblast has been reviewed in 2006 for the period 2007-2015

3) Strategy's objectives

- Flood protection; nevertheless, the revised State Program for Flood Protection does not include any climate change scenarios. In other words, there is a serious risk that the implemented and planned flood protection measures are not effective enough for dealing with increased frequency and intensity of floods in the coming decades.

- The "Program of Integrated Anti-Flood Protection in the Tysa River Basin of Zakarpatska Oblast for 2002-2006 and Forecast till 2015" (Decision of the Cabinet of Ministers of October 24, 2001) reviewed in 2006 for period 2007-2015 with 1/100 years safety level) , has implemented "classic" extensive structural measures (e.g. dyke strengthening), this Program also contains the installation of different types of flood control reservoirs (in the mountainous upper reaches of the rivers flood protection riverbed dams with temporarily flooded bowls, in the foothill, lowland part of the region temporarily flooded polders) as well as environmental improvements in forestry and agricultural. It would cost over EUR 300 million, but the sources of financing are not yet clearly identified and secured.

4) Most important driver(s) to initiate strategy development (high-low ranking)

- Floods of 1998 and 2001

5) Understanding of CLIMATE CHANGE in the region: is it happening?

- The results of scientific research during the last few years show that climate change in Ukraine could have significant impacts on agriculture, forestry, water and coastal resources.
- Climate change scenarios for Ukraine have been developed (www.climate.org.ua)

6) How does new CC information / innovations enter the policy-making process (e.g. via informal (shadow) networks, formal commissions, etc.?

- Unique information system (of monitoring stations) compared to other post soviet countries.
- Analytical work on climate change is task of Hydromet. Hydromet provides information to water authorities, and other Ministeries. There is mutual information system between hydromet and water authorities.

7a) Implemented or Planned Actions: Entirely new management measures?

- Spatial river basin planning with respect to appropriate land use change;
- Transboundary cooperation with Hungary, Romania, Slovakia

7b) Implemented or planned actions: Entirely new physical interventions in river basin?

Mainly enhancement of existing measures!

Momentarily, the flood defense system is being upgraded and improved steadily:

- Water course and dam construction measures in the floodplains;
- Replacement of (destroyed) dykes was done after last floods. In most cases, distance between the new dykes was increased.
- Retention areas to reduce flood run-off: Beregovo region (transboundary polder - UA/HU, Ukrainian part - 54,000 ha.); in Latorica valley (Ukrainian part - 9,900 ha). There are some smaller polders as well.
- Cascade of (retention)polders in the mountains and floodplains are planned, but are under serious discussion with local people, since their arable land will be used.
- Most of the drainage system was constructed 25-30 years ago. They are upgraded constantly, but not sufficient, so also new plans are needed
- Reforestation areas to reduce flood run-off are highly on the agenda in the Zacarpathian region (Statistical Report of Zacarpathia, 2003): According to the rules, the number of the cut forest should be equal to the planted trees. During the last years, the number of the planted trees are higher than cut (A. Iaroshevitch)
- Restriction of settlement in risk areas: Flood risk maps are not available and it is not clear when they will be ready. However, according the Water Code of Ukraine, it is prohibited construction (as well as any other activities) closer than 25 m to the riverbed for the small rivers and 50 m for medium rivers (bigger than 2000 km2). Although the majority of people ignore these rules, there are some cases when authorities destroyed the houses built in the flood prone area
- After floods 2001 99% of destroyed houses rebuilt with raised foundations (30-40 cm)

8) Are structural constraints (e.g. political, economical, technical, etc.) being recognized? Which ones, and how are they being addressed?

Not specifically.

9) Are uncertainties being recognized? If yes, how are they perceived and addressed?

There is recognition of uncertainties, but they are not being specifically addressed so far:

- The results of scientific research during the last few years show that climate change in Ukraine could have significant impacts on agriculture, forestry, water and coastal resources.
- Climate change scenarios for Ukraine have been developed (www.climate.org.ua)

- "Different points of view on CC, therefore we cannot establish one strategy for CC"

10) Changes in the actor network? (E.g. Change in Mandates/Positions/Interests? New actors?

Involvement of NGO's is very limited, but slowly increasing.

The Ukrainian key water management actors could be divided into state authorities and their regional and local branches such as:

- Ministry of Environmental protection
- State Water Management Committee
- State Hydrometeorological Service (Hydromet)
- Ministry of Emergency Situations
- Ministry of Health
- Regional and local administrations as well as
- The public, NGOs.

Stakeholders are involved in decision-making (rayon councils, village councils, water authorities, administration of env protection, ecosent (NGO Tisza), ecological league

11) Change in regulatory framework?

- Program of Integrated Anti-Flood Protection in the Tysa River Basin of Zakarpatska Oblast has been reviewed in 2006 for the period 2007-2015, but not due to expected impacts of climate change

12) New norms and values?

- EU norms have become more dominant: WFD and RBM planning, strong involvement of civil society, protocol being developed for ensuring public participation

Appendix V: Adaptation strategies in Hungarian Tisza

Introduction

This questionnaire is focusing on the development/implementation of an adaptation strategy to deal with the (expected increase in frequency and intensity of) floods and droughts in the Upper Tisza in Hungary.

A strategy is being defined as a policy document and/or plan which describes the objective(s), means to achieve this objective (plan of measures), and a time schedule for implementation.

Questions and Answers

Based on interviews in Upper Tisza by Patrick Huntjens and Zsuzsanna Flachner and based on relevant literature + Responses to Valentina's questionnaire

1) Strategy currently in place (or being developed) to deal with floods and/or droughts:

1) Hungarian National Climate Change Strategy (for the period of 2008-2025), which was approved by the government;

2) There is also a Strategy of Disaster Management for better coping with emergency cases

In Hungary the disaster management has a long tradition and a very well establish half military hierarchy – the Board of decision makers comes from high level governmental and military services and supported by a Scientific council as well.

3) The new Vásárhelyi Plan, 2003 (abbreviated in Hungarian as VTT): In the spring of 2003 the Hungarian government issued a decree 1022/2003 that marked a substantial shift in addressing water management. It was followed by a Law approved by the Parliament, which defined a new water policy for the Tisza River in North-Eastern Hungary recognized rural development and nature conservation as important objectives next to flood protection. Floodplain rehabilitation and land-use change were introduced in water management to replace or complement the prevailing flood levee dominated engineering approaches. The VTT envisaged the development of six emergency reservoirs along the Upstream- and Middle Tisza sections to enhance the level of flood safety in the region.

2) Current status of strategy:

Strategic goal setting without plan of measures: National Climate Change Strategy is a general guideline for mitigation and adaptation for different sectors, but it does not contain any specific measures.

In the frame of VTT 2 polders have been established – almost finished with the implementation of water engineering measures, but lacking the solution of the landscape management elements, unfortunately. Besides several measures to

improve the runoff in the primary floodplain took place, with substantial impacts on ecosystems (cut floodplain forests, disturbed meadows with high protected species).

The Government has approved a decree in November 2007 to modify the time-horizon and reduce the complexity of the responsibility falling under the coordinative body in the frame of Ministry for Environment and Water and ask more intensive cooperation from other Ministries. But these Ministries (such as agriculture and rural development) are claiming for resources for their actions, which are not provided so far.

SZÖVET – Alliance for the Tisza River, established in 2006 addresses the complexity of the implementation and highlights the importance of the complexity for the original VTT law. By implementing small scale projects the SZÖVET brings concrete examples on multiple benefits of floodplain revitalization along the Tisza.

3) Strategy's objectives

- National Climate Change Strategy is a general guideline for mitigation and adaptation for different sectors. One of the difficulties in the implementation is that it has several very detailed actions as well – so it is a mixture of strategy and action plan. The Action plan of the CCS is under development and will be presented to government during the year.
- VTT (2003) envisaged the development of six emergency reservoirs along the Upstream- and Middle Tisza sections to enhance the level of flood safety in the region. VTT defined a new water policy for the Tisza River in North-Eastern Hungary recognized rural development and nature conservation as important objectives next to flood protection. Floodplain rehabilitation and land-use change were introduced in water management to replace or complement the prevailing flood levee dominated engineering approaches.

4) Most important driver(s) to initiate strategy development (high-low ranking)

- Climate-related disasters (floods, droughts, storms)
- Other threats, such as cyanide spill from Romania; water reservoir development in Ukraine and in Romania.
- National and international policies (e.g. EU policies)

5) Understanding of CLIMATE CHANGE in the region: is it happening?

Yes, there is more recognition from the scientific community. On policy level there is an emerging recognition mostly due to EU and international concern.

The local surveys underline the public awareness on water issues related to CC – including increasing flood, drought, risk to production (winds and very intensive precipitations). These concerns many times overruled by messages communicated by subsidies, cross contradicting measures and investments and not proper implementation of projects (such as Bodrogköz reservoir).

Best example – the fund for house insolation and heating structures to be more energy efficient has been emptied in 2 days by public applications (2007).

6) How does new CC information / innovations enter the policy-making process (e.g. via informal (shadow) networks, formal commissions, etc.?

To tackle the increasing risk stemming from global climate change, and to support the founding of the domestic climate policy the Hungarian Ministry of Environment and Water together with the Hungarian Academy of Sciences launched a common research programme named VAHAVA, "The domestic effects of global climate change, and the answers to be given to the challenge". Primary aim of this project was the preparation to the potential negative and positive effects of climate change, harm reduction, prevention and advancement of restoration.

Climate scenarios for the National Climate Change Strategy (Hungarian Meteorological Service and Eötvös Loránd University, 2006.)

The implementation of the Aarhus convention, leads to the conclusion that the information on water (in more broad sense), quality of the environment, main pressures and key feedbacks are not available in an easy accessible and easy understandable format.

7a) Implemented or Planned Actions: Entirely new management measures?

- General tracks for adaptation on conceptual level in the National Climate Change Strategy focusing on agriculture, forest and water sectors
- Plans for National Drought Committee and a Drought Fund
- Transboundary cooperation with Ukraine, Romania, Slovakia
- Planning for flood mitigation systems of forecasting, early warning, evacuation, and post-flood recovery.
- Regional climate change scenarios in PRUDENCE project, and also by the Hungarain Meteorological Service.
- And many more scientific programs to elaborate the cause-effect linkages, such as the Klima KKT (follow up of the VAHAVA)

However, since there is no agreement yet on these climate change scenarios it hasn't been included in current Hungarian water policy. Jolankai et al. (2005) concludes that, based on the analysis of climate-change and precipitation scenarios, that higher floods than observed so far may occur, needing upgraded flood-control strategies (with the meaning that presently contemplated strategies, such as the VTT in Hungary, may not be sufficient to cope with floods).

Koncsos et al. (2007) analyzed the different flood mitigation strategies in light of the expected climate variability's, and highlighted the importance of the floodplain utilization as long term, cost effective measure – compared to the establishments of the polders (6- or 11).

7b) Planned actions: Entirely new physical interventions in river basin?

Below measures are not specifically targeted at CC adaptation (currently the 100-year flood level dictates what they do):

- Reforestation areas to reduce flood run-off are planned, but there are problems with practical implementation

- Floodplain restoration, incl. shallow flooding of floodplain (natural retention of flood water) is being implemented
- Retention/ inundation areas to reduce flood run-off: The new Vásárhelyi Plan (abbreviated in Hungarian as VTT), adopted on the 15 of October, 2003, envisaged the development of six emergency reservoirs along the Upstream- and Middle Tisza sections to enhance the level of flood safety in the region. Two of them have been almost implemented, but lacking the solution of the landscape management elements, unfortunately
- Morphological changes are planned in the frame of navigation in the frame of the TEN, both in the Danube and Tisza – many of these plans are totally unsustainable and not taking into account the expected water level changes due to CC (even on the Danube it may cause high problems with the present shipping technology interest).

8) Are structural constraints (e.g. political, economical, technical, etc.) being recognized? Which ones, and how are they being addressed?

- Not specifically – see the article from Saskia Werners et al, 2008 – there are many obstacles, such as :
- Barriers set by the water managers in the implementation interest to follow the well-known methods
- Financial complexity – lack of good management (both EU and national) of complex program financing
- Ignorance of dubble dividence – ecological benefits, social and other benefits (such as biomass for decentralized energy production is not recognized – neiher on financial nor at political level.

9) Are uncertainties being recognized?6 If yes, how are they perceived and addressed?

Some recognition, but not addressed:

- For natural system uncertainties have been recognized by developing climate scenarios for the National Climate Change Strategy (Hungarian Meteorological Service and Eötvös Loránd University, 2006.). However, since there is no agreement yet on these climate change scenarios it hasn't been included in current Hungarian water policy.
- Hungary is one of the region in Europe where uncertainties of CC predictions are highlighted – there are still several meteorologists who take 120 years data series and other climate documentations and prove the same trends and extremities in the past (before the "big flooding season" from 1998-2006 several decades the Tisza river was not flooding, the region suffered of huge drought). This is also an underlining factor to have adaptive systems in place

6 There might be different types of uncertainty: variability (unpredictable system behaviour), incomplete knowledge (lack of information, unreliable information, lack of theoretical understanding, ignorance), multiple knowledge frames (e.g. different/conflicting ways of understanding the system, different values/beliefs). All these types of uncertainty could apply to the natural system (e.g impacts of CC), or technical system (e.g. innovations), or societal system (political/legal aspects).

both able to utilize in very different circumstances and to avoide big structural changes – such as water dams.
- Political/institutional and economical uncertainties (e.g. unemployment rates, recession) are not dealt with. The SCENES project implemented in the Tisza river basin as well is developing scenarios in the riverbasin for 2050. The process involves different levels and very difernet stakeholders, including students, politicians (Flachner, 2008).

10) Changes in the actor network? (E.g. Change in Mandates/Positions/Interests? New actors?

The new networks, local organizations are coming up pretty much – see SZÖVET and its local action groups, the LEADER groups activated in the Tisza basin, etc.

More there is a problem of good and efficient lobby and get involved in projects right from the beginning to be able to influence strategies (as it has happened in the Bereg landscape- Flachner, FAO TCP report, 2008)

- Some key NGO's with national dominance are involved like WWF, but they do not always present the local interest, more interested in publicity.
- In general, NGO's can only put issues on agenda when it is supportive to central state agenda. – in the VTT process the Bokartisz in collaboration with E-Misszio NGO could take the floodplain revitalization in the main focus of the plan. (Werners, et al, 2008)
- In general, NGO's do not have enough resources to implement or influence – more to say the resources to be part of the processes to elaborate plans are very difficult due to the problem of continuous funding opportunities.
- In general, lower levels of government are not capable and not trying to influence decision-making, although a few municipalities are trying, but concerning water management they feel is not their responsibility, and they are financially dependent from central government, so they are afraid to lose their incomes. The latter also applies to NGO's.

11) Change in regulatory framework?

- The VTT has been changed due to the very well implemented cooperation of NGOs and Research institutions (such as BME and MTA TAKI)- see above and in the article attached.

12) New norms and values?

- EU norms have become more dominant: WFD and RBM planning strong involvement of civil society, protocol being developed for ensuring public participation.
- More emphasis on local cooperation, market development and supply chain development to support the maintenance of local societies are coming up. People start to realize the importance of watersheds and water saving maeasures.

Appendix VI: Adaptation strategies in Lower AmuDarya, Uzbekistan

Introduction

This questionnaire is focusing on the development/implementation of an adaptation strategy to deal with the (expected increase in frequency and intensity of) floods or droughts in Uzbekistan, more specifically related to the Lower AmuDarya in Khorezm and Karakalpakstan.

A strategy is being defined as a policy document and/or plan which describes the objective(s), means to achieve these objectives (plan of measures), and a time schedule for implementation.

Questions and Answers

Based on interviews in Uzbekistan by Patrick Huntjens and based on relevant literature + Responses to Valentina's questionnaire by Maja Schlueter

1) Strategy currently in place (or being developed) to deal with floods and/or droughts:

- No strategy in place;
- No shared recognition of climate change related problems at all; no clear shared vision for an adaptation strategy and action plan; no program and measures related to climate change adaptation; the Second National Communication to IPCC from Uzbekistan is currently being prepared by Uzhydromet with support of UNEP; preparation of GEF proposal on Adaptation of Agriculture to Climate Change by UNDP in 2007.
- There are several government programmes for developing policy documents for the State Program for Water Saving, with a time horizn of 2020. However, these programmes do not take into account climate change.

2) Current status of strategy:

Not applicable.

3) Strategy's objectives

Not applicable.

4) Most important driver(s) to initiate strategy development (high-low ranking)

- Drought of 2000: The impact of regional CC is felt for several decades now in the region. Since this has not triggered any measurable adaptation strategies it is questionable whether this is going to happen in the near future.
- National and international policies,e.g UNFCCC (Initial Communication of the Republic of Uzbekistan p. 14).
- On local level potentially institutional changes in water management, e.g. introduction of water user associations

- Migration from the so-called regions of ecological disaster (Khorezm, Karakalpakstan) (labor migration etc.)
- Availability of (international) funding is also a driver. Since the region is relatively dependent on donor funding the availability of funds for certain issues might be able to trigger the development of an adaptation strategy. Under the current political regime though this may only be the case if the political decision makers do not consider the strategy as a possible political threat.

5) Understanding of CLIMATE CHANGE in the region: is it happening?

In general, only by scientists and politicians – citizens are not well informed.

Experts who are directly involved in CC research generally acknowledge the fact of CC and its implications, which are currently observed already. They expect serious consequences, such as higher frequency and intensity of droughts.

Other experts in the field such as water managers and policy makers are not (yet?) aware of the problem or do not acknowledge the link of CC to water management.

RBO AmuDarya only works with prognoses for short time period, RBO does not work with long term scenarios.

Quoting policy maker from Lower Amudarya Irrigation Management Basin Authority (BUIS): "Since climate change is difficult to assess, no climate change policy is being developed. We are only preparing for one or two year ahead, there no preparations for far future."

6) How does new CC information / innovation enter the policy-making process (e.g. via informal (shadow) networks, formal commissions, etc.?

UZhydromet services is independent institute of the cabinet of ministers, they proivde information on run-off, and information on water quantity in AmuDarya.

On ad-hoc basis local people are prepared by means of forecast for floods and droughts via BUIS. Additionally, there a number of leaflets on leaching and vegetation to prepare local stakeholders for droughts.

A lot of informal structures and relationships, mainly because formal system is failing.

In general, research on what is needed on lower level, and then they provide to higher level, than management is coming from top, although top level governemnt is anxious to get the consensus and loyalty of the middle levels.

7a) Implemented or Planned Actions: Entirely new management measures?

Since 2003 there has been an organizational change at all hierachical level (from territorial to hydrological boundaries). Minister of Water Management who was in charge in 2003 introduced IWRM, but there was no follow-up from successor.

For making water management easier, Uzbekistan has established BUIS and WUAs, all intended for bottom-up governance, but they don't have enough experience, and higher levels do not understand the idea of bottom-up governance very good.

7b) Planned actions: Entirely new physical interventions in river basin?

Only improvement of existing measures:

- Enlargement of storage capacity of delta floodplains, construction of polders, Mezhdureche reservoir
- Leakage reduction, more efficient irrigation
- Upgrade drainage systems, plans for increasing capacity of pumps, etc.
- On a local scale the main solution for dealing with droughts is to apply more organic fertilizers to increase humidity, and using hand pumps to get groundwater.

8) Are structural constraints (e.g. political, economical, technical, etc.) being recognized? Which ones, and how are they being addressed?

Not specifically.

9) Are uncertainties being recognized? If yes, how are they perceived and addressed?

Not specifically.

10) Changes in the actor network? (E.g. Change in Mandates/Positions/Interests? New actors?

Water user associations (WUA's) have been introduced, although they are controlled by the government. Decisionmaking on water distrubution/allocation is controlled by Ministry of ARW (and BUIS), based on fair distribution according to the needs of the farmers.

11) Change in regulatory framework?

Not specifically.

12) New norms and values?

Not specifically.

Appendix VII: Adaptation strategies in the Kagera Basin (Uganda, Rwanda, Tanzania, Burundi)

Introduction

This questionnaire is focusing on the development/implementation of an adaptation strategy to deal with the (expected increase in frequency and intensity of) floods or droughts in the Kagera Basin (Uganda, Rwanda, Tanzania, Burundi).

A strategy is being defined as a policy document and/or plan which describes the objective(s), means to achieve these objectives (plan of measures), and a time schedule for implementation.

Questions and Answers

Based on interviews in the Kagera Basin by Patrick Huntjens and based on relevant literature.

1) Strategy currently in place (or being developed) to deal with floods and/or droughts:

- There is not a shared vision on climate change
- UNFCC has been ratified by all countries; 6 countries developed the National Action Programme for adaptation (NAPA's), but projects lack a defined vision. In other words, there is a strong need to develop a clearly defined climate change vision for the NAPA strategies.
- 5 countries belong to the East African Community (EAC), which have their own development of shares resources (e.g. Lake Victoria);
- Nile Basin Initiative (NBI) is bringing countries together for development of sustainable resource management for the Kagera Basin (By NELSAP - Kagera Transboundary Integrated Water Resources Management & Development Project)

2) Current status of strategy:

- With the support of UNFCCC secretariat, preparation of NAPA with for each country few projects proposed for funding through GEF. However no clear actions at national and regional level except reforestation campaigns and river basin management and development under NBI. Adaptation strategies have to be improved and a strategy for resource mobilization developed. Many countries faced some catastrophes related to climate change (e.g. in Tanzania).

3) Strategy's objectives

- See above, under no. 2.

4) Most important driver(s) to initiate strategy development (high-low ranking)

- Climate-related disasters (especially droughts, which is a serious threat to food security);
- Rwanda is affected by floods annually;
- National and international policies (e.g. UNFCCC);
- Population dynamics (e.g. migration, population growth)
- The higher the population, the more the pressure on land, and hence land use changes for the better only if the people are exposed to wise use of land;
- Funding opportunities (external funds, donors)

5) Understanding of CLIMATE CHANGE in the region: is it happening?

Politicians seem to have other priorities than climate change, they do not want to take responsibility.

In general, only understanding of climate change by scientists, while citizens are not well informed. Public debates only by elite, normal people do not participate.

Experts who are directly involved in CC research generally acknowledge the fact of CC and its implications, which are currently observed already. They expect serious consequences, such as higher frequency and intensity of droughts, and higher temperatures. Both impacts pose serious threats to food security.

Other experts in the field such as water managers and policy makers are not (yet?) aware of the problem or do not acknowledge the link of CC to water management.

6) How does new CC information / innovation enter the policy-making process (e.g. via informal (shadow) networks, formal commissions, etc.?

National governments are reluctant to share information. Information flow is very problematic.

7a) Implemented or Planned Actions: Entirely new management measures?

- Early warning system for droughts
- Improvement of transboundary cooperation (by NELSAP - Kagera Transboundary Integrated Water Resources Management & Development Project), although Common Framework Agreement (CFA) has not been approved yet.
- Uganda started some experimentation on IWRM
- GEF funded Rwanda for Integrated Management Critical Ecosystems (IMCE)

7b) Planned actions: Entirely new physical interventions in river basin?

So far, mainly improvement of existing measures:

- Maintenance and enhancement of water storage;
- Adjustment of planting dates and crop varieties;
- Terracing and contouring is widely done in the catchment;

- Reforestation campaigns (especially at hill tops);
- Expanded use of rainwater harvesting (e.g. by Rwanda Rainwater Harvesting Association);

8) Are structural constraints (e.g. political, economical, technical, etc.) being recognized? Which ones, and how are they being addressed?

Not specifically, although the Kagera Transboundary Integrated Water Resources Management & Development Project is trying to establish a Common Framework Agreement (CFA) between the countries. This has not been consolidated yet.

Major constraints include:

- Problems in organisational setup related to horizontal and vertical integration;
- Lack of human capital (people skilled and educated for certain tasks);
- Low level of awareness among decision makers on climate change issues: how will climate change, what the impacts will be, which adaptation is needed?
- Lack of adequate financial resources for adaptation;
- Spatial and temporal uncertainties associated with climate projections for future.

9) Are uncertainties being recognized? If yes, how are they perceived and addressed?

Not specifically.

10) Changes in the actor network? (E.g. Change in Mandates/Positions/Interests? New actors?

Involvement of civil society is slowly increasing, for example by the Nile Basin Discourse Forum (NBDF) in each separate country of the Kagera Basin (www.nilebasindiscourse.org)

11) Change in regulatory framework?

Not specifically.

12) New norms and values?

Not specifically.

Appendix VIII: Adaptation strategies in Upper Vaal catchment, South Africa

Introduction

This questionnaire is focusing on the development/implementation of an adaptation strategy to deal with the (expected increase in frequency and intensity of) floods or droughts in South Africa.

A strategy is being defined as a policy document and/or plan which describes the objective(s), means to achieve these objectives (plan of measures), and a time schedule for implementation.

Problem setting (Source: SA National Climate Change Response Strategy, 2004)

With regard to water resources, South Africa's rainfall is already highly variable in spatial distribution and unpredictability, both within and between years. Much of the country is arid or semi-arid and the whole country is subject to droughts and floods. Bulk water supplies are largely provided via a system of large storage dams and interbasin water transfer schemes and such infrastructure takes years to develop. Thus a reduction in the reliability of rainfall, or an increase in evaporation would exacerbate the already serious lack of surface and ground water resources. Water availability in the arid and semi-arid regions, which cover nearly half of South Africa, is particularly sensitive to changes in precipitation. Desertification, which is already a problem in South Africa, could be exacerbated by climate change. Furthermore, climate change may alter the magnitude, timing and distribution of storms that produce flood events.

Questions and Answers

Based on interviews in South Africa by Patrick Huntjens and based on relevant literature + Responses to Valentina's questionnaire by Chris Dickens

1) Strategy currently in place (or being developed) to deal with floods and/or droughts:

- South African National Climate Change Response Strategy (DEAT, 2004)
- National Water Resource Strategy (2004), although consensus on possible adaptation strategies is limited. It is expected that the National Water Resources Strategy version 2 (NWRS2 in 2009) will be stronger on this.

2) Current status of strategy:

In general, translation of strategy into operational policy has not occurred yet

- Strategic goal setting: National Climate Response Strategy is a general guideline for mitigation and adaptation for different sectors, and proposes general interventions (although not very specific).

- Although excellent information on CC is available, implementation of good policy is very poor. This ranges from a lack of monitoring of social and biophysical issues, to a critical failure to respond to obvious needs in the basin (From: C. Dickens) or rather the country, since you are referring to the whole of South Africa, where we have up to 14 (sub)-basins
- These adaptation strategies however are hampered by current institutional arrangements, extreme lack of skills and human capacity, and the traditional notion of water management, as well as insufficient improvements with regards to demand management

3) Strategy's objectives

Objectives stated in SA National Climate Change Response Strategy, 2004:

- Offset South Africa's vulnerability to climate change, amongst others by Water resource management and contingency planning (see question 7a for more details). Also adaptation of rangeland practices, agriculture, forestry, health protection, biodiversity.

The National Climate Change Response Strategy of South Africa (2004) identifies a number of approaches to water resource management which will facilitate adaptation to climate change. These are broadly divided into (see question 7a for more details):

- Strategic resource management
- Flexibility in water use allocations
- Water demand and conservation mechanisms;
- Contingency planning for extreme events such as floods and droughts
- Communication
- Optimising the operation of existing infrastructure and
- Constructing new infrastructure.

4) Most important driver(s) to initiate strategy development (high-low ranking)

- Threat of extreme climate changes (Actual disasters help motivation; Food security is a big driver)
- Implementation and capacity are both a problem, which is a motivation,
- Need to build resilience,
- Availability of (international) funding is also a driver as this is plentiful.

5) Understanding of CLIMATE CHANGE in the region: is it happening?

Current research in SA suggests that the political and planning response is lagging behind compared to the understanding of climate change (Mukheibir, 2007)

As stated by the National Climate Change Response Strategy (2004, p18):

"Climate change is a relatively new issue in South Africa due to the prior isolation of this country from international events. Education, training and public awareness thus lag behind the requisite standards. The raising of public awareness on climate-

related issues is promoted by the government through the Department of Environmental Affairs and Tourism (DEAT) and the South African Weather Services."

6) How does new CC information / innovation enter the policy-making process (e.g. via informal (shadow) networks, formal commissions, etc.?

As stated by the National Climate Change Response Strategy (2004):

"A better understanding of these issues is expected from an ongoing research programme funded and managed by the Water Research Commission, which will facilitate prioritising intensified interventions in areas where the effects are greatest and/or will occur soonest. It will be necessary to improve meteorological and hydrological monitoring systems to detect the onset and development of the effects of climate change on water resources."

Chris Dickens: "The Orange Basin is fortunate to have an excellent scientific base. This comes essentially from the top class climate information including detailed downscaling of the IPCC data which has already been done. (amongst others by Prof. Bruce Hewittson from UCT). There is also excellent modeling of the implications of future climates on the water resources in the basin. (by Prof. Roland Schulze and his team from the University of KwaZulu-Natal). When it comes to water resource management, the country also has a long tradition in excellent modeling of water resources, which capacity resides within DWAF as well as with some consultants."

As regard informal shadow networks (quoting Chris Dickens): "There is a rapidly grwoing influence of shadow networks on this subject in some aspects of society, partly precipipated by the crisis we have had in electrcity supply. Now people are starting to respond despite policy – and I'm sure policy will follow. So, for climate change the networks are growing. The networks for water are actually weakening – they were strong a decade ago, but over time are being eroded. Reasons? Loss of skills, brain drain – but also the move in government from a broad consultative attitude to one of more command and control – which is becoming the way. What is really concerning is that there have been several exposes of terrible water pollution and mismanagement by government, and nothing happens!

7a) Implemented or Planned Actions: Entirely new management measures?

- In general terms, the National Climate Change Response Strategy mainly proposes enhancement of existing measures (= already introduced independent of climate change).
- Plenty of possible adaptation measures are being mentioned, but no consensus yet, so implementation not guaranteed.

Chris Dickens: "There is very little adaptive capacity in the South African government. Ironically, it is Lesotho (in the Upper Orange region) which shows the greatest willingness to be adaptive as evidenced by their audit of environmental flows policy and their attempts to adapt."

As stated by the National Climate Change Response Strategy (2004, p18): "The strategies, which are described in the National Water Resource Strategy, scheduled

to be established in terms of the National Water Act, 1998, during 2004, are sufficiently flexible to accommodate the anticipated effects of climate change without the need for special programmes or projects."

Page 18: "Approaches to water resources management that will facilitate adaptation to a changed climate can be broadly divided into strategic resource management, flexibility in water use allocations, water demand management and water conservation measures, contingency planning for extreme events such as floods and droughts, communication, optimising the operation of existing infrastructure and constructing new infrastructure."

- Replacing in-perpetuity riparian water rights
- Contingency plans for extreme events such as droughts and floods will be embodied in the disaster management framework prepared in terms of the National Disaster Management Act. The current monitoring and forecasting systems for droughts and floods would need to be improved and baselines established.
- The demand for water may be reduced in all user sectors through a range of measures that encourage efficient water use, such as pricing strategy for water use charges prescribed in the National Water Act, water-efficient technologies and practices, mandatory water auditing and accounting, and education in water conservation and demand management. However, although successful adoption of measures to reduce water use in the long term by increasing the efficiency of use is desirable, it could limit the extent to which users can accommodate any short-term restrictions on water use that may be necessary during times of drought without prejudicing productivity or reducing standards of living.
- Water conservation measures such as clearing alien invasive vegetation from infested catchments will increase the amount of surface water runoff and recharge to groundwater, whilst water harvesting in agriculture and homes, especially those in rural areas, could reduce reliance on supplemental irrigation by optimising the effectiveness of rainfall.
- Leakage reduction
- Operating procedures for all infrastructures, including inter-basin transfer schemes will be reviewed and revised where necessary to ensure optimum efficiency.
- Public consultation programmes, mandatory under the National Water Act for all significant implementation interventions, need to put greater emphasis on making water users and the public aware of the implications of climate change.

7b) Planned actions: Entirely new physical interventions in river basin?

Although there may be costs incurred in adapting to the physical changes that result from climate change, such actions could also lead to sustainable development benefits that could be achieved, even if climate change were not a factor. Water saving schemes offers just one example (From: SA National Climate Change Response Strategy, 2004).

Planning of new dams and interbasin transfers is on the way, especially to allow for the further expansions of water-intensive industries.

8) Are structural constraints (e.g. political, economical, technical, etc.) being recognized? Which ones, and how are they being addressed?

- Current research in SA suggests that the political and planning response is lagging behind compared to the understanding of climate change (Mukheibir, 2007)
- Capacity in the region is rapidly becoming a serious limiting factor. This is particularly evident in South Africa where the task is so much larger but there has been a serious loss of skills. Capacity building programs are on the agenda of DEAT and DWAF yes, but it is not compensating the continuing loss of skills

9) Are uncertainties being recognized?7 If yes, how are they perceived and addressed?

There is recognition of uncertainties, but they are not being specifically addressed so far:

Good CC scenarios available (IPCC downscaled)

A key issue raised by planners when planning based on scenarios of future climate change is the uncertainty associated with projections of climate variables at specific geographical locations and spatial scales. This has been cited as a reason for the difficulty in using climate scenarios for adaptation planning beyond "no regrets" measures (Gagnon-Lebrun & Agrawala 2006).

From Mukheibir, 2007): "There also exists an uncertainty attributed to the response measures. It is not a perfect science as to how these climatic impacts will affect livelihoods and productivity in sectors such as agriculture, fishing and forestry or how they will affect health in terms of vectors and pathogens. People,communities and large urban settlements will all adapt to these physical and resource impacts in different ways with differing levels of adaptive capacities."

The financial cost to firstly build resilience to adapt these impacts, and secondly the cost of damages and how this will affect the insurance industry is largely unknown.

7 There might be different types of uncertainty: variability (unpredictable system behaviour), incomplete knowledge (lack of information, unreliable information, lack of theoretical understanding, ignorance), multiple knowledge frames (e.g. different/conflicting ways of understanding the system, different values/beliefs). All these types of uncertainty could apply to the natural system (e.g impacts of CC), or technical system (e.g. innovations), or societal system (political/legal aspects).

10) Changes in the actor network? (E.g. Change in Mandates/Positions/Interests? New actors?

As stated by the National Climate Change Response Strategy (2004, p18):

"Although the Department of Environmental Affairs and Tourism has been designated as the lead agency for climate change response in South Africa, it is recognized that this is a cross cutting issue that has ramifications for diverse activities in other government departments. A national climate change strategy will thus require that many government departments work together in a coordinated manner, to ensure that response measures are properly directed, acceptable to all and carried out with a national focus. General awareness within government on the likely impacts of climate change is somewhat limited in those departments not directly involved with the issue. In order to adapt to climate change, and to prepare adequately for the likely impacts, capacity has to be built. This will ensure that the policies formulated will adequately address climate change adaptation. Further, it is important that the available skills and competencies within government are efficiently harnessed. Officials in other departments, within all spheres of government, often do not see climate change as a priority and some even see it as working against national development priorities. They are concerned that South Africa has a huge backlog of service delivery where the performance of each department is measured by how effective and efficient it is on service delivery. Therefore climate change needs to be addressed in such a way as to assist these departments to achieve their service delivery objectives i.e. through so-called "win-win" or "no regrets" measures."

The respective government bodies are the National Committee on Climate Change as well as the Government Committee on Climate Change, which comprise various government departments

11) Change in regulatory framework?

South Africa currently has a number of laws relating to the protection and management of the environment. The overarching legislation is contained within the provisions of the National Environmental Management Act of 1998. Climate change is referred to explicitly in the White Paper on Integrated Pollution and Waste Management of 2000, and referenced in the White Paper on a National Water Policy for South Africa, 1997. It is also specifically addressed in the Government's National Water Resource Strategy (2004), but consensus on possible adaptation strategies is limited. It is expected that the National Water Resources Strategy version 2 (NWRS2 in 2009) will be stronger on this.

12) New norms and values?

Appendix IV Correlation coefficients between variables of the management system

	type of leadership	level of cohesion	level of authority	public awareness	capacity building	type of governance	level of stakeholder participation	horizontal cooperation	horizontal conflict resolution	vertical cooperation	vertical conflict resolution	transboundary cooperation	transboundary conflict resolution	time horizon in policy development	flexible measures, keeping options open	experimentation	consideration of possible measures	Actual implementation of policies	Monitoring & Evaluation	Joint/participative information production	Elicitation of mental models/ critical selfreflection about	Consideration of uncertainty	Broad communication	Utilization of information	Decision support	Resources	Cost recovery	Allocation of resources	private-public RBM	Risk perception	insurance against risk	Level of compliance	Adoption of (inter)national regulation
type of leadership		0.68	0.14	0.55	0.36	0.87	0.61	0.41	-0.02	0.80	0.54	0.68	0.38	0.55	0.34	0.75	0.74	0.76	0.49	0.74	0.71	0.65	0.59	0.68	0.58	0.42	0.44	0.35	0.47	0.55	-0.02	0.63	0.15
level of cohesion	0.68		0.59	0.57	0.19	0.77	0.31	0.66	0.62	0.82	0.72	0.58	0.70	0.59	0.81	0.36	0.48	0.58	0.49	0.80	0.67	0.68	0.58	0.61	0.40	0.35	0.20	0.22	0.12	0.31	-0.15	0.73	0.60
level of authority	0.14	0.59		0.63	0.28	0.18	-0.12	0.58	0.73	0.24	0.73	0.43	0.57	0.13	0.58	0.11	0.02	-0.15	0.52	0.52	0.56	0.32	0.32	0.21	-0.01	0.38	-0.13	0.05	0.06	0.00	0.08	0.81	0.65
public awareness	0.55	0.57	0.63		0.82	0.71	0.63	0.80	0.59	0.71	0.68	0.88	0.82	0.56	0.30	0.47	0.66	0.27	0.79	0.86	0.84	0.77	0.85	0.71	0.56	0.56	0.42	0.42	0.66	0.67	0.21	0.74	0.10
capacity building	0.36	0.19	0.28	0.82		0.52	0.81	0.53	0.29	0.54	0.19	0.86	0.70	0.66	0.10	0.23	0.78	0.33	0.66	0.71	0.62	0.77	0.77	0.78	0.66	0.48	0.76	0.72	0.89	0.88	0.45	0.37	-0.22
type of governance	0.87	0.77	0.18	0.71	0.52		0.77	0.69	0.33	0.97	0.55	0.78	0.67	0.76	0.42	0.63	0.83	0.77	0.54	0.88	0.71	0.85	0.85	0.83	0.77	0.47	0.56	0.41	0.55	0.72	0.03	0.55	0.06
level of stakeholder participaption	0.61	0.31	-0.12	0.63	0.81	0.77		0.39	0.07	0.75	0.09	0.78	0.62	0.84	0.14	0.31	0.96	0.73	0.49	0.70	0.53	0.82	0.77	0.89	0.80	0.39	0.87	0.78	0.85	0.95	0.26	0.20	-0.27
horizontal cooperation	0.41	0.66	0.58	0.80	0.53	0.69	0.39		0.74	0.68	0.68	0.71	0.67	0.49	0.37	0.53	0.43	0.17	0.48	0.81	0.57	0.71	0.88	0.59	0.65	0.60	0.28	0.08	0.46	0.46	0.30	0.63	0.04
horizontal conflict resolution	-0.02	0.62	0.73	0.59	0.29	0.33	0.07	0.74		0.45	0.55	0.38	0.77	0.32	0.54	-0.11	0.10	-0.03	0.45	0.52	0.43	0.46	0.49	0.30	0.14	0.20	-0.04	0.03	0.01	0.16	-0.09	0.45	0.42
vertical cooperation	0.80	0.82	0.24	0.71	0.54	0.97	0.75	0.68	0.45		0.48	0.81	0.77	0.79	0.50	0.46	0.84	0.81	0.63	0.91	0.76	0.90	0.82	0.85	0.71	0.33	0.59	0.46	0.52	0.75	-0.06	0.50	0.13
vertical conflict resolution	0.54	0.72	0.73	0.68	0.19	0.55	0.09	0.68	0.55	0.48		0.41	0.48	0.23	0.48	0.56	0.17	0.04	0.37	0.59	0.56	0.34	0.50	0.33	0.24	0.62	-0.18	-0.05	0.07	0.03	0.04	0.91	0.53
transboundary cooperation	0.68	0.58	0.43	0.88	0.86	0.78	0.78	0.71	0.38	0.81	0.41		0.75	0.73	0.35	0.49	0.87	0.58	0.78	0.95	0.83	0.93	0.88	0.87	0.74	0.50	0.75	0.61	0.84	0.87	0.30	0.60	-0.03
transboundary conflict resolution	0.38	0.70	0.57	0.82	0.70	0.67	0.62	0.67	0.77	0.77	0.48	0.75		0.75	0.61	0.00	0.66	0.47	0.71	0.82	0.72	0.83	0.72	0.77	0.47	0.32	0.48	0.59	0.47	0.66	0.00	0.53	0.34
time horizon in policy development	0.55	0.59	0.13	0.56	0.66	0.76	0.84	0.49	0.32	0.79	0.23	0.73	0.75		0.62	0.14	0.86	0.77	0.33	0.79	0.43	0.90	0.76	0.97	0.82	0.52	0.82	0.83	0.68	0.79	0.35	0.35	0.14
flexible measures, keeping options open	0.34	0.81	0.58	0.30	0.10	0.42	0.14	0.37	0.54	0.50	0.48	0.35	0.61	0.62		-0.08	0.30	0.46	0.17	0.57	0.32	0.52	0.31	0.53	0.26	0.37	0.21	0.43	0.03	0.14	0.07	0.58	0.81
experimentation	0.75	0.36	0.11	0.47	0.23	0.63	0.31	0.53	-0.11	0.46	0.56	0.49	0.00	0.14	-0.08		0.38	0.24	0.24	0.50	0.44	0.34	0.56	0.33	0.55	0.55	0.16	-0.12	0.41	0.28	0.25	0.55	-0.22
consideration of possible measures	0.74	0.48	0.02	0.66	0.78	0.83	0.96	0.43	0.10	0.84	0.17	0.87	0.66	0.86	0.30	0.38		0.84	0.60	0.82	0.67	0.90	0.77	0.94	0.79	0.38	0.89	0.79	0.83	0.95	0.20	0.34	-0.12
Actual implementation of policies	0.76	0.58	-0.15	0.27	0.33	0.77	0.73	0.17	-0.03	0.81	0.04	0.58	0.47	0.77	0.46	0.24	0.84		0.37	0.64	0.50	0.73	0.48	0.76	0.58	0.09	0.72	0.63	0.44	0.70	-0.11	0.17	0.09
Monitoring & Evaluation	0.49	0.49	0.52	0.79	0.66	0.54	0.49	0.48	0.45	0.63	0.37	0.78	0.71	0.33	0.17	0.24	0.60	0.37		0.71	0.95	0.64	0.53	0.49	0.20	-0.01	0.37	0.33	0.47	0.64	-0.26	0.50	0.10
Joint/participative information production	0.74	0.80	0.52	0.86	0.71	0.88	0.70	0.81	0.52	0.91	0.59	0.95	0.82	0.79	0.57	0.50	0.82	0.64	0.71		0.82	0.95	0.90	0.89	0.74	0.55	0.33	0.53	0.68	0.76	0.22	0.71	0.19
Elicitation of mental models/ critical selfreflection	0.71	0.67	0.56	0.84	0.62	0.71	0.53	0.57	0.43	0.76	0.56	0.83	0.72	0.43	0.32	0.44	0.67	0.50	0.95	0.82		0.71	0.62	0.60	0.32	0.18	0.37	0.34	0.47	0.63	-0.21	0.68	0.22
Consideration of uncertainty	0.65	0.68	0.32	0.77	0.77	0.85	0.82	0.71	0.46	0.90	0.34	0.93	0.83	0.90	0.52	0.34	0.90	0.73	0.64	0.95	0.71		0.90	0.95	0.82	0.46	0.81	0.68	0.76	0.89	0.26	0.48	0.05
Broad communication	0.59	0.58	0.32	0.85	0.77	0.85	0.77	0.88	0.49	0.82	0.50	0.88	0.72	0.76	0.31	0.56	0.77	0.48	0.53	0.90	0.62	0.90		0.86	0.89	0.65	0.65	0.45	0.78	0.79	0.41	0.53	-0.14
Utilization of information	0.68	0.61	0.21	0.71	0.78	0.83	0.89	0.59	0.30	0.85	0.33	0.87	0.77	0.97	0.53	0.33	0.94	0.76	0.49	0.89	0.60	0.95	0.86		0.86	0.59	0.85	0.81	0.80	0.87	0.37	0.48	0.07
Decision support	0.58	0.40	-0.01	0.56	0.66	0.77	0.80	0.65	0.14	0.71	0.24	0.74	0.47	0.82	0.26	0.55	0.79	0.58	0.20	0.74	0.32	0.82	0.89	0.86		0.70	0.79	0.55	0.82	0.77	0.61	0.31	-0.28
Resources	0.42	0.35	0.38	0.56	0.48	0.47	0.39	0.60	0.20	0.33	0.62	0.50	0.32	0.52	0.37	0.55	0.38	0.09	-0.01	0.55	0.18	0.46	0.65	0.59	0.70		0.33	0.36	0.56	0.29	0.78	0.67	0.12
Cost recovery	0.44	0.20	-0.13	0.42	0.76	0.56	0.87	0.28	-0.04	0.59	-0.18	0.75	0.48	0.82	0.21	0.16	0.89	0.72	0.37	0.33	0.37	0.81	0.65	0.85	0.79	0.33		0.84	0.88	0.89	0.45	0.06	-0.29
Allocation of resources	0.35	0.22	0.05	0.42	0.72	0.41	0.78	0.08	0.03	0.46	-0.05	0.61	0.59	0.83	0.43	-0.12	0.79	0.63	0.33	0.53	0.34	0.68	0.45	0.81	0.55	0.36	0.84		0.71	0.75	0.36	0.20	0.11
private-public RBM	0.47	0.12	0.06	0.66	0.89	0.55	0.85	0.46	0.01	0.52	0.07	0.84	0.47	0.68	0.03	0.41	0.83	0.44	0.47	0.68	0.47	0.76	0.78	0.80	0.82	0.56	0.88	0.71		0.89	0.61	0.28	-0.39
Risk perception	0.55	0.31	0.00	0.67	0.88	0.72	0.95	0.46	0.16	0.75	0.03	0.87	0.66	0.79	0.14	0.28	0.95	0.70	0.64	0.76	0.63	0.89	0.79	0.87	0.77	0.29	0.89	0.75	0.89		0.25	0.19	-0.31
insurance against risk	-0.02	-0.15	0.08	0.21	0.45	0.03	0.26	0.30	-0.09	-0.06	0.04	0.30	0.00	0.35	0.07	0.25	0.20	-0.11	-0.26	0.22	-0.21	0.26	0.41	0.37	0.61	0.78	0.45	0.36	0.61	0.25		0.19	-0.25
Level of compliance	0.63	0.73	0.81	0.74	0.37	0.55	0.20	0.63	0.45	0.50	0.91	0.60	0.53	0.35	0.58	0.55	0.34	0.17	0.50	0.71	0.68	0.48	0.53	0.48	0.31	0.67	0.06	0.20	0.28	0.19	0.19		0.57
Adoption of international regulation	0.15	0.60	0.65	0.10	-0.22	0.06	-0.27	0.04	0.42	0.13	0.53	-0.03	0.34	0.14	0.81	-0.22	-0.12	0.09	0.10	0.19	0.22	0.05	-0.14	0.07	-0.28	0.12	-0.29	0.11	-0.39	-0.31	-0.25	0.57	

P ≥ 0.9 (significant)

P ≥ 0.95 (very significant)