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Deliverable 2.2

Report reviewing existing large-scale scenarios and reasons for selection of the set most relevant to European water issues for the fast-track process

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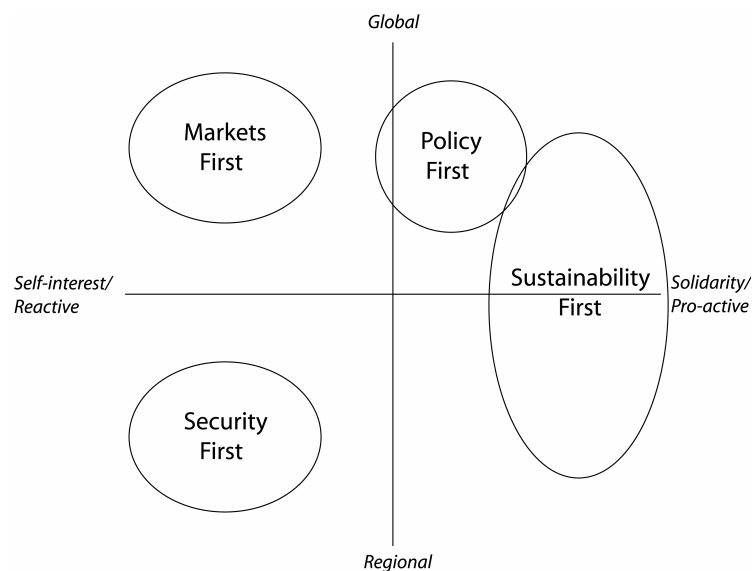
Deliverable 2.2 (SCENES WorkPackage 2, scenarios)

Report reviewing existing large-scale scenarios and reasons for selection of the set most relevant to European water issues for the fast-track process

Kasper Kok¹ and Joseph Alcamo²

1: Department of Environmental Sciences, Wageningen University, Wageningen, the Netherlands

2: CESR, University of Kassel, Kassel, Germany



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Preface

This Deliverable consists of two parts. Part 1 contains the review of a set of existing global and European scenarios and the selection of the set that is most relevant for use in SCENES. Part 2 contains a detailed description of a set of scenario archetypes and the four scenarios in the set that was selected (GEO-4). This second part thus goes beyond the original requirements of the Deliverable. The description serves a double purpose of providing insight in the actual content of some of the sets of scenarios and a means to document the GEO-4 scenarios and their relation to water issues. As such it also complements Milestone 2.2, “Review of pan-European scenarios”.

PART 1 – SCENARIO REVIEW AND SELECTION OF MOST RELEVANT SET FOR SCENES

Kasper Kok and Joseph Alcamo

1.1 Introduction

At the Kick-off meeting of SCENES, a time mismatch between activities of WP2 and WP3 was identified. The deadline for WP2 to evaluate existing large-scale scenarios and select the most relevant set for the fast-track process is month 12: “D 2.2 Report reviewing existing large-scale scenarios and reasons for selection of the set most relevant to European water issues for the fast-track process. (month 12)”. However, the deadline for WP3 to produce a first set of quantitative fast-track scenarios is also month 12: “D 3.1 Fast track modelling results (month 12)”.

The conclusion was that in order for WP3 to proceed, it was absolutely necessary to make a decision as soon as possible on which set of scenarios would be used for the fast-track. Obviously this does not mean that later in the process the set could be altered and/or expanded, but we needed to define our common starting point. We therefore planned a meeting between the (co-)leaders of WP2 and WP3 in December 2006 to quickly evaluate the existing large-scale scenarios and propose a set to be used in the fast-track procedure. The following analysis is based on this evaluation.

1.2 Selection of most relevant scenario study

A first step was to define European and/or global scenarios studies that are potentially relevant for SCENES. We selected the following 7 studies:

1. **Intergovernmental Panel on Climate Change. Special Report on Emissions Scenarios – IPCC-SRES** (Nakicenovic et al., 2000). In our evaluation we included a number of recent studies that used the IPCC-SRES storylines and enriched + downscaled them to Europe. Most important are the A-TEAM (Rounsevell et al., 2006); EURURALIS (Westhoek et al., 2006); and PRELUDE (EEA, 2007). All scenario sets have four scenarios, termed A1, A2, B1, and B2 in the original IPCC-SRES assessment, while some of the European studies have given names (see also Part 2).
2. **Millennium Ecosystem Assessment – MA** (see Carpenter et al., 2005). The MA included global scenarios as well as a number of so-called sub-global assessments of which some were carried out in Europe (Portugal, Sweden 2x). These were included in the evaluation although it concerns mostly rather localised studies. All scenario sets have four scenarios, Global Orchestration; Techno Garden; Adaptive Mosaic; and Order from Strength.
3. **Global Environment Outlook – GEO-3/GEO-4** (for GEO-3 see UNEP, 2002; for GEO-4 see UNEP, 2007). Because the GEO-4 scenarios were not available at the time of the evaluation, we included the previous scenario work as carried out within GEO-3. There are four scenarios called Policy First; Markets First; Security First; and Sustainability First.
4. **Visions/MedAction** (see Rotmans et al. (2000) for Visions and Kok et al. (2006a and 2006b) for MedAction). These two projects include European scenarios; Mediterranean scenarios; local case study scenarios; and European visions. There are three European scenarios, Big is Beautiful?; Convulsive Change; and Knowledge is King.

5. **World Water Vision – WWV** (Cosgrove and Rijsberman, 2000). The WWV includes three water-specific global scenarios: BAU, ‘Technology, economics, and private sector’, and ‘Values and Lifestyles’. It included some specific information on Western Europe.
6. **EEA European Water Outlook**. (to be published; see also EEA, 2005). There are three scenarios.
7. **Global Water Outlook – GWO** (Rosegrant et al., 2002). Included are three water specific scenarios with BAU, Sustainable world, and Water Crisis.

We can basically distinguish three types of scenario studies:

- Global integrated scenario studies that are very complete and normally distinguish four scenarios along two main uncertainties and elaborated storylines and quantitative models. These studies usually do not focus specifically on water. These studies are IPCC-SRES; GEO-4; MA.
- Scenario studies that focus specifically on water. These studies are usually far less elaborate and include only sketchy storylines. These studies are World Water Vision; Global Water Outlook; EEA European Water Outlook.
- Studies that are specific for Europe. These include Visions/MedAction and the various downscaling studies from IPCC-SRES (ATEAM, EURuralis, PRELUDE).

After deciding on the relevant studies, we listed the main characteristics of each study including the main advantages and disadvantages regarding their application in SCENES (see Table 1). Subsequently, we (semi-)quantified the main characteristics by scoring each characteristic for each scenario study. Finally, we provided a weighting factor for issues that we considered more important. We gave particular weight to storyline elaboration, European specificity (including downscaling exercises), availability of gridded driving forces, scientific acceptance, relation to water issues, and currency. Our simple objective scoring and weighting gave the final scores presented in Table 2. Please keep in mind that the tabular information should merely be regarded as systematic background information; not as strict selection criteria.

Table 1. Main characteristics of selected scenario studies

Scenarios	Time horizon	Spatial extent	Advantages	Disadvantages
IPCC (downscaled)	2100 (2030/50)	Global (EU15/25)	Applied in sub-global settings European versions available Focus of European studies not on water Quantified water scenarios available for Europe Climate oriented	Rudimentary storylines Outdated Climate oriented
MA (SGAs)	2050	Global (local)	Elaborated storylines Water scenarios available for Europe Very recent Quantified water scenarios available	Storylines not downscaled for Europe Ecosystem oriented
GEO-4 (GEO-3)	2050 (2032)	Regional (global)	Brand new! Elaborated European storylines developed by stakeholders Quantified water scenarios available for Europe	Storylines brief Not finalised until late 2007 Input from scientists small
Visions/MedAction	2050/2030	European	Specific for Europe Detail for Mediterranean Very elaborated storylines	Information on water is limited Some scenarios are less plausible No water quantification available.
World Water Vision	2025	Global	Water-specific scenarios On-going process and discussion	Sketchy for Europe Outdated? BAU + two variations
EEA European Water Outlook	2030	European	Recent and available	Only quantitative Very sketchy storylines
Global Water Outlook	2025	Global	Water-specific scenarios Some storyline information	Mainly quantitative BAU + two variations

Table 2. Scoring table of main characteristics and weighting factor for each of the selected scenario studies.

Criterion	IPCC (down- scaling)	MA	GEO-4	WWV	Visions/ Med- Action	EEA Eur Water Outlook	Global Water Outlook	Weighting Factor
Storyline elaboration + creativity + complexity	4	8	6	4	7	1	4	3x
European specificity (including downscaling exercises)	6 (8)	4	8	3	9	9	4	3x
Time horizon	4 (8)	6	6	8	7	9	8	1x
Availability of gridded driving forces	8	8	8	8	2	9	5	2x
Scientific acceptance	9	7	7	5	5	5	5	2x
Policy acceptance for water	1	4	4	4	4	6	4	1x
Information on water	2	6	6	6	6	8	6	2x
How current?	6	8	9	4	7	5	6	2x
Date of publication/ Current availability	9	9	4	9	8	8	9	1x
Total Score	94 (104)	113	116	88	107	107	89	

From the information in Table 1 and Table 2 we started an elimination procedure: Two of the water-specific studies (WWV and GWO) score low on the comprehensiveness of the storylines, as well as on the scientific acceptance, while in the rapidly advancing field of scenario development, they are relatively outdated. To some extent, the same holds for the EEA European Water Outlook, but this is a recent study within which WaterGAP is being applied for Europe. However, storylines are so brief that they are not suitable for the application in WP2 of SCENES. In other

words, we dismissed all specifically water-related scenario studies as being useful within the fast-track procedure of SCENES. All Europe-scale scenario studies scored slightly higher, but they all have important drawbacks: Although storylines in Visions/MedAction are among the most elaborate, the study provides mainly qualitative data, which make it unsuitable for WP3. The various European studies that developed downscaled versions of the IPCC-SRES storylines score low on the policy acceptance and on the information on water. Additionally, gridded information on driving forces is not always available. We therefore narrowed down our options to the three global studies, IPCC-SRES, MA, and GEO-4. Of these three the IPCC has most disadvantages (simple storylines; relatively outdated; and overly focused on climate for our purposes). This left us with the MA and GEO-4. The key differences between both studies are clear from Table 2. The MA scores significantly lower on European specificity, while GEO-4 has simpler storylines, certainly compared with the MA where storylines are the most elaborate of all studies considered here. The decisive factor proved to be the date of publication. GEO-4 will be published in the course of 2007 and is therefore the most recent of all studies. A potential drawback is that it might be problematic to acquire the preliminary versions of both storylines and quantitative model runs. As WP3 is heavily involved in the scenario activities within GEO-4, this was not considered to be a problem in practice.

Thus, GEO-4 was selected as the most relevant set of scenarios, and therefore the set that was selected as input for the fast-track procedure.

1.3 Similarities and complementarities

The high degree of similarity between the various scenario studies is an important observation that we took into account when making this recommendation. Various recent publications have compared the underlying assumptions of a number of sets of scenarios and have classified them into a relatively small group of scenario archetypes (e.g. Busch, 2006; Raskin et al., 2005). Moreover, often the models used to quantify these assumptions were the same in different studies. These similarities in underlying assumptions, storylines, and model quantification will be further elaborated in Part 2 of this Deliverable which will contain a full review and comparison of the existing scenario studies. Here it suffices to note that there are large overlaps between the different scenarios. Consequently, selecting one set of scenarios (GEO-4) does not exclude using information from other studies while constructing the fast-track scenarios. For example, for WP2, the MA scenarios with their elaborated storylines bear relevance and information from the MA storylines will be incorporated where possible. WP3 will make use of the current involvement of WaterGAP in the EEA World Water scenarios and in the MA, besides the involvement of CESR in GEO-4.

PART 2 – SCENARIO ARCHETYPES AND THE GEO-4 SCENARIOS

Kasper Kok

2.1 Introduction

In Part 1, it was concluded that the global scenario assessments of IPCC-SRES, GEO-3/GEO-4, and MA bear most relevance to the scenario development in SCENES. Moreover, all of these studies developed four scenarios, using a similar methodology. We therefore limited our evaluation of scenario archetypes to those global studies. To those we added the Visions/MedAction study, because of the elaborate storylines, and the work of the Global Scenario Group (GSG). The scenarios developed by the GSG were essentially the first effort to develop a set of global storylines (Gallopín et al., 1997; Raskin et al., 1998; Raskin et al., 2002). All subsequent global assessments were based on these first scenarios to a greater or lesser extent. The importance of GSG scenarios lies, however, primarily in the fact that they were the first. Therefore, they were not included in the selection procedure of Part 1, but they are in this construction of scenario archetypes.

2.2 Past scenario classification efforts

There have been various recent attempts to classify the wealth of scenario studies (Zurek, 2006; Busch, 2006; Westhoek et al., 2007). All of these attempted to group the individual scenarios. The archetypes that are presented below draw heavily on the classes that have been proposed by these studies. However, all efforts to review existing scenarios have focused on the *quantitative* scenarios. That is, differences between scenarios are analysed by using the quantitative assumptions and parameter settings in the various models that were used. This has been a very useful and clear method of comparison, because only a small number of different models has been employed in the different scenario assessment. Often-employed models are IMAGE, WaterGAP, AIM, and IMPACT. However, the aim of WP2 is at the construction of scenarios that are largely *qualitative* in nature. Thus, for a good description of scenario archetypes in this case, it becomes essential to compare the storylines that underlie the model settings. A thorough comparison of the narratives is as yet lacking. This Deliverable attempts to classify the existing scenarios and subsequently combine elements from the different scenarios (with a different focus) into archetypes that thus are richer than the original storylines. The main objectives of Part 2 are thus to identify and describe the scenario archetypes, and to substantiate the link between those archetypes and the GEO-4 scenarios. Through this link, it becomes feasible to supplement the GEO-4 scenarios with information from the corresponding scenario archetype.

2.3 Four scenario archetypes

All major projects considered here have used by and large the same methodology to develop scenarios. First, a list of major drivers is assembled (economic development; population growth etc., see also Table 4). Based on this list two critical uncertainties are selected, which are subsequently used as a coordinate system, defining four quadrants and thus four scenarios. All major assessments have used two critical uncertainties that are very similar, and that can be described as:

1. Global versus regional development.

2. Proactive versus reactive attitude towards the environment. Alternative descriptions are economy/environment; self-interest/solidarity; low/high level of regulations.

The global/regional axis is present in all scenario studies under exactly the same name, and there seems to be little discussion on either its naming or what is indicated by the uncertainty. The second uncertainty is termed differently in the various scenario studies, which reflects minor differences in how the uncertainty (and thus the resulting scenarios) is interpreted. For example, the MA uses proactive/reactive to the environment which focuses the uncertainty on environmental issues. The EURURALIS study uses high/low regulation, which covers a broader spectrum of sectors. Yet, in practice the underlying assumptions and interpretations given in the actual storylines are very similar. Figure 1 depicts two uncertainties and the names of the scenarios in the several scenario studies.

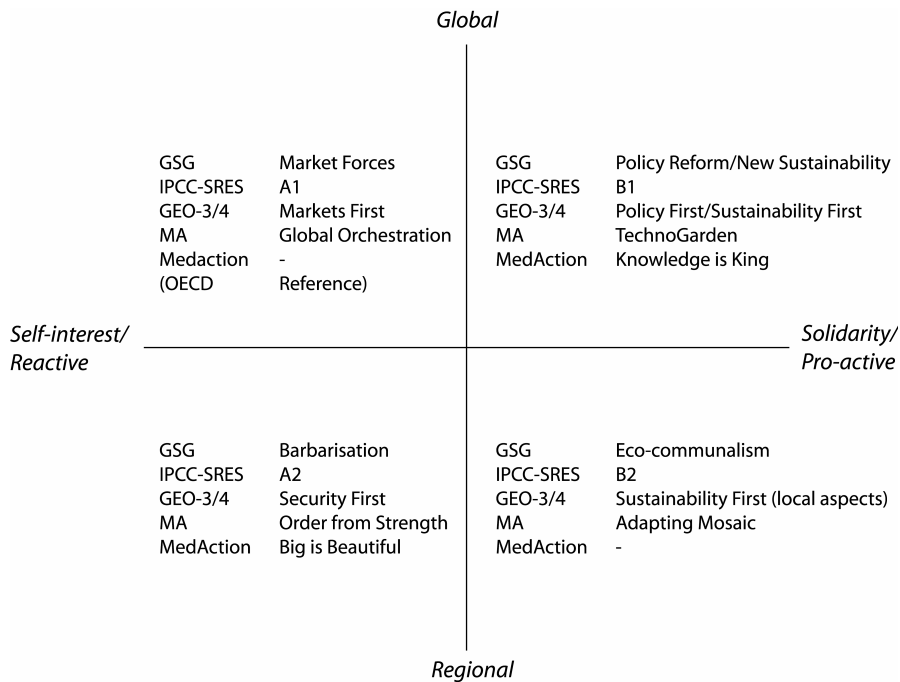


Figure 1. Two main uncertainties and corresponding scenarios in five scenario studies.

Unfortunately, at first glance it seems that the set of scenarios developed within GEO only partly fit in this framework. As illustrated in Figure 2, *Markets First* and *Security First* fit, while some of the assumptions in *Policy First* are not very pro-active towards the environment, while *Sustainability First* is a mix between bottom-up and top-down forces. Yet, the final situation in *Sustainability First* strongly resembles the end situation in a compartmentalised, proactive world such as sketched for example in the MA scenario *Adapting Mosaic*. Similarly, the endpoint in *Policy First* resembles in many ways a (moderate) version of for example a B1-world. In other words, the four GEO scenarios can be mapped on the four scenario archetypes, albeit with some caution.

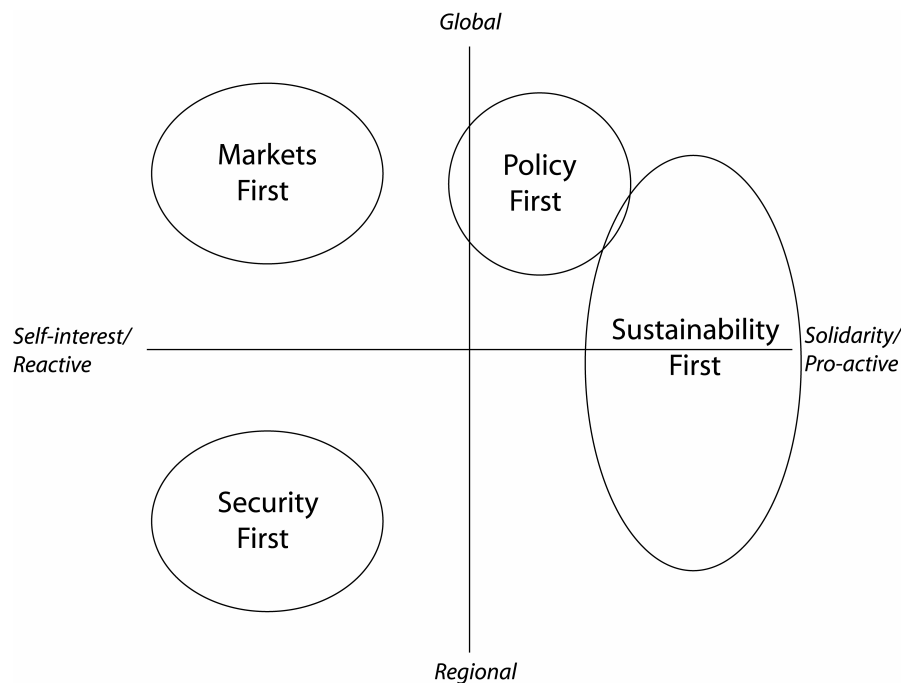


Figure 2. Position of the GEO-3/4 scenarios on the uncertainty axes.

An excellent starting point to define the scenario archetypes are the scenarios developed by the Global Scenario Group. First, this group of scenarios has served as example and/or input for all subsequent global scenario studies. Second, the GSG defined six scenarios such that they can both cover the GEO scenarios and the set of scenarios defined by most other global studies. Table 3 provides the basic classification of six scenarios archetypes in four main categories.

Table 3. Scenario archetypes and comparison with other scenario studies.

Classification	GSG	GEO-3/4	IPCC	MA	Visions/ MedAction
I. The Global Market	Conventional – Market Forces	Markets First	A1 (A1b)	Global Orchestration	Big is Beautiful (first decade)
II. Continental Barriers	Barbarisation – Fortress World	Security First	A2	Order from Strength	Big is Beautiful (last decade)
a. Fortress					
II. Continental Barriers	Barbarisation – Breakdown	-	-	-	c.f. Big is Beautiful (middle-term)
b. Collapse					
IIIa. Global Sustainability	Conventional – Policy Reform	Policy First	B1(B1-450)	(elements of Global Orchestration)	-
a. Policy					
IIIb. Global Sustainability	Great Transitions – New Sustainability	Sustainability First (global elements)	(elements of B1)	Techno Garden	Knowledge is King
b. Technology					
IV. Regional Sustainability	Great Transitions – Eco-communalism	Sustainability First (local elements)	B2	Adapting Mosaic	(elements of Convulsive Change)

In summary the scenario archetypes can be classified as follows:

- I. The Global Market. Global, reactive, economy-based developments lead to dominance of the international markets with a low level of regulations.
- II. Continental Barriers. Regional, reactive, economy-based world, with a broadening gap between rich and poor, and higher levels of crime, violence, and terrorism. The GSG developed a second variation in which the world as we know it would largely collapse. This variation has not been developed in any other scenario study.
- III. Global Sustainability. A global world with an increasingly proactive attitude towards the environment and a high level of regulation, with two variants. In the Policy variation, the emphasis is on top-down policy regulations and international laws that protect the environment and social capital. In the Technology variation, technological breakthroughs – besides a higher level of policy intervention – reduce the burden on the environment.
- IV. Regional Sustainability. Regional world where most initiatives to proactively improve the state of the environment are bottom-up, eventually trickling up to international policy making.

The GEO-3/4 scenarios are examples of the archetypes I (*Markets First*), IIa (*Security First*), and IIIa (*Policy First*). *Sustainability First* is a mix between archetype IIIb and IV, having stronger similarities with type IV. Below is a detailed description of all main scenario archetypes, emphasising those that match the GEO scenarios.

I The Global Market

Virtually all sets of scenarios have a version of *Global Market*. In describing the Conventional World scenarios, the Global Scenario Group points out that in these futures the global system evolves without major surprise, sharp discontinuity, or fundamental transformation in the basis of human civilization. The dominant forces and values currently driving globalization shape the future (Raskin et al., 2002). In other words, in many ways this scenario could also be regarded as a (positive) Business As Usual.

GEO-3 Markets First

Most of the world adopts the values and expectations prevailing in today's industrialized countries. The wealth of nations and the optimal play of market forces dominate social and political agendas. Trust is placed in further globalization and liberalization to enhance corporate wealth, create new enterprises and livelihoods, and so help people and communities to afford to insure against social and environmental problems. Ethical investors, together with citizen and consumer groups, try to exercise growing corrective influence but are undermined by economic imperatives. The powers of state officials, planners and lawmakers to regulate society, economy and the environment continue to be overwhelmed by expanding demands (see Westhoek et al., 2007).

GEO-3 Markets First – Other relevant points

Most important driving forces are:

- increase in food demand
- increased energy consumption
- free trade
- phasing out of agricultural subsidies
- technological advances

- increased demand for biofuels

Water-related impacts

- privatisation of 'water'
- improvements in water technology (desalinisation; irrigation systems)
- increased water use efficiency
- focus on augmenting water supply (to meet increasing demand)
- water stress increases (supply cannot meet demand)
- issue of patents on water technology (especially for poorer regions)
- increase in volume of wastewater / technology cannot keep up
- quality of surface water decreases (more irrigation, more fertilisers, more intensive livestock). Problem occurs in all regions.

This scenario archetype describes a world in which water-related impacts will grow. On the positive side, multiple new water technologies will be developed that will increase water-use efficiency. These include large-scale water transport plans that will locally strongly increase water supply. However, these improvements cannot keep pace with the increases in water demand, driven by the strong economic growth. Worse yet are problems with water quality. The volume of waste water increases and the quality of both surface water and groundwater decreases in most parts of the world, caused by an overall neglect of environmental problems.

GEO-4 – Europe

- globalisation and liberalisation are embraced and trade barriers are removed
- technological innovations spread quickly
- cutbacks in social security system – massive inequality
- shortage high-skilled labour
- increased immigration
- “a series of market and government failures” (after 2030)
- “frustration especially in Eastern Europe” (of less investments in infrastructure and energy grid)
- unemployment increases & deep recession
- agricultural subsidies phased out; Less Favoured Areas disappear. Extensive land abandoned, intensive agriculture intensifies.
- Increase wastewater in Central and Eastern Europe.
- Hot-spots of water pollution throughout Europe.

Summarising, the European version of the *Global Market* is a rather negative version of the global storyline. It assumes that Europe will be outcompeted in the long run by other regions; that multinationals do not take the full responsibility of education, social security, energy supply, environmental protection etc., while agricultural subsidies disappear. On top of that climate change starts to be a serious factor. In general, however, most of the negative consequences are assumed to take place after 2030. Shorter-term changes are mostly related to agriculture. Also, it seems that technological advances could be beneficial. Note that in assuming a lesser economic growth, the pressure on the environment and thus on water quantity and quality will be less.

II Continental Barriers

All sets of scenarios also have one in which market and policy adjustments are not able to cope with social, economic and environmental problems as they arise. Instead, they cascade into self-amplifying crises that overwhelm the coping capacity of conventional institutions. The result is a compartmentalised world, with augmented differences between rich and poor and strong regional barriers. In the most pessimistic versions (e.g. Barbarisation – Breakdown from the GSG), civilization descends into anarchy or tyranny; while in the more optimistic versions, the regionalised world prospers. However, by and large underlying assumptions of the future worlds are very similar.

GEO-3 Security First

This scenario assumes a world of striking disparities where inequality and conflict prevail. Socio-economic and environmental stresses give rise to waves of protest and counteraction. As such troubles become increasingly prevalent, the more powerful and wealthy groups focus on self-protection, creating enclaves much like the present day ‘gated communities’. Such islands of advantage provide a degree of enhanced security and economic benefits for dependent communities in their immediate surroundings but they exclude the disadvantaged mass of outsiders. Welfare and regulatory services fall into disuse but market forces continue to operate outside the walls.

GEO-3 Security First – Other relevant points

- security and market forces dominate global agenda
- little attention is paid to social and environmental issues
- widespread believe in market forces as regulators of social welfare
- increasing number of conflicts
- Eastern Europe makes little economic progress
- short-term crises dominate government and NGO agendas
- economic malaise
- technological advances (agriculture, medicine, environmental)
- eventually slowdown in advances in all sectors
- poor-rich divide & rich dominate and dictate the poor
- exploding mega-cities
- violence becomes endemic
- “islands of prosperity” in gated communities
- globalisation continues (between bubbles of wealth)

Water-relevant impacts

- climate change is severe with extreme events with a staggering financial price
- widespread droughts, high water demand, water transfer projects
- deterioration of arable land (emptying of the countryside)
- excessive waste puts burden on ‘poor’ regions
- overuse of water
- decreasing water quality (fouling of water)
- “uneasy stability by 2032”

This scenario archetype projects developments that are both good and bad for water-related issues. First and foremost, the regionalised and divided world cannot

successfully combat climate change, leading to widespread extreme events. There are also widespread problems with increased water demand (by the rich) and overuse of water, but most of the problems are the burden of the poor. The situation slightly improves by 2030 due to new technologies that 'fix' part of the problem. Yet, the rich benefit more than the poor.

GEO-4 – Security First for Europe

- main drivers are global insecurity, conflicts, limited freedom, and climate change
- EU stops enlargement
- Eastern Europe turns to the Far East
- brain drain
- corruption, nationalism, intolerance
- unprecedented environmental degradation
- strong national governments
- use of old technology
- high costs to combat impacts of climate change
- sharp increases of water demand
- agriculture is subsidised

Summarising, the European version of the *Security First* scenario by and large follows the global storyline. It pictures a grim vision of the future with an extremely high pressure on the environment because of an increased demand and because of the effects of climate change. Also, the braindrain and thus use of old technologies leads to a downward spiral. War, terrorism, and violence are less emphasised. Like in the global version, there is a somewhat more positive outlook for the period after 2032. Even though the European version is slightly less negative than the global outlook, it is by far the most negative of the four scenarios.

IIb: Collapse

One scenario – Barbarisation-Breakdown – goes beyond the general storyline followed in most scenarios, ending up in a world that is not very pleasant to live in. The total collapse of society as we know it, was regarded as too extreme to be either plausible or credible by most scenario studies. Besides, the usefulness of these very extreme scenarios has been questioned in general (Kok et al., 2006b).

These two types of scenario archetypes can be regarded as 'BAU when all goes well' and 'BAU when all goes wrong'. The visions start to differ slightly more, when the emphasis is on scenarios that incorporate more drastic changes from the onset and that assume profound transformations in the fundamental values and organising principles of society. The most plausible, least differentiating assumptions can be typified in a third archetype that is shared by most scenario studies:

III Global Sustainability

Essentially, this scenario assumes a globalised world, in which governments and businesses alike successfully take responsibility to fight a number of the pressing issues of today, such as poverty and environmental degradation. Similarly, investments in science and technology lead to a large number of breakthroughs and inventions that significantly contribute towards a sustainable world. More so than in the previous two scenario archetypes, there are differences between the various scenario studies in which of the elements above is most strongly emphasised. In fact, this archetype could be subdivided into two:

IIIa Policy solutions

IIIb Technological solutions

What connects these two archetypes is that in both a globally connected world is portrayed, where certain groups of actors – scientists and governments – have a deciding role in a successful road towards a more sustainable road. The following scenarios can broadly be placed under these archetypes:

IIIa Global Sustainability – Policy solutions

This archetype has a similar basic philosophy as the *Global Market*, but includes policies to correct market failures with respect to social development, poverty alleviation and environmental protection. Contrary to the *Global Market*, these policies are not assumed to fix problems after they arise, but assumes them to become effective from the very beginning. In other words, although the way society is functioning does not change fundamentally, the effect of the policies, both directly on environmental problems and indirectly on human behaviour, is much stronger.

GEO-3 Policy First

Governments take far-reaching initiatives to reach specific social and environmental goals. A coordinated pro-environment and anti-poverty programme is designed and implemented at any (economic) cost. Policy measures and regulatory frameworks are reinforced by fiscal levers or incentives such as carbon taxes and tax breaks. International treaties and binding instruments affecting environment and development are integrated into unified blueprints. This predominantly top-down process later gives way to an open consultation processes which allows for regional and local participation.

GEO-3 Policy First – Other relevant points

- climate change reduced
- global equality achieved (“Global Gini Index”)
- increased public investment in health, education, R&D, environmental protection.
- economic and political integration
- focus on environmental protection
- removal of agricultural policies (but replaced by Rural Development Programmes, or other environmental protection measures)
- biofuel area increased

Most important water-related impacts:

- strong investments in increasing water supply and decreasing demand
- social and political institutions help manage water resources

- increased water treatment, but it does not keep pace with increases in demand. But in Europe the situation is very good, with a 50% reduction in volume of untreated water.
- “generally positive progress”

The impact of early and powerful environmental policy actions is strong. New technologies help reducing water demand, the reduction of climate change helps avoiding droughts and flooding, and water quality problems are alleviated. Yet, the demand for water in this globalising world are strongly increasing as well, because of which water problems remain.

GEO-4 – Europe

- EC and European Parliament stronger; Euro adopted in more countries
- Shift of subsidies towards R&D and education
- Some social groups struggle
- Plans to adapt to climate change
- Accent on material consumption continues
- Overall amount of subsidies decreases
- Falling water withdrawals
- “Society has learned to cope with water scarcity”

Summarising, the European version of the global *Policy First* storyline is only moderately positive. Many factors are pointing ‘in the right direction’, with an increased environmental protection, and more investment in social capital, R&D and education. However, it is specifically noted that some social groups struggle and for example that the overall amount of subsidies decreases. In general, the scenario is more like a BAU, building more on existing trends, and not specifically surprising, challenging, or different compared to today’s world. In many ways this scenario resonates the scenario it was based on, the GSG’s Conventional World – Policy Reform.

IIIb Global Sustainability – Technological solutions

As can also be seen in Table 4, there are a number of scenarios that assume a globalising world, where the main solutions for environmental, social, and economic problems are technological in nature. The best global example is the *Techo Garden* scenario from the MA, and the European scenario *Knowledge is King* developed in Visions.

These scenarios assume worlds that rely strongly on environmentally sound technology, using highly managed, often engineered, ecosystems to deliver ecosystem services. However, these technological solutions sometimes create new problems and the costs of managing the environment are continually rising. This scenario archetype contains many more surprises and non-linearities than type IIIa. There is no equivalent in the scenario set of GEO.

IV Regional Sustainability

The last main group of scenarios are those that sketch out developments that lead to a regionally divided, but sustainable future. In many aspects, this archetype is different from the previous three. First of all, these scenarios assume a future that deviates

strongest from the current situation. More specifically, it assumes radical (local) social and cultural changes, that have far-reaching economical, political, and environmental consequences. Secondly, it is the only archetype in which regional forces guide world developments. The *Continental Barriers* archetype also envisions a regionally compartmentalised world, but the discontinuation of the globalisation process is the result of the failure of initially essentially global forces and a subsequent breakdown of society.

This *Regional Sustainability* archetype could be regarded as paradoxal. The scenarios are part of a global exercise, but offer a package of regional solutions and picture a diverse world bound together by a mosaic of local initiatives from which a globally sustainable world emerges. On the other hand, it is important to reason through the potential consequences of such a 'green' but fragmented world.

The GEO-3/4 scenario *Sustainability First* is categorised as this type of scenario, even though certain elements assume a rather globalised world and would better match the *Global Sustainability* archetype.

GEO-3 Sustainability First

A new environment and development paradigm emerges in response to the challenge of sustainability, supported by more equitable values and institutions. This is accompanied by a radical shift in the way people interact with one another and with the world around them. There is a much tighter multi-scale connection between governments, citizens and other stakeholder groups in decision-making. A bottom-up, top-down consensus is reached on what needs to be done to satisfy basic needs and realise personal goals.

This scenario assumes a fundamental change in behaviour that could be termed a 'new sustainability paradigm'. This change takes place at all levels of society, ranging from international policy to regional governments, to local NGOs. Change is in general driven by local initiatives but with a strong support at higher levels. This double positive feedback spirals the world into a fundamentally different direction. Globalisation is redefined focusing on environmental aspects, and there is a strong focus on new technologies. Additionally, there is a myriad of dialogues between individuals as well as new international initiatives. Important problems are mostly related to the enormous economic costs.

GEO-3 Sustainability First – Other relevant points

- a more visionary state prevails
- myriad dialogues between individuals
- Local Agenda 21 spreads
- multi-scale initiatives
- new governmental initiatives (e.g. Global Forest Watch)
- EU expands further
- "new sustainability paradigm"
- the switch is most significant in North America and Western Europe
- globalisation is redefined focusing on positive aspects
- strong focus on new technologies, but poor distribution
- change driven by local with strong support at higher levels
- very positive scenario driven by multi-scale behaviour change

Most important water-related impacts:

- trading of ‘virtual’ water as agricultural products
- new technologies solve problems: improvement in water use efficiency, desalination etc.

The information on water is relatively sparse in this scenario. However, it is evident that water problems will be reduced. The behavioural change will lead to a reduction in water demand as well as an improvement in water quality. New multi-scale laws and treaties and the success of local Agenda 21 initiatives (and also the Water Framework Directive) will benefit the environment and water quality. The local character of the initiatives inhibits a widespread adoption which hampers solutions in some cases.

GEO-4 – Europe

- increased consensus between government and citizens
- slow economic growth, high additional costs
- improvement quality of life
- technological breakthroughs
- less pressure on water resources (less demand)
- still high number of people live with severe water stress
- water quality improves
- people and industry have ‘learned to cope’
- agricultural subsidies disappear, environmental policies continue

Summarising, the European *Sustainability First* scenario is as positive as the global version. The multi-scale, multi-sectoral behavioural change, accompanied by important technological breakthroughs assure a higher quality of life while maintaining the environment. The only drawback seems to be the economic cost, but the ‘new sustainability paradigm’ seems to ensure that this is easily accepted as unavoidable.

2.4 The role of water in narrative storylines

All of the global and European scenario efforts treat the issue of water. The future of water supply, water demand, and water quality are all uncertain and linked to the main driving forces as incorporated in most scenario studies. Two studies stand out in providing information on water, the World Water Outlook and the European Environment Outlook. Furthermore, explicit information on water is available particularly in the MA and GEO-3.

2.4.1 Driving forces across the scenarios and relevance for water

Excellent overviews of the driving forces and their assumed changes on various scenario archetypes are given by Westhoek et al. (unpublished draft) and Busch (2006), although their scenario archetypes differ slightly from the ones presented here. The adapted assumptions are given in Table 4. Below follows an analysis of the importance of each driver for water-related issues.

Table 4. Changes in main drivers in the scenario archetypes.

	I Global Market	IIa Continental (Fortress)	IIb Continental (Breakdown)	IIIa Global Sustainability (Policy)	IIIb Global Sustainability (Technology)	IV Regional Sustainability
Economic development	very rapid	slow	very slow	rapid	rapid	slow
Population growth	low	high	high	low	high	medium
Technology development	rapid	slow	slow	medium-rapid	very rapid	slow-medium
Environmental attitude	reactive	reactive	reactive	reactive-proactive	proactive	proactive
Trade	globalisation	barriers	barriers	globalisation	globalisation	barriers
Institutional strength	policies help economy	strong national governments	lack of control	policies help market failures	technology and strong institutes	local steering
State of environment	very poor	degrading	first degrading, later improving (failing)	improving	improving	improving (local differences)
Main objective	economic growth	security	security	economy and environment	various goals	local sustainability
Corresponding GEO scenario	Markets First	Security First	-	Policy First	-	Sustainability First

Economic development

Crucial in scenarios; important, but mostly indirectly related to water

Economic development is the most important underlying driver in most of the scenarios, and especially in Global Markets and Global Sustainability. However, the direct link with water is not very strong. More economic growth will result in a higher demand for food, for agricultural products and therefore water demand will be higher. Yet, the influence of international trade and population growth are similar and normally stronger. Particularly when the environmental attitude is proactive, the effect of economic growth is offset with policies or technological improvements. In summary, although at the heart of many scenarios, economic growth by itself does not strongly influence water demand. On the other hand, the indirect effects of (lack of) economic growth can be significant. A general reasoning is that lower economic growth results in less incentive for environmental policies and less overall attention to the environment. The reasoning is less relevant for developed countries.

Population growth

One of the most important drivers; high level of certainty

The global population will grow in all scenarios. This places a direct and strong demand on food and thus on (agricultural) water demand. Moreover, built-up area will grow, which can lead to local water pollution effects. Moreover, more people will live in areas prone to drought or floods, which will increase human exposure to these extreme events. There are several sub-factors related to overall population growth that are equally important. To mention a few: in-migration (including tourism); outmigration (land abandonment); and ageing. These are related to total number of people, but also to changes in culture and tradition, which in turn will alter water demand. Population growth including migration patterns is one of the most important drivers in relation to water. Additionally, it is one of the less uncertain of the important drivers.

Technology development

Very important for water demand; focus on technology transfer

The importance of new technologies has a prominent role predominantly in the proactive scenarios, i.e. *Global Sustainability* and *Regional Sustainability*. Particularly in archetype IIIb, where technological development is stimulated and transfer in the globalised world is relatively quick, technology development is crucial. However, new technologies are assumed to be introduced in all scenario archetypes. Many of the envisioned technologies have direct implications for water management. For example, in dry areas, water salinisation, drought-resistant crops and other related technologies could potentially increase water supply and have a decisive importance. Most technologies that are mentioned are not new but currently too expensive, which shifts the key question to technology transfer rather than development. In any case, new technologies can heavily influence future RBM strategies

Environmental attitude

Essential in 'proactive' scenarios

The second axis of most scenario studies, and thus the second key future uncertainty besides globalisation versus regionalisation, is environmental attitude. In fact, most sets of scenarios consider this to be the single most important change needed to reach a future state where sustainable development includes the environment. Yet, just how this essentially bottom-up change should take place is often poorly elaborated. Nevertheless, the main message is that without a fundamental change in environmental attitude, it is for instance difficult to imagine a world with a successfully implemented Water Framework Directive (WFD). As such, it is the most influential driver of all. At the same time, however, it is also the most uncertain one. For water issues, this is equally true.

Trade

Important for Europe; tightly related to other drivers

International trade is directly related to agricultural production in any given region, and thus directly to water use. Trade is tightly related to a number of other drivers, most importantly economic development, but has a more direct impact. Trade also relates to international economic blocs such as the EU, and organisations such as the WTO or World Bank. Particularly trade liberalisation could have a strong impact on the agricultural sector and water use.

Institutional strength

Very important in 'regulated' scenarios

This driver relates both to the strength of institutions and the level at which they are most active and influential. The rate of success of the WFD, for instance, partly depends on assumptions on the role of the government. This is a driver that is almost omnipresent in any of the scenario archetypes. Many of the so called scenario branchpoints are in some way related to either local or international governance. Often strength of institutions depends on public attitudes and/or economic growth and human well-being.

State of the environment

Very important in proactive scenarios

Strictly spoken, this is not an initial driver of the system. Yet, in the proactive scenario archetypes, it is assumed that the environment is increasingly important, resulting in relatively environmentally healthy future outlooks such as *Techno Garden* or *New Sustainability*. The tendency to act more environmentally friendly has consequences for the water issue.

2.4.2 Critical uncertainties related to water

Gallopín and Rijsberman (2000) list 10 key uncertainties related to water that are either very difficult to anticipate or that have a very strong influence on water resources. They used these uncertainties to construct the World Water Visions. Although the WWV scenarios do not completely match the scenario archetypes, the uncertainties are equally valid and cover a broad spectrum of relevant issues:

1. *Water productivity trends*, including water use efficiency and the role of technological innovation and rate of adoption.
2. *Expansion of irrigated agriculture*, which is accounting for 70% of total water use.
3. *Production increase from rainfed agriculture*, mostly through partial irrigation or new crops.
4. *Dematerialisation of economies*. Through technology increase in agriculture, or favouring other sectors over agriculture.
5. *National self-sufficiency versus global food security*. Global system would be more water efficient.
6. *Availability of cheap water-purifying technology*.
7. *Public acceptance of GMOs*.
8. *Public opposition of large dams*.
9. *Fundamental scientific discoveries*. Many are theoretically possible and some could solve the water problem.
10. *Significant changes in human values and lifestyles*.

Not all of these ten are equally relevant for the situation in Europe. Especially those that are related to “who will feed the world” (e.g. 2-3 on agricultural expansion, or 7 acceptance of GMOs) and agricultural expansion are less critical to the European situation. This list confirms the analysis of the driving forces above: The key uncertainties for water in Europe are Technology (including scientific breakthroughs); Human Values (including public acceptance); and Globalisation.

2.5 Water stories for Europe

Table 5 summarises the changes in the most important water-related factors in the scenario archetypes relevant to GEO. Future developments are based on statements made in the various scenarios sets (particularly GEO-3 and GEO-4), and on the analysis of the main drivers presented in the previous section. The statements in the table reflect the projected main developments in the stories; in some cases there are large regional differences.

Table 5. Water-related issues in scenario archetypes

Scenario archetype	<i>I Global Market</i>	<i>IIa Continental (Fortress)</i>	<i>IIIa Global Sustainability (Policy)</i>	<i>IV Sustainability First</i>	
	Markets First	Security First	Policy First	Global Sustainability First (global developments)	Regional Sustainability First (local developments)
Water demand	Strong increase	Sharp increase; overuse of water	Increase despite strong investments	Decrease (global food security; virtual water trading)	Strong decrease (local behavioural change)
Water supply	Slight increase (new technologies)	Decrease (widespread drought)	Increase	Strong Increase	Increase (with drought problems)
Water stress	Increase	Strong increase (but not for all; water transfer projects)	Increase (learning to cope with scarcity)	Decrease (people and industry learned to cope)	Decrease (but still groups that live with water stress)
Water quality	Decrease (hot-spots of water pollution)	Strong decrease but not for all (excessive waste)	Increase (increased water treatment)	Increase	Increase
Water technology	Extra investments to boost supply and quality issues	Use of old technologies	Strong investments	Strong focus on new technologies	Lower adoption rate, less breakthroughs
Water distribution	Large inequalities (rich have more access to clean water)	Very large inequalities (bubbles of wealth)	Very equal, although some groups struggle	Very equal	Differences between regions; Europe has significant improvement
Water for Food	Much more irrigation, more fertiliser, more livestock agricultural subsidies are phased out.	Agriculture remains subsidised	Less subsidies Irrigation increases	Subsidies are replaced by environmental payments.	Agriculture becomes more traditional and extensive. Irrigated area is stable
Water for Nature		Unprecedented environmental degradation	Focus on environmental protection	Corridors of national parks	
Water for People			Accent on consumption continues		People dematerialise and need less water
Other issues	Water is privatised		Generally positive		

2.5.1 *Water in Markets First*

Water demand versus water supply

This scenario projects an ongoing process of liberalisation and globalisation, in which economic growth is maximised on the expense of ecological and social development. The biggest water-related uncertainty is the balance between water supply and water demand. Water demand will increase because of population growth and economic development, which results in a larger per capita water consumption. However, technological breakthroughs are assumed to happen that will increase water use efficiency and improve crop tolerance to drought. In large parts of Europe, water demand will not increase much and it is thus assumed that water demand will be able to meet water supply. Moreover, water quality will also not be affected strongly by the economic focus taken in this scenario. However, this rosy image does not apply to all countries (specifically not to CEE), where per capita water consumption has not reached the levels of western Europe.

Water quality

A strong economic development combined with a *laissez faire* environmental attitude negatively influences water quality. Particularly in CEE, where new investments are widespread and economic growth reaches levels of more than 5% per year, the pressure on clean water increases. Eutrophication of rivers and lakes, outdated or absent wastewater treatment plants, and the lack of strong pressure from governments to improve the situation are just a few of the problems that many countries in this region face. At the same time in the Mediterranean region, the increased water demand and occurrences of drought decrease water quality of aquifers. Widespread illegal irrigation, which is said to be up 25% of the total water use, a general lack of interest in environmental problems, and intrusion of brackish seawater in coastal areas eventually lead to a serious impoverishment of water sources in the Mediterranean. Note that the situation in 2050 is fairly heterogeneous. Nevertheless, new and established technologies spread fast reducing the initially high number of hot-spots of water pollution throughout Europe.

Droughts and flooding (climate change)

In line with the ongoing process of globalisation, climate change negotiations continue with more success than in a compartmentalised world. However, shorter-term economic interest prevails over long-term environmental concerns, and the negotiations result in treaties and agreements that are not binding nations to seriously reduce their CO₂ emissions. This leads to an acceleration of climate change. Although most changes are very long-term and therefore not relevant in the timeframe considered here, it is particularly the increase in extreme weather events that do have a strong impact. All areas currently experiencing either drought or floodings see a strong increase in the number and intensity of these events. In addition, in a number of countries both floodings (in spring and autumn) and drought (in summer) become a problem. Even in notoriously wet countries such as the Netherlands, dry spells in spring and summer demand more irrigation and in places lead to crop loss. The struggle against these extreme events is particularly difficult for the agricultural sector. Phasing out of the Common Agricultural Policy has made the sector vulnerable and in many places the least favourable lands were abandoned, as farmers get outcompeted. Those that survive now have very little to hope for from the European

Union in terms of financial compensation in case of financial set backs caused by climate-related events.

The Water Framework Directive

The overall tendency in the Global Market scenario is towards a more globally connected society, as well as a European Union in which internal borders slowly fade. As a result, obstacles for international collaboration on watershed management become less as the scenario progresses. This also holds for initiatives such as the WFD. On the other hand, the scenario also projects a market-based economy, with little specific attention for environmental issues. This hampers the further development and implementation of the WFD. Although international institutions can operate more easily, this might not be the case for WFD with its specific environmental goals. It is to be expected will continue to exist, without becoming an enforcing instrument. This has consequences especially for the more polluted and poorer regions.

2.5.2 Water in Security First

Water demand versus supply

In many ways, this scenario describes a Europe when the transition to a global market fails, resulting a regionally focused, reactive world. This might be disastrous for water demand. Technology transfer slows, which leads to the continued use of old technologies and stagnation of water use efficiency in some regions. Additionally, agriculture remains subsidised. This combined effect of the continuation of the Common Agricultural Policy (CAP) but using partly outdated technologies boosts water demand, certainly in the first decades of the scenario. Additionally, water transport projects are increasingly sabotaged, resulting in huge water losses. At the same time, however, the gaps between poor and rich grows, which slows the demand increase. An important consequence of the regionalisation of the world is the failure of global measures to stop climate change. This will lead to less water supply predominantly in the Mediterranean. Moreover, there is a large difference between the rich and the poor. Those that live in the gated communities will have sufficient access to new technologies to counteract the increases in demand. But particularly in the poorer areas in the countryside, an increase in water stress is to be expected.

Water quality

Beyond any doubt, water quality will decrease in many places. The increasingly large gap between the poor and the rich, in combination with the lack of investment in environmental policies and other initiatives, corruption, use of old technologies, and the high cost to combat climate change result in a strong decrease of water quality. Additionally, international agreements and thus Integrated River Basin Management (IRBM) fail, which leads to an increasing pollution of all major rivers in Europe. Most of the rich will be 'protected' by wastewater treatment plants, but the direct environmental degradation and impact on aquatic ecosystems is enormous.

Drought and flooding (climate change)

As said, climate change and its impacts are by far the worst in the Security First scenario. Besides an increase in the intensity and amount of droughts, storms, and floods, the impact is also larger than for example in the Global Markets scenario,

particularly among the poor. Effects are similar as portrayed in the GM scenario, with two important differences: First, the agricultural sector remains subsidised. Extensive agriculture will therefore not disappear with the same rate. Combined with increased drought, this further pushes water demand from the agricultural sector. Secondly, overall conditions in the countryside are much worse. The distribution of the available water will favour cities, tourism, and industries, while particularly citizens might experience severe water stress.

The Water Framework Directive

It is not surprising that in this fragmented and divided Europe, the WFD does not succeed. There is no organised support as national interests prevail, while corruption, mistrust and violence severely hamper participatory processes. However, in later decades the call for flood protection provides some incentive for international collaborations. Additionally, large-scale water-transport projects also involve integrated management strategies. These only get started when the impacts of climate change are fully visible and start impacting the rich.

2.5.3 Water in Policy First

In this scenario, far-reaching policy reforms are projected to take place. In a globalising world, people take advantage of the increased connectivity to implement old and new EU-wide policies. In some ways, this is a slightly more positive version of the Global Markets scenario.

Water demand versus water supply

First and foremost, climate change is combated successfully. In fact, new climate policies set the stage for an ambitious policy reform. Additionally, governments and businesses introduce new technologies that are adopted quickly. As a result, water use efficiency increases strongly, while climate slowly stabilises with droughts become less frequent. Thus, water supply increases (strongly). Like in the Global Markets scenario, it is uncertain how the balance with water demand will be. Investments in technology are stimulated which will in the long run reduce water demand. Yet, economic development and population growth will put pressure on freshwater resources. Although the outlook is more positive than in Global Markets, it is uncertain if a framework of European and global policies will suffice to significantly reduce problems with water stress. Like in GM, the CAP is phased out, but it is being replaced by a strong set of Rural Development Policies to counter land abandonment and landscape destruction. As a result, the agricultural sector remains strong, also in marginal areas. This, however, puts additional pressure on water demand, which is countered with a set of new technologies. All in all, water quantity problems are not solved, but 'society is slowly learning to cope with water scarcity'.

Water quality

Climate-energy-transport policies, and related technology improvements dominate the political agenda. Problems with water quality therefore receive less attention. Nonetheless, The improvements in the volume of untreated water are very large. This is strongly related to the further implementation and enforcement of the WFD, which stimulates participation and local solutions.

Drought and flooding (climate change)

There is a strong and successful international commitment to combat climate change. As a result, droughts and floods are getting less severe and less frequent. However, the positive impacts of this climate change policy become apparent only after several decades. Shorter-term problems with droughts and floods remain a problem up until 2030. Technological advances to increase water use efficiency alleviate the problem, but investments in this area are relatively small. On the other hand, the implementation of the WFD has positive spin-offs in all major watersheds in Europe.

Water Framework Directive

Beyond doubt, this is the scenario where the WFD is most fully implemented. In the rest of the pan-European region, EU-style water management becomes the standard. An important side note is that this scenario assumes a predominantly top-down stimulation of sustainable development by a variety of policy instruments. A great transition with a widespread multi-scale behavioural change does not take place. For Europe however, many developments have strong parallels, both because of the strong influence of policies (such as the CAP or the WFD) and because of the good starting situation in terms of wastewater treatment and water use efficiency.

2.5.4 Water in Sustainability First

This scenario is in all aspects a positive version of the Policy Reform scenario. Policy reform goes beyond climate change and the WFD, and is accompanied by a behavioural change across scales and sectors, including local actors, businesses, and the use of technology. Environmental (and thus water) problems are put centre stage.

Water demand versus water supply

The point of departure is the Policy First scenario. However, several additional developments are assumed that improve that situation. Water demand decreases strongly because of a behavioural change towards a lower water consumption. A focus on local production of organic food enhances this tendency. Similarly, water demand decreases further because the high adoption rate of new technologies due to bottom-up initiatives. It is also envisioned that more and more diverse new technologies will be developed. On top of that, local initiatives are better adapted to the local situation and add to the top-down policy instruments. In short, the combination between top-down policies, and bottom-up initiatives improves the water quantity problem in many places in Europe. Obviously, even this most positive outlook is not for everybody. In certain places the hugely expanded bureaucracy to deal with this multi-level governance inhibits progress. Also, clean and cheap transport in combination with the generally good prospects boost tourism. Construction of second homes in the more favourable climates locally increases water demand, that new technologies can only partly compensate for.

Water quality

In line with the above, water quality will improve dramatically. Local Agenda 21, the WFD, technological breakthroughs and swift adoption thereof, and all other aspects of the new sustainability paradigm will positively influence water quality throughout Europe.

Drought and flooding (climate change)

Here also, the starting point is that of the Policy First scenario. Climate change is combated and eventually droughts and floods decrease in frequency and intensity. However, in this scenario it is projected that the short-term problems will be dealt with through the use of efficient irrigation systems, and adequate supply lines. This complements the widespread change in behaviour, because of which many have learned to cope with water stress and accept water problems where they continue to exist.

Water Framework Directive

As in the Policy First scenario, the WFD is implemented. The key difference is a stronger bottom-up process, which has positive effects in most river basins, but leads to an overly complicated process with many parties involved in others. On a whole, the WFD is a less powerful instrument.

As is clear from the above, this scenario is extremely positive. It is important to note that most of the developments take years or even decades to become apparent, and it comes at a cost. Bureaucracy increases, economic growth is low, and e.g. aviation within Europe is limited. It is only because of the assumed change in (local) behaviour, that these measurements and its costs are accepted. Thus, there might well be places and river basins in which a future unfolds that is less rosy than the one projected here. Additionally, this is the scenario with the highest uncertainty, as many developments are projected that are radically different from today and are accompanied by a paradigm shift.

2.6 Conclusions

- The GEO-4 scenarios were selected as principal input in the Fast-Track scenarios, both for the qualitative and quantitative scenarios.
- The differences between the various scenario studies was not very large. Particularly the MA scored high as well. The various water-related scenario studies scored relatively low.
- The GEO-3 and GEO-4 storylines provide an excellent starting point for further storyline development both at pan-European and at Pilot Area level.
- The scenario archetype analysis showed that various scenario studies – notably the MA, IPCC-SRES, and GSG – constructed their scenarios along the same two major uncertainties as the GEO-3/4, although there is no perfect match. With some caution it will be possible to include information from other scenario assessments in the scenario development process that is based on the GEO scenarios.
- There is abundant water-related and Europe-specific information in the GEO-3/4 scenarios. Part of this information is related to output from quantitative scenarios (WaterGAP), part of it inherent to the storyline.

2.7 Next steps

The storylines as described here are part of the so-called Fast-Track procedure of SCENES. Together with the Fast-Track quantitative models runs of the WaterGAP model (see WP3, deliverable D3.1), they provide the starting point for all scenario-development activities. They will be discussed and reviewed by the pan-European panel in a series of three workshops. Similarly, they will be presented at all Pilot Area stakeholder workshops, assuming that they can be used as a set of wind tunnels that

will provide boundary conditions for all the Pilot Area scenarios. The Fast-Track scenarios will thus ensure that both the pan-European and the local scenarios in all Pilot Areas be not only methodologically consistent, but will also depart from the same set of Fast-Track scenarios.

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