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# A method to explore social response for sustainable water management strategies under changing conditions



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## ABSTRACT

Society aims at a sustainable water management, which means that it is effective (meeting targets for people, planet and profit), robust (able to cope with uncertainties) or flexible (easy adaptable to changing conditions). The past has demonstrated that extreme weather events and their impacts are important triggers for adaptations in water management. Furthermore, societal changes or events lead to changes in perception of desired situations, goals, and valuation of costs and benefits. Insight in the dynamic nature of societal perspectives and responses provides information about the (non-) support and sustainability of water management strategies. The method presented here comprises the 'Perspectives method', derived from Cultural Theory to classify, analyze and explore present and future perspectives and according social response. These are presented in a so-called perspective map. We illustrate the method with a historic example of the river Meuse.


**Keywords**: sustainable water management, social uncertainties, social response

## Introduction

Water management has always been adapting to changing conditions. Although mostly successful in the end, adaptation processes are often costly and accompanied by disturbances in society (for example after a flood). For the next 100 years water management may be challenged more through expected climate change and socio-economic developments. More techniques and knowledge are available but the increasing population has resulted in limited space and increasing flood risk. The challenge is to cope sustainably with potential global impacts and the inherent future uncertainties in both the water system and the social system (see also Haasnoot *et al.* 2009). Uncertainties in the physical system relate to (changes in) drivers and pressures and their effects on the state, like the effects of climate change on discharges. Uncertainties in the social system involve core beliefs, demands, goals, and values like a moral sense to care for the environment and the demand for more environmentally friendly developments. If we strive for identifying sustainable water management strategies, which are able to cope with different possible futures or can be easily adapted to different futures, we need to take into account a wide range of uncertainties in both the water and social system.

Recent water management studies (for an overview see (Haasnoot *et al.* 2009) analyze the robustness of a strategy by calculating the performance in terms of effects on floods and droughts for different possible futures. Most studies often only included possible climate futures and a few included possible socio-economic developments, which for example often ignore situations in which economy declines (see also Haasnoot *et al.* 2009). However, in reality the success (or failure) of a given strategy depends not only on its performance in terms of floods and droughts. Levelling up dikes could be very effective in terms of flood prevention, even if our climate would change. However, if society disagrees with this (for example because higher dikes block the view on the river or if they are seen as unnecessary or unnatural), the support for a policy may decrease and it may get impossible to implement the chosen strategy. In other words, the dominant societal perspective is crucial for the success or failure of a water management strategy.

This observation generally holds for issues of sustainable development. The nature of this concept is highly contested, complex, and multi- interpretable. Furthermore, it has been proved that the perception of sustainable development changes (Williams and Millington 2004). The concept of sustainable development can thus be interpreted through different perspectives. The importance attached to people, planet and profit may differ from person to

person. For example, there is a lot of disagreement about the roots of sustainability problems, and ways to solve them. An often used distinction is between weak and strong sustainability (Williams and Millington 2004). Weak sustainability sees the inefficient use of resources as one of the major sustainability problems and thinks that solutions have to be found in the use of innovative technologies to increase resource supply (a technological fix approach). Strong sustainability on the other hand focuses on the demand side of resource use. Humans (especially in the developed world) consume more than the carrying capacity of the earth can handle. In the strong sustainability movement solutions should be found in behavioural change and a decrease of human demands (Williams and Millington 2004). Change of the interpretation of sustainable development on such a fundamental level can have significant implication for the appropriateness of management options.

Previous research (Hoekstra 1998; van Asselt *et al.* 2001) has shown how social perspectives can be taken into account for developing robust water management strategies. In this paper, we build upon their approach by elaborating on the implication of societal perspective change. To this end, we adopt the starting point that a sustainable water management strategy is 1) effective, indicating that objectives for people, profit and planet are achieved as much as possible; and 2) robust, which means that it is able to cope with a wide range of future uncertainties or 3) flexible enough to adapt to changing physical and social conditions. To assess the sustainability of river management strategies, one thus needs to test the success of those strategies under a variety of non-linear developments of the coupled water - social system

In this paper, we will develop such a method for sustainability assessment, focusing on exploring the social response for water management strategies under changing conditions (Haasnoot *et al.* 2009). First we will shortly show how the water system and society are related along a framework of Pressure – State – Impact - Response. Second, we describe our method to explore social response. We describe the perspectives methodology, elaborate on our approach to operationalise perspective diversity and perspective change, and show how water system and society can be integrated within a tool (technological framework) to assess the sustainability of different water management strategies under future uncertainties. Third, an historical example of perspective change and its effects on water management policy is given. Finally, we describe how this method can be used by scientists and policymakers to explore the social system and future acceptance for water management strategies in order to determine sustainable water management pathways.

## 2. The interaction of water systems with social systems

Water management generally aims at providing protection against floods and adequate amounts of water of proper quality for various water-related services. It involves finding a balance between water demand and water availability. The water demand is determined by water-related services and individual behaviour, which are part of the social system. The water availability is determined by the climate and geomorphologic characteristics (in other words the water system, which on its turn may be influenced by policies and measures resulting from the social system and vice versa). Flood and drought events may result in an impact on different water functions, such as drinking water supply, agricultural damage or habitat development. These events may also have an effect on our perception on the functioning of the world. It may confirm, amplify or change our expectations about the future climate or the extend to which water can be controlled. The development of water management strategies is often based on past water events and average conditions, expectations of the future state and the current (sometimes implicitly) objectives and values of

society. In other words, the water and social system interact and consideration of both contributes to the identification of sustainable water management strategies.

# FIGURE 1 HERE

**Figure 1. The PSIR framework which shows the relation between the water system and the social system (Valkering *et al.* 2008b; Valkering *et al.* 2009)**

The *PSIR* concept (OECD 1993; Rotmans and de Vries 1997; Hoekstra 1998; Valkering *et al.* 2009) describes these interactions in the form of a pressure-effect chain (Figure 1).. Environmental (P) pressures such as climate change and land use changes influence the water availability. Socio-economic pressures (P) determine the water demand and spatial claims. These factors thus influence the system state (S), including water quantity and water quality. The state has an impact (I) on social, economic and ecological services, such as drinking water supply, agriculture and habitats. The responses (R), finally, are divided in water policy and autonomous responses. Water policy refers to practices, measures and implementations resulting from actions taken by policy institutions (local, regional, national or international). The autonomous responses include agricultural practices by farmers, the recreational use of water, lifestyle issues and patterns by the general public. The nature of the response (what do people actually do?) as well as the perception of problems is highly influenced by one's perspective.

## 3. A method to explore social response and acceptance under changing conditions

### 3.1 Perspectives

To understand the social system we explore attitudes relevant for coping with water management challenges. For this purpose we use the Perspectives method. Perspectives can be defined as: perceptual screens through which people interpret the world (the worldview) and which guides them in acting (the management style) (van Asselt 2000). They are steering for the content of the response. The Perspectives method is derived from Cultural Theory (Douglas 1973; Thompson 1990). This typology was initially developed to classify, analyze and interpret communities' behaviour according to their (religious) rituals (Douglas 1973) and is less spatially or temporally bound than some other typologies (Pendergraft 1998). Later on it has been used to analyze different views on nature and resources (Thompson 1990), uncertainty (van Asselt 2000; Valkering *et al.* 2008b) and climate change (Pendergraft 1998). Furthermore, it is a useful typology to interpret and classify perspectives on water (Hoekstra 1998; Valkering *et al.* 2008b).

Three active, stereotypical perspectives can be distinguished: the *Hierarchist*, *Egalitarian* and *Individualist*. Applied to water (Figure 2) (Hoekstra 1998; van Asselt *et al.* 2001; Middelkoop *et al.* 2004; Valkering *et al.* 2008b), the *Hierarchist* believes in controlling water and nature, high government responsibilities, the importance of research and expert knowledge. Water is mainly seen as a threat to human safety. A sustainable water system highlights safety and flood prevention and leaves space for some economic and natural development. As a consequence, preferred water policy options would be: building dikes, levelling up or broadening dikes, and channelling. *Egalitarians* on the other hand, prioritize ecological recovery and natural development. They urge for more space for nature, water and natural developments. Humans went too far in controlling nature, or even thinking they are able to control. They call for participatory decision making processes with a more equal voice for everyone. Also the needs of animals and plants should be seriously considered. As a consequence, preferred water policy options are space for the river, decreasing human

demands, relocation at higher areas, and precautionary actions. A sustainable water system focuses on strong sustainability with space for natural and ecological processes and reconsideration of human demands. *Individualists* adhere to a more optimistic point of view. They do not see water as being a thread; on the opposite: water offers great opportunities in terms of economy, images, creativity, self development and recreation. They claim for an adaptation approach, great trust in technology and a liberal market. On correspondence with their beliefs, their preferred water management policies focus on innovative projects, like amphibian living*, living on water, and building off shore islands. A sustainable water system is inspired by weak sustainability (Williams and Millington 2004) with a focus on economic opportunities and innovative, technological solutions to unsustainable situations. In cultural theory a fourth perspective, the *Fatalist,* is distinguished (Douglas 1973; Thompson 1990). A stereotypical *Fatalist* is not concerned about the future and sees live as a lottery. Everything is determined by destiny which can not be influenced. One has to enjoy every day, party, buy expensive and luxurious products and make the most of the present. Policy does not exist and sustainable development is not worth to discuss about: fate is unchangeable. Because our research is directed towards policy understanding and the formulation of strategies we decided to exclude the *Fatalist* in our first analysis.

# FIGURE 2 HERE

**Figure 2. The perspective triangle with a short description of every perspective (Valkering *et al.* 2008b). * refers to the present, average perspective of Dutch water professionals (see paragraph 3.2)**

### 3.2 Towards an operationalisation of perspectives: perspectives mapping and dynamics

Although there are some examples of operationalisation of perspectives (see for example Dake 1991; Rippl 2002) there are only a few examples of the operationalisation (Hoekstra 1998) or measurement of social perspectives on water. To use Cultural theory for water management purposes, the above presented descriptions have been further elaborated for different core beliefs and characteristics related to water management (Table 1, left column). For each belief, the stereotype interpretation of the three perspectives is given. This can be used to measure the perspective of a group or individual and map it in a so-called Perspective triangle, thereby indicating the similarities with the three archetypes (Figure 2). When all features of a group correspond with one of the stereotypical Perspectives, e.g. the *Egalitarian*, this group can be classified as an *Egalitarian* stereotype and mapped at the right corner of the triangle. If a perspective exists of interpretations of different stereotypes, it will be located somewhere in the middle of the triangle, depending on the exact completion of the map.

The three different perspectives are theoretically well distinguishable, however, in reality they are not. Real life perspectives are heterogeneous (Douglas 1973; Pendergraft 1998; Valkering *et al.* 2008b). While previous empirical studies focused on classifying individuals or groups in one of the stereotypical (and thus extreme) positions in the triangle of Figure 2, we allow Perspectives to be heterogeneous (Valkering *et al.* 2008b). Preliminary results of our study confirmed this heterogeneous character of perspectives (Table 1). Real life perspectives on water turned out to consist of combinations of different interpretations coming from different perspectives. This implies that it is possible to have characteristics of more than one

* Amphibian living: buildings or infrastructures are (partially) built on the water surface and follow the dynamics of the water surface. They are suited both to float on the water surface as well as to be on solid ground.

stereotypical perspective (e.g. to have a *Hierarchical* interpretation for the belief 'water problems versus manageability' and an *Egalitarian* interpretation of the belief 'water system organization'). Besides, it is also possible to adhere to more than only one perspective for one belief (e.g. I believe both in water as a source of rest and well being, as well as a reliable source to fulfil different functions). The dominant Dutch perspective measured under Dutch water professionals in 2008[†] consists of a combination between *Hierarchism* and *Egalitarism*, with some *Individualistic* characteristics (Table 1). In general, expectations about the future, as well as responsibility issues are dominantly approached in a *Hierarchical* way. However, the *Hierarchical* idea of water as being a threat against we have to fight is less popular at the moment. Instead, professionals are searching for ways to combine natural developments, space for water and nature with innovative, technological opportunities. Water offers opportunities, the ideas and wishes of citizens and other stakeholders should be heard, but the government stays the final responsible for water management. The location of this heterogeneous perspective can then be assessed by calculating a score for every perspective (the sum of every column standardized to 3) and plot this outcome within a standard triangle, which results in a dot (see for example the asterisk in Figure 2). It is also insightful to make different triangles for different combinations of beliefs. The first five beliefs in Table 1 are beliefs on a worldview level (how does the world function?), the last four beliefs are directed towards the process part of water management (how should we arrange our water management?). The remaining beliefs focus on the content of water management (what should be done?).

In society different perspectives occur. Within this broad spectrum of perspectives usually a dominant perspective and (one or more) undercurrents can be distinguished (Loorbach 2007) A dominant perspective consists of interpretations of beliefs upon which the majority of people in a group (family, policy, nations) explicitly or implicitly agree. This could be a *Hierarchical* idea of control and regulation, resulting in reinforcing dikes. Undercurrents refer to interpretations of beliefs according to the minority of people in a group or a subgroup, e.g. resulting in an *Individualistic* perspective with focus on opportunities and innovation and a strong preference for amphibian living. Because of the dynamic nature of perspectives, the interpretation of beliefs could change over time, as well as the distribution between dominant perspectives and undercurrent(s). Eventually, an undercurrent could become dominant at costs of the previous dominant perspective. In our example this would imply a loss of support for further dike reinforcements and growing popularity and attention for amphibian infrastructures.

# TABLE 1 HERE

Perspectives change due to surprises (Thompson 1990; Verweij *et al.* 2006; Valkering *et al.* 2008b). Surprises are events, developments and occurrences (possibly catalyzed by people or the media) which show that the day-to-day reality deviates with once expectation about the reality. In that case, there is a mismatch between perspective (expectation, or how people think the world functions) and actuality. For a *Hierarchist*, with great trust in dikes, it would be a surprise to face a dike breach. However, in practice perspectives offer resistance against surprises. When confronted with a surprise, people will try to ignore its occurrence, or try to explain it in such a way that it still fits within the former expectations (Thompson 1990). This ignorance however, is only tenable up to a certain tipping point. At this tipping point, reality

[†] This inventory (N=90, Cronbachs' Alpha= 0.78) was meant to be a first test case for a next, large scale information gathering by questionnaires to be held among Dutch stakeholders in 2009.

can not be denied any longer, and the perspective will change. Perspectives change if at least one interpretation of one belief in Table 1 changes according to new insights. With a changing dominant perspective, the social support for a given water management strategy may also change. To avoid protests, indefensible situations and any other difficulties concerning the implementation of a strategy, the robustness of a strategy for changing perspectives, in other words the social robustness, has to be tested in advance. A sustainable strategy is able to cope with developments in the water system as well as developments in the social system (perspective change). This contributes to make the water system sustainable and future proof (in stead of only climate proof).

### 3.3 IAMM tool to analyze to interaction between social and water system

To analyze the interaction of the social and the water system through time an Integrated Assessment Meta Model (IAMM) is being developed based on simple cause-effect relations (Haasnoot *et al.* 2009). With this model it is possible to analyze the PSIR chain for many transient scenarios without a large calculation time. Transient scenarios comprise time-series of the climate, including flood and drought events, socio-economic trends, social events, surprises and interactions between the water system and society. At any moment in time it is possible to evaluate a water management strategy and adapt if necessary. As described by Haasnoot *et al*. (2009) this evaluation is – amongst others- based upon performance indicators. These indicators may differ according to once perspective. For example, for an *Egalitarian* who values nature and ecological development over economic issues, shipping suitability[‡] is allowed to be lower than for *Individualists* who highly value economic prosperity (see section 5). The result is a set of storylines, together making up an ensemble of transient runs including dynamics due to natural and social variability and interaction between the water and social system. Each storyline will be evaluated on events, management style, impacts (damage, costs, and effects on nature) and changes in perspectives. Threats and opportunities for different strategies will become clear, which can then be used to improve the strategies. We could for example identify no-regret or regret measures, analyze the risk of doing nothing or waiting and then analyze the range of possible futures.

## 4. From theory to practice: historical perspective changes in the Meuse valley

To gain more insight in perspectives and perspective change, four stakeholder workshops for the case study of the Meuse valley in the province of Limburg, Netherlands were organized. In the first workshop we explored historic perspectives and drivers (surprises) for change. To this end, a number of water management experts were invited, including representatives of government (regional and national scale), NGOs, and researchers. In a facilitated discussion, they were asked to reflect on the historic perspective changes and their drivers concerning the Meuse, resulting in a historical timeline linking, event, developments, influential people and perspective change. Summarized four periods could be distinguished according to the participants (Valkering *et al.* 2008b):

1. From 1800 till 1960 could be characterized as a combination between *Hierarchism* and *Individualism*. In a context of economic growth, technological innovations, industrialization and mining activities (and the related increased demand for fast and large scale shipping of coal to the port of Rotterdam), this period caught on manipulability, which resulted in regulation of the Meuse for large scale coal transportation throughout the whole year.
2. Starting as from the 1960s, the dominant perspective moved towards *Egalitarism* (although the first undercurrents date back to the early 1920s). Main driver was a growing

[‡] Expressed in the percentage of time with hindered navigation time.

environmental awareness, catalyzed by some major, visible calamities (like the Endosulfan poisoning of the river Rhine, and the explosion in the power plant of Chernobyl) and some initiatives (like 'plan Ooievaar', which asked for more space for water and nature). With increased attention for both water and ecological quality as well as the right for future generations which should be able to meet their needs, attention for nature and natural recovery became more popular. The accumulation of calamities empathetically served as surprise for the *Hierarchical- Individualistic* perspective with trust in technology, control and the belief that nature is robust for external disturbances. Reality could not be denied any longer which made the perspective change towards *Egalitarism*.

3. In 1993 and 1995, the Meuse area was hit by floods, which caused the dominant perspective to become more *Hierarchical* again. An increased awareness of unsafety and the expected effects of future climate change on discharges, combined with an increased pressure on the Meuse valley (mainly due to an increased urban area), a more *Hierarchical* perspective came into force. Within this perspective, there was high attention for protection against floods, combination of different water functions, and strong government responsibilities. Here we see that events and developments besides their role as surprise also function as a reproduction mechanism. A reproduction mechanism is an event or development which reflects expectations about reality, and strengthens a given perspective. After the 1960s there was still a group who believed in the controlling capacity of dikes and their importance for human safety (undercurrent). Because of the 1993 and 1995 floods, their perspective was reproduced and eventually won popularity again.
4. Around 2006 the dominant perspective consisted of a combination of all stereotypes. *Hierarchical* elements were protection against floods as leading principle, government responsibilities, and controlling/ regulating measures (like off-shore sand supplement and raising the levels of the IJsselmeer Lake). *Egalitarian* characteristics include participatory decision making processes, citizen involvement and reservation of natural area (as preventive measure against the possible consequences of climate change). *Individualistic* elements were financing measures to pay the costs for natural development or conservation with profits from recreation, catering or education. In addition, the increased attention for the innovative use of water and space (like amphibian living) suits perfectly in the *Individualist* perspective.

This short summary shows the dynamic nature of perspectives, the relation between perspectives, societal support, and preferred water policy options (both content wise, e.g. dike reinforcement as well as process wise, e.g. expert knowledge or participatory decision making). Mostly, perspectives changed due to *external* events or developments, occurring outside the area of the Meuse and often external to the water system (like the Chernobyl disaster). Further it states that the role of undercurrents should not be underestimated. The eccentric ones at this moment could possibly be the dominant ones in the next decades.

# FIGURE 3 HERE

**Figure 3. Visualization of the historical transition path for perspective change in the Dutch Meuse valley from 1800 till 2007 (Valkering *et al.* 2008b).**

## 5. Sustainable water management paths that are robust and flexible

History illustrates that the process of perspective change can metaphorically be described as paths and roads on hiking maps (therefore the background in Figure 2 and Figure 3 represents a map). On a map, it is possible to identify where you came from, what your current position is, where you would like to go to and what expectable obstacles are (like rivers and gorges). However, it is not illusory that if the journey goes along, unexpected circumstances, (like washed away trails, broken bridges or bulls on a pasture) come across. The same is true for perspectives: we are able to identify the road being followed by perspective changes, the position we are right now, and which direction we wish to follow for the near by future. However, depending on social, technological and natural uncertainties there is a multitude of different futures possible: one can choose to turn into different pathways (different measures) and one could be confronted with different unexpected development (the surprises), like a flood or failure of technology. Besides, in reality there are a lot of unofficial roads, which are not stated on the map, but are used by some walkers as an alternative pathway; which is comparable with an undercurrent. At the moment these unofficial paths gain popularity and are being walked on by more and more people, they become more visible and eventually develop into an official road, indicated on a map and possibly resulting in a very good alternative.

Given the willingness to identify sustainable water management strategies and the thoughts of the map metaphor the following question arises: What is a good way to assess the most promising pathway to achieve a sustainable water system in a changing world? Partially, this is a matter of robustness as the path should be able to cope with different possible futures in terms of different circumstances and developments. For example, the path should still be accessible in case of heavy rainfalls or droughts and besides it should be suited for a lot of different personal situations. A flat trail is better able to cope with such personal circumstances (like injuries, fatigue, broken shoes) than for example a hilly trail. The same should be true for a water management strategy: it should be able to cope with natural developments, such as climate change, as well as societal developments (changing perceptions, goals and demands from society on water management), hence it should be *robust*. In addition, a sustainable strategy is a matter of flexibility. If a pathway turns out to be washed away, it should be easy and fast to find another trail, leading to the same destination as the initial road. If space for the river turns out to be ineffective in terms of climate change or societal response, it should be relatively easy to transform: the strategy has to be *flexible*.

A first step in the sustainability assessment thus consists of a social robustness analysis. This analysis explicitly draws from the added value of the diversity of perspectives that exist at any point in time. This diversity of perspectives can be illustrated by analyzing the current perspectives on Dutch water management (Valkering *et al.* 2008b), which can be placed within the perspectives triangle (Figure 4). Some of the perspective-based points of view may seem unbridgeable as they are based upon fundamental different assumptions about how the world functions and how the world should preferably be managed. However, this diversity does not automatically result in ignorance and solitary situations. Every perspective possesses certain core qualities which have to be combined (Douglas 1973; Thompson 1990) to achieve a constructive dialogue and starting point for a social robustness analysis. According to Douglas (1973) and Thompson *et al*. (1990) each perspective needs each of its rivals, either to make up for deficiencies, to exploit, or to define itself against. The *Hierarchist*, for example is decisive but innovation fails due to a web of governmental rules. The *Individualist* is a source of innovative ideas, however lacking attention for environment and solidarity, and the *Egalitarian* focuses on environmental issues and harmony, while lacking decisiveness

(Douglas 1973; Verweij *et al.* 2006; Valkering *et al.* 2008c). However, that no perspective can exist alone does not mean that every perspective has to be represented equally within a group (Thompson 1990).

# FIGURE 4 HERE

**Figure 4. The perspectives triangle and possible measures categorized by perspective (Valkering *et al.* 2008c)**

A social robustness analysis to assess the performance of a strategy under different possible social perspectives can be executed by a critical dialogue between representatives with different perspectives. Every perspective comments on the preferred measures of the others based upon their own worldview (Table 2). In this way risks and vulnerabilities of a strategy become visible. Filling in the perspectives map and comparing the results between different stakeholders could be very helpful in reaching agreements for a given strategy or even to improve a strategy. This comparison elegantly visualizes the beliefs upon which people disagree, or why a given strategy may be rejected by one or more parties. It offers opportunities to direct the dialogue towards laying the finger on the sore spot and try to come to agreement by making certain adjustments on the initial idea (e.g. to ensure enough attention for human safety and natural developments for animal and plant species in the 'living on water idea' to comply better to respectively the *Hierarchist* and *Egalitarian* who prioritize safety and ecological recovery instead of innovation and self developments like the *Individualist*). If it is impossible to find adjustments to make a strategy at least acceptable for other perspectives, the strategy lacks robustness for social change.

# TABLE 2 HERE

A second step in the robustness analysis consists of confrontment with surprises. To this end, management strategies are confrontment with a number of possible scenario developments and events that will typically contain surprises. In the IAMM tool, users will be confronted with surprises and reproduction mechanisms (see paragraph 4) by means of news paper headlines (Figure 5). Also a score for public support for a given strategy and the performance of a strategy including flood and drought events will be given. Although history has given some insights about the effects of these surprises and reproduction mechanisms (e.g. change or enforcement of perspectives), little is known about the direction of change (e.g. if a *Hierarchist* gets confronted with a couple of surprises, will he or she change into the direction of *Egalitarism* or *Individualism*?). To gain more information about drivers and thresholds for change, the direction of change and the role of undercurrents herein we use the IAMM tool game in a participatory setting (Valkering *et al.* 2008a). We will carefully analyze choices, changing perspectives and support for a given water management strategy, resulting in a second robustness test. We will also investigate opportunities to adapt to loss of social support for a strategy. The latter is important if a strategy ( e.g. dike reinforcement) scores well for the water system (e.g. no floods occur, ecological diversity is high), but society is dissatisfied with the (results) of the strategy because it is unsightly, unnecessary or it takes away the beautiful view on the river for example. Furthermore, the score for the results of a strategy (the performance indicators) depends on objectives. These objectives are part of an extended perspectives map (an extension of Table 1.) and differ for every perspective (e.g. a *Hierarchist* does not accept any flood, whereas *Egalitarians* accept some small floods in a

given time span; the *Individualist* requires a very high shipping suitability whereas *Egalitarians* and *Hierarchists* are satisfied with less).

# FIGURE 5 HERE

**Figure 5. Examples of headlines in the IAMM tool. The left one is a surprise for the *Hierarchist* (and a reproduction mechanism for the *Individualist* and *Egalitarian*). The right one is a reproduction mechanism for the *Individualist* and a surprise for the *Hierarchist* and –to a lesser extend because of the space given to the water- the *Egalitarian*.**

## 5. Conclusion and prospects

Sustainable water management involves analysing the interaction between the social and water system. A sustainable water management strategy is effective, robust and flexible. Effective means that targets for people, planet and profit are being met. Robust means being able to cope with different future events and developments in the social and water system (like changing social perspectives, floods, droughts, and increased discharges). Flexible means that a strategy can be adapted to changing social and physical circumstances. In other words, a sustainable strategy has to be acceptable under different futures or it should be easy to adapt it in order to become acceptable again. Identification and implementation of sustainable water management strategies has several benefits: it saves costs if there is no need to replace, or change costly measures taken before because the strategy turns out to be unsustainable. Therefore, a dialogue based negotiation process with a focus on highlighting positive aspects of every perspective is needed. This leads to a more satisfying situation for all involved, since the strategy should be acceptable under all different perspectives and futures. Furthermore, it offers opportunities for analyzing vulnerabilities of strategies, and exploring and visualizing differences in perspectives and disagreement resulting from that. There are different perspectives on promising ways for sustainable water management strategies. The Perspectives method can be used to classify, interpret and analyze these different perspectives. In this way they can be used to analyze the response to future social and water events and the future social acceptance of different water management strategies. The outcome of this analysis will be used in an IAMM tool and integrated with information of the water system into storylines. These storylines will be evaluated for their social and physical robustness and their capacity to adapt to changing conditions. First results of this type of analysis show that surprises are important for decisions on water management strategies and the performance for strategies for the nearby future is mainly determined by climate variability, while for the longer term (> 50 years) climate change is important to take into account. A sustainable strategy could then be a strategy which is robust for climate *variability* (fluctuations *within* the climate) and social change in the near future, and flexible enough to adapt to climate *change* (fluctuations *between* different climates) and social change on the long term.

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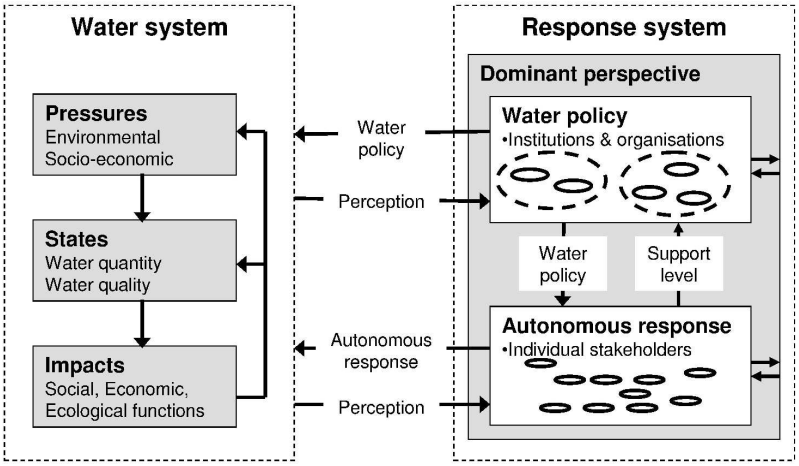
Table 1. A first operationalisation towards perspectives on water (Valkering *et al.* 2008b). The underlined texts refers to the present dominant perspective on water for Dutch water professionals (n=90). For every belief (left column) respondents have to choose which interpretation fits best to their personal impression. For every belief, one, two or even three interpretation can be selected.

| | **Hierarchist** | **Egalitarian** | **Individualist** |
|---|---|---|---|
| *Value of water* | Reliable source for fulfilment of functions | Source for rest and well-being | Source of prosperity and self development |
| *Water problems vs manageability* | Serious problem, but manageable | Serious problem, and not manageable | No problem |
| *Expectation about climate change* | Average trend as forecasted by experts | High trend (worst case) | Low trend |
| *Trust in technology* | Moderate positive, reserved trust | Negative, low trust | Positive, great trust |
| *Expectation socio- economic context* | Average trends | Low trends (e.g. small population growth) | High trends (e.g. high population growth) |
| *Water priorities* | Preservation of current function; win- win | Compensation and ecology | Innovation and economy |
| *Managing safety* | Flood prevention | Avoidance of areas sensitive to floods | Adaptation and utilizing opportunities |
| *Water supply in dry times* | Demand driven | Supply driven | Market driven |
| *Water system organization* | Damming and regulation | Naturally | Opportunistically |
| *Spatial planning & water* | Water follows | Water steers | Water offers opportunities |
| *Responsibility* | National and European governments | Regional governments and NGOs | Private companies and individuals |
| *Process design* | Norms and expert knowledge | Participatory decision making | Free market - Privatization |
| *Identity & knowledge* | Dutch water authorities | River catchment - local | International companies |
| *Level of integrality* | Sectoral | Integral | Competition |

Table 2. Three examples of measures and possible reactions and critiques on these measures from the other perspectives (Valkering *et al.* 2008c).

| | **Hierarchist** | **Egalitarian** | **Individualist** |
|---|---|---|---|
| **Relocate activities** | Renounces the rich Dutch history of water management. Besides it is unnecessary because we have the capacity to control the water. | *Relocate infrastructure and buildings to higher areas which are not vulnerable to floods. Gives more space to the river.* | Too expensive and we are in need for more space for building areas, especially if populations continue to grow. Would be a missed change to profile the Dutch capacity to govern water. |
| **Offshore islands** | There is not enough scientific proof for its consequences. Might harm sea water quality for swimming due to changing sea streams | Disturbs and harms ecological dynamics, birds and other organisms. Not natural. | *Building innovative islands to protect the coast from erosion and flooding. Preferably the shape of these islands should be innovative too (e.g. the shape of a tulip) to boost innovative image.* |
| **Level up dikes** | *Levelling up existing dikes in order to better cope with increased discharges. The vulnerability of the dike goes down, the safety for people as a consequence goes up.* | Unnatural and only a short term solution with regards to climate change. Besides it is clumsy for people and prevents development of natural river banks. | Too soft, not innovative enough. Besides it's a bit old-fashioned, blocks peoples' view on the river. Same space could be used more efficiently and for a better living enjoyment. |




The PSIR framework which shows the relation between the water system and the social system (Valkering et al. 2008b; Valkering et al. 2009).
215x279mm (600 x 600 DPI)

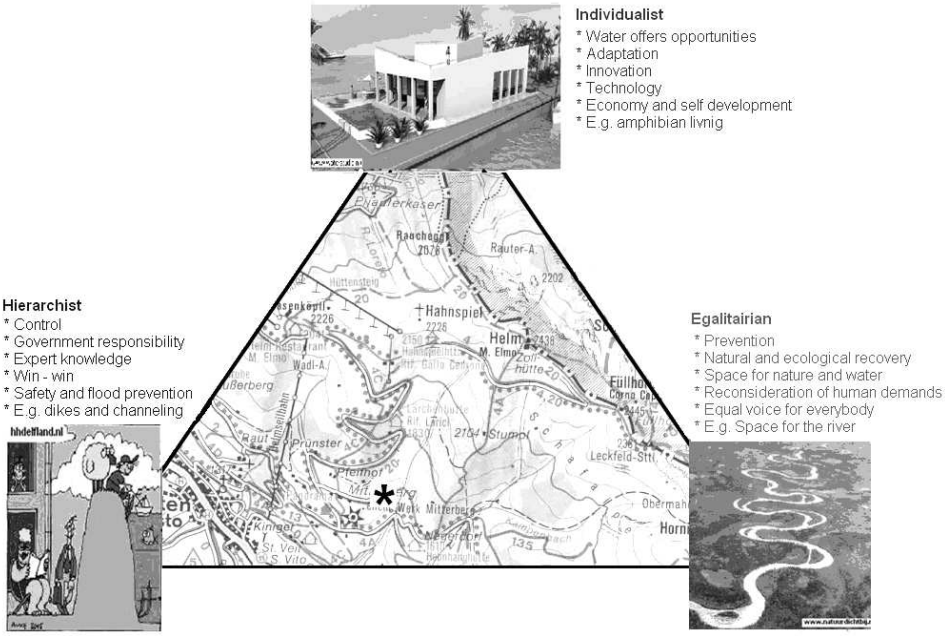



Figure 2. The perspective triangle with a short description of every perspective (Valkering et al. 2008b). * refers to the present, average perspective of Dutch water professionals (see paragraph 3.2)
277x177mm (96 x 96 DPI)

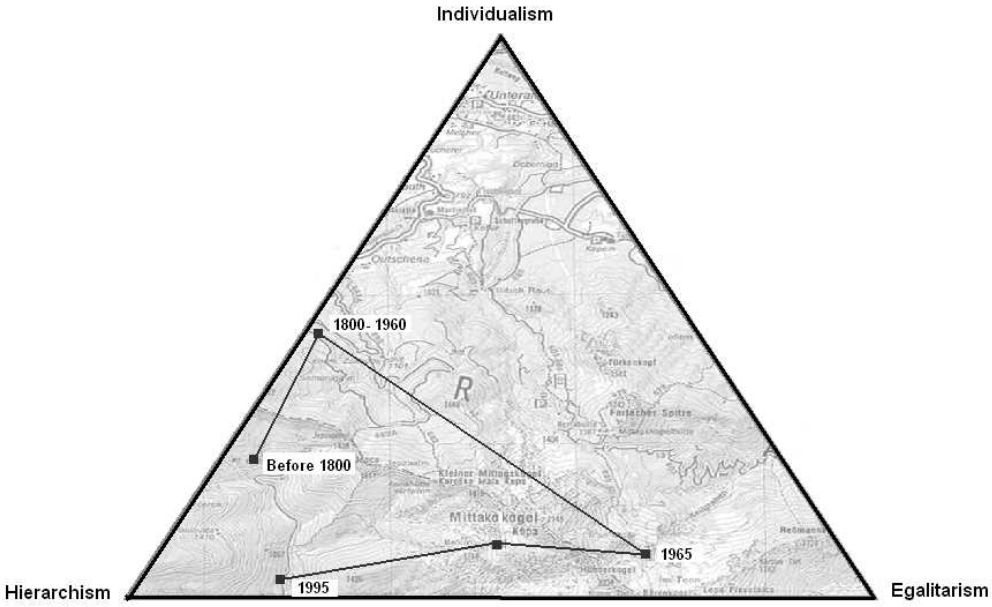



Figure 3. Visualization of the historical transition path for perspective change in the Dutch Meuse valley from 1800 till 2007 (Valkering et al. 2008b).
229x145mm (96 x 96 DPI)

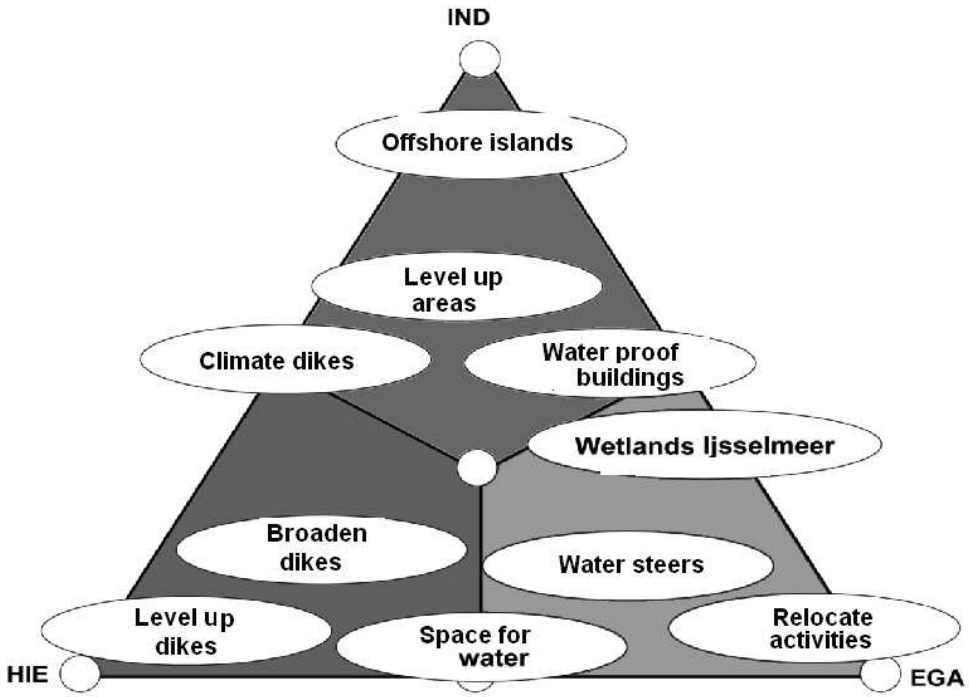



Figure 4. The perspectives triangle and possible measures categorized by perspective (Valkering et al. 2008c).
210x150mm (96 x 96 DPI)

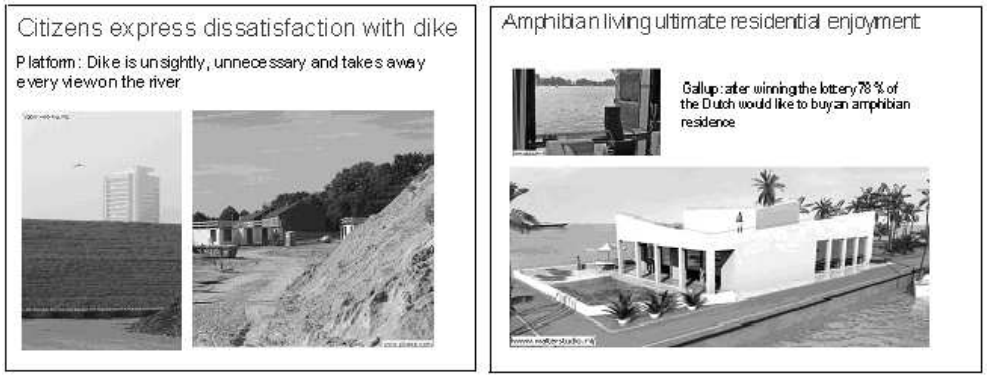



Figure 5. Examples of headlines in the IAMM tool. The left one is a surprise for the Hierarchist (and a reproduction mechanism for the Individualist and Egalitarian). The right one is a reproduction mechanism for the Individualist and a surprise for the Hierarchist and –to a lesser extend because of the space given to the water- the Egalitarian.
175x127mm (96 x 96 DPI)