

# MEDUSA 2008 - Water in the Var catchment: Accounting for today, accommodating for tomorrow.

## Presented by the Water Working Group

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# 1. Introduction

Water is essential for life: both human activities and the nature need water. Globally fresh water ecosystems are relatively species rich; they only form 0.8% of the habitats but there are more than 100 000 species that are adapted living in these environments and many of these species are endemic. Fresh waters are especially important to amphibians, reptiles, insects and many bird species. The Living Planet Index measures trends in the Earth's biological diversity. The Living Planet Index for fresh waters is declining faster than the one of terrestrial and maritime ecosystems (Millennium Ecosystem Assessment (MA, 2005).

There are both natural (e.g. run off, evapotranspiration) and anthropogenic (e.g. industry, tourism) influences to the hydrological cycle of the Var catchment like shown in Figure 1. Because of the dry climate most of the precipitation in the catchment is transpired.

The amount of water in the future depends strongly on the land use in the area. At the moment the biggest users of water in the Var catchment are agriculture and tourism.

In recent decades the amount of agricultural land has decreased and the amount of forests increased in the upstream part of the catchment. This has decreased the amount of erosion but also the precipitation efficiency (the amount of rainwater that flows into the river). Downstream industrial activities are growing and therefore the water demand is increasing (Fig. 1).

The expected increasing temperature and decreasing amount of precipitation with climate change in the future does reduce the amount of water available in the catchment. With increasing forest area and rising temperatures the number of forest fires may go up: this in turn causes higher demand of water to extinguish fires.

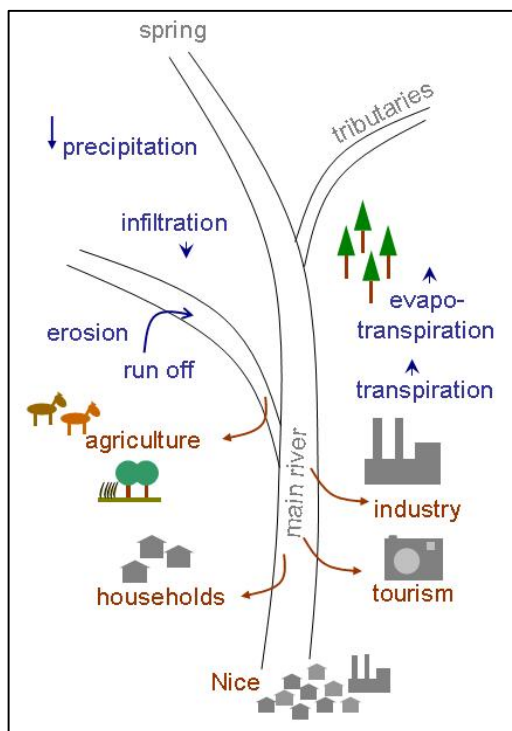


Figure 1. An overview of the Var catchment and the hydrological components.

Grey= physical components of the hydrological system; Blue= components of the natural hydrological cycle; Red= anthropogenically controlled components.

The aim of the research is to identify the key ecosystem services and main drivers of changes in the water sector as well as produce future scenarios according to the MA.

**Research questions:**

- How to sustain and provide ecosystem services of the water sector?
- What changes will be likely to impact the water sector?
- How will the water sector affect biodiversity and how will the status of biodiversity affect the water sector?

## **2. Materials and methods**

The project methods consist of several steps. At each step different materials are used.

### **2.1 Stakeholder dialogue**

For a true vulnerability assessment it is crucial to get feedback from the local people in order to identify, understand and integrate the socio-economic processes related to the state and evolution of the water sector. These groups were represented by Madame L'Eau (water sector), Mister Duchamp (farmers' association), Mister Europe (European Union), Madame L'Argent and two nature conservationists (Manager of the local National park and a representative from an NGO "Wolves International").

In an interview the stakeholders were asked the following questions which were used to identify their demands and wishes for the future development of the area:

- What projects are running in the area?
- What problems are already faced considering floods, fluctuations in water availability, water shortage?
- How is water being used/which water is being used? Are there any future changes expected in the use?
- What are the expectations of the MEDUSA project?
- What EU directives are applied in the region, especially considering the water sector?
- What measures are taken for saving water?
- What developments in the water sector are expected in the area?
- Are there any Natura 2000 areas in the Var catchment?

### **2.2 Field trip**

To experience the system of a river catchment in the area we visited the Plateau de Valensole, le Lac de Sainte-Croix and the Parc naturel régional du Verdon. We spoke to a social scientist from Marseille about the agriculture on the Plateau de Valensole and the areas around. At the Lac de Sainte-Croix we got informed about the impact of building a

reservoir on the local people, industry and the environment. The guide of the Parc naturel regional du Verdon explained the principles of Parc naturel regional and brought us to the Gorge du Verdon to experience the beauty of the region.

### **2.3 Scenarios delineation**

Information on the Var catchment was assembled using available references and the stakeholder interviews to identify the most important drivers for the region. The drivers were merged with the four scenarios of the MA: Global Orchestration, TechnoGarden, Order from Strength and Adapting Mosaic (MA, 2005). We transferred the general storylines to the Var taking into account the different drivers.

The MA developed scenarios to explore plausible futures for ecosystems and human well-being based on different assumptions about driving forces of change and their possible interactions. Two future time slices were used: 2020 (short term for management measures) and 2050 (long term for political decisions to be made). The years 1990 – 2005 served as the baseline for the scenarios. These four scenarios were adapted to the Var catchment and then used, together with the drivers, to derive the possible trends in pressures for the region and analyze the impacts and responses for the region in each scenario.

### **2.4 Impact assessment**

The impacts were used to assess the vulnerability of the catchment. In order to cope with the risk of future vulnerable states, possible adaptive measures were developed, which were in turn assessed for the probability of their use under each of the four scenarios. This process resulted in an assessment of threats for the water sector under each scenario.

## **3. Results**

With extended literature research it was possible to assess the current status of the Var catchment. To determine the ecosystem services provided by the water sector the MA was used as a framework. With the knowledge from different disciplines in the group table 1 was created.

The relationships between the main drivers and processes in the Var catchment (Fig. 2) was established during a process of group discussion with help of some specialists (tutors and stakeholders). This resulted in an overview of the main conflicts in the water sector (Table 4).

### **3.1 Current status of the Var catchment**

In recent years precipitation in the Var catchment area has been c. 800 mm per year from which only 25% is efficient precipitation, i.e. is not being evapotranspired and is thus available for use (Diren PACA, 2007). Part of the precipitation in this area comes as

snow and is highest in February-March ([www.var.fr](http://www.var.fr)). In recent years there has been a decrease in the amount of snow (Diren PACA, 2007). Besides water quantity also water quality is important and an adequate flow is needed to maintain the quality of water (MA, 2005). In the Alpes Maritimes the quality of ground water and surface water was in 2007 evaluated to be very good but decreasing. State of molluscs and invertebrates in the Var river has also been found to be good. However, water could become more polluted in the coming decades since nitrates and pesticides filtrate into ground water very slowly (scenarios on the territorial future of Europe) (Diren PACA, 2007).

The absolute demand for water in the area was 230 000 liters in 2004; most of the water (60%) comes from ground water sources (Diren PACA, 2007). This raises concerns over possible salinity problems because drawing groundwater near the sea can cause flux of water from the sea into the ground water source. The demand for water per household was 285 litres per person per day in 2004, which is the greatest in the whole of the Provence/Alpes/Côte d'Azur region and almost the double of the average French household (164 litres per person per day) (personal communication, tourist office le Lac de Sainte-Croix). This is at least partly due to summer and winter leisure activities attracting a high number of tourists. No data was available on re-use of water but we can assume the use of these technologies to be relatively small.

The dynamic agricultural sector of the area is of economic importance. One quarter of the 429 000 hectares of the Alpes Maritimes is farmland producing  $\frac{1}{4}$  of the total production in France, characterized by diverse systems of agricultural production. The main livestock in the area is represented by sheep and the main fruit production is olives (Ministry of agriculture and fisheries). The climate and the used techniques provide products throughout the whole year. Without irrigation the Provence region could not play an important role in the national production of agricultural products (Ministry of agriculture and fisheries) and a network of canals has been developed in the area. The gravity makes irrigation still useful in current times although sprinkling and micro-irrigation is winning terrain. The agriculture in the area is not very profitable and most farms are kept alive in sideline by families or family members who do not get paid (<http://www.nationsencyclopedia.com/economies/Europe/France-AGRICULTURE.html>). This difficult situation results in abandonment of agricultural fields which again can lead to soil erosion and increased soil instability (MacDonald et al. 2000) affecting water quantity and quality. However, at the moment nitrate levels in the Alpes Maritimes are below the European nitrates directive 91/676/CEE 1991. This directive constitutes the principal set of rules to fight pollution related to nitrates from agriculture. The EU threshold limit is 50 mg /l and in the Alpes Maritimes the nitrate levels are 0 to 2 mg/l.

Changes in land use patterns and the higher temperatures due to climate change will increase the risks of fires and the demand for water in the future. From 1860, 8 000 to 10 000 ha have been burning each year in the Var. The risk has been increased by both larger areas of forests and homogenous structure of the stands (Hubert 1991). This leads to more erosion and threat to the wildlife of the area. This in turn increases the need of water because wild fire suppression is very water demanding.

### 3.2 Ecosystem services provided by the water sector

The most important ecosystem services provided by the water sector in the Var catchment are presented in table 1. Mainly provisioning services are considered, in particular fresh water: it represents the natural resource at the centre of different demands where conflicts originate at present and in future scenarios. Both water quantity and quality are assessed .

Table 1. Ecosystem services provided by wetlands and rivers (adapted from MA).

Category	Service	Example	Importance of service
Provisioning	Food	Fish	High
	Fresh water	Irrigation and drinking	High
	Fiber and fuel	Timber, fuel wood	Medium
	Biochemical products	Materials from biota	Low
	Genetic materials	Medicine	Low
Regulating	Climate regulation	Temperature, precipitation	Medium
	Hydrological regimes	Storage of water	High
	Pollution control and detoxification	Removal of excess nutrients and pollutants	High
	Erosion protection	Retention of soils	Medium
	Natural hazards	Flood control	Medium
Cultural	Spiritual and inspirational	Well-being and feelings	High
	Recreational	Tourism	High
	Aesthetic	Appreciation	Medium
	Educational	Training	High
Supporting	Biodiversity	Habitats	High
	Soil formation	Sediment retention	High
	Nutrient cycling	Storage, recycling	High
	Pollination	Support for pollinators	Low

### 3.3 Main drivers of change in the water sector

The main drivers of change in the water sector at Var catchment and their relationships are shown in table 2 and figure 2.

Table 2. Main drivers of change and associated processes in the Var catchment.

<b>Drivers</b>	<b>Processes</b>
Demography	<ul style="list-style-type: none"> <li>• Consumption</li> <li>• Waste</li> <li>• Urbanisation</li> <li>• Pollution</li> <li>• Education</li> </ul>
Climate change	<ul style="list-style-type: none"> <li>• Erosion</li> <li>• Water Stress</li> <li>• Population</li> <li>• Floods</li> <li>• Fluctuations in water availability</li> </ul>
Landuse	<ul style="list-style-type: none"> <li>• Erosion</li> <li>• Urbanisation</li> <li>• Pollution</li> <li>• Consumption</li> <li>• Waste</li> <li>• Fluctuation in water availability</li> <li>• Floods</li> </ul>
Tourism	<ul style="list-style-type: none"> <li>• Consumption</li> <li>• Erosion</li> <li>• Pollution</li> <li>• Waste</li> </ul>
Technology	<ul style="list-style-type: none"> <li>• Supply</li> <li>• Efficiency</li> <li>• Consumption</li> <li>• Quality</li> <li>• Treatment</li> <li>• Pollution</li> </ul>
Policy	<ul style="list-style-type: none"> <li>• Management</li> <li>• CAP (EU Community Agricultural Policy)</li> <li>• Education</li> </ul>
Lifestyle	<ul style="list-style-type: none"> <li>• Education</li> <li>• Pollution</li> <li>• Consumption</li> <li>• Waste</li> </ul>

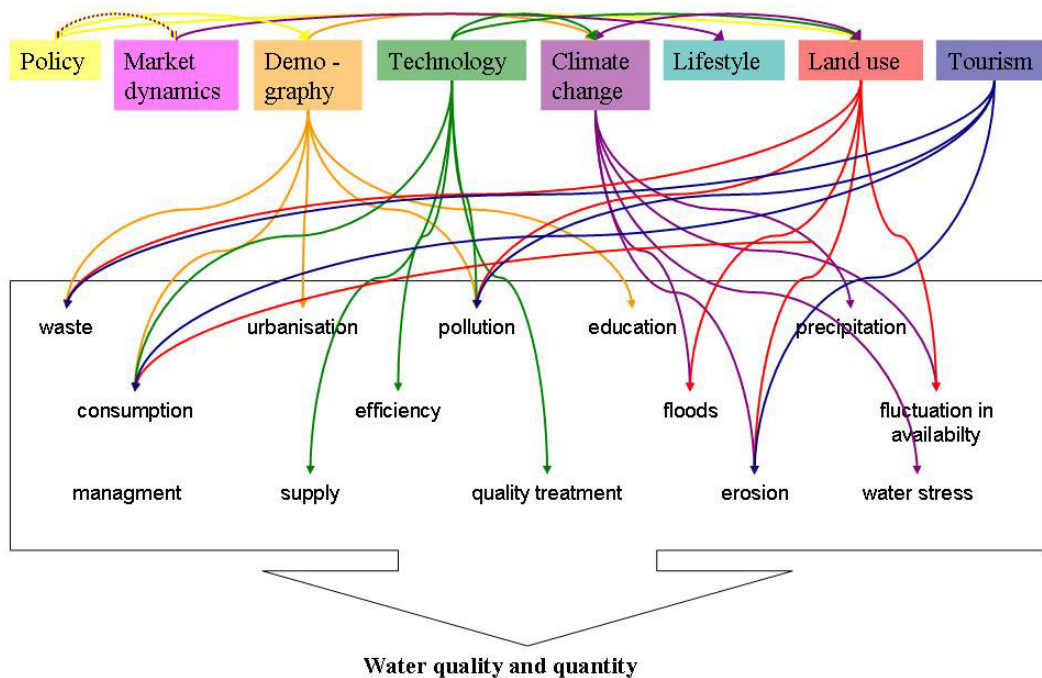


Figure 2. The relationships between the main drivers and processes in the Var catchment.

### 3.4 Stakeholder interviews

During the interviews with the stakeholders several demands have been identified. These can be found in table 3.

Table 3. Demands of different stakeholders revealed in the stakeholder interviews.

Stakeholder	Demands
Water	-reservoir -water plants -water recycling
Farmer	-irrigation -preserve current status of agriculture
Developer	-construction of new houses, that requires more and qualitatively good water -no investments for water infrastructure
Nature Conservation	-more water for nature -more qualitative water
EU	-implementation of water framework directive -habitat directive -bird directive

### 3.5 Current conflicts in the Var catchment

The water sector regroups several activities: management and mobilisation of the resource, agriculture, industry, buildings, energy, health and biodiversity. In the face of increasing water scarcity, the water sector faces several challenges today. These relate to the conflicting demand for the provisioning, regulating, cultural and supporting services of water as a resource, and the desire to realise all of these services simultaneously.

Hindering the decline of typical cultural landscapes and sustainable rural communities in the upper Var catchment depends on:

- 1) maintaining traditional activities of agricultural production e.g. sheep and goats herding;
- 2) the extent of the rural-urban interface and secondary homes;
- 3) the scope of the tourist sector.

Farming activities and herding practices maintain landscape mosaic, while reducing the risk of wildfire.

While agricultural holdings provide jobs and help maintaining open landscapes, the agricultural sector is the greatest consumer of water in the Var catchment and causes soil erosion. Soil erosion, together with a low water table did impoverish the water quality in 2007 and 2008 to the detriment of the pisciculture sector. Fertilisers and extensive irrigation affect the quality and quantity of water. Upstream this concerns the real estate and the tourism sector given large all year round fluxes of secondary residents and tourists.

Downstream the highest population density and largest amount of irrigated land can be found (Water sector working group 2007). Water demand from the flourishing city of Nice, its surrounding industries and golf fields competes with upstream uses. Downstream, it is not possible to increase the degree of water tapped from the underground aquifer as this raises concerns over salinity through water intrusion from the Mediterranean Sea.

High pressure on water demand, whether downstream or upstream, compromises the ecosystem services that the water sector provides. The presence of a dam compromises the surface water river flows, decreases pollution control and detoxification through removal of excess nutrients. Large populations being connected to sewage results in discharge of organic waste and nutrients into surface water. The most important sources of organic waste are household waste water, industries such as paper and food processing and slurry from agriculture. Severe organic pollution leads to rapid de-oxygenation of river water and decline fish and aquatic communities. Dams and high drainage of surface water also leads to habitat loss, resulting in the degradation and fragmentation of remaining habitats. Consequently, the distribution and abundance of aquatic species is negatively affected.

Table 4. Current conflicts of water supply in the Var catchment.

	<b>Conflicting uses over a scarce water supply</b>		
<b>Within upper and lower catchment</b>	<b>- Provisioning services</b> <i>Real estate, industries, energy</i>	<b>Vs.</b>	<b>- Cultural services</b> <i>Tourism, recreation, landscapes</i>
<b>Between upper and lower catchment</b>	<b>Upstream – provision services</b> <i>Households, agriculture, pisciculture</i> <b>Upstream – cultural services</b> <i>Tourism</i>	<b>Vs.</b>	<b>Downstream – provision services</b> <i>Industry, population pressure, energy</i> <b>Upstream – cultural services</b> <i>Tourism</i>
<b>Within entire catchment</b>	<b>-Provision services</b> <i>Industry, energy, pisciculture</i> <b>- Cultural services</b> <i>Tourism, recreation, landscapes</i>	<b>Vs.</b>	<b>- Regulating services</b> <i>Pollution control and detoxification</i> <b>-Supporting services</b> <i>Aquatic and terrestrial</i>

#### 4. Specific storylines of MA scenarios for the water sector







In this chapter a description of storylines in the four scenarios of the Millennium Ecosystem Assessment is presented according to the specific indicators selected from the general description of the scenarios provided by the Synthesis group.

As already mentioned in all scenarios temperature increases while precipitation decreases in the Var catchment; extreme events also increase in both frequency and intensity according to the regional scenarios of climate change in South Western Europe.

In the Global Orchestration scenario population in the Var catchment increases causing a generally higher consumption of freshwater. Agricultural activities decrease and scale-up due to international competition resulting in less sustainable agriculture. Urbanization takes place, therefore water consumption increases in urban areas and tends to decrease in the countryside. Water consumption increases in touristic areas because ecotourism options with a more sustainable use of water are not exploited by tourist operators.

Water quality decreases because remaining agricultural areas are intensively used and there is a higher pressure of urban citizens and tourists with unsustainable behaviours and the wrong attitude towards the environment (see Fig.3).

current situation 

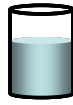
Drivers	Indicators of importance for the water sector	trend	quantity	quality	
Climate change	- Temperature (°C) - Precipitation - Extreme events	i (react appr) d i	d d fluct	? d d	
Demographics	- total population - Proportion of year-round residents	i d	d i	d i	
Land use and management	- % land in agriculture - % land in urban development - % agriculture sustainable	d i d	i d d	i d d	
Lifestyle	- Freshwater consumption per capita - Attitude/values towards the environment	i d	d d	d d	
Policy	- % land area under conservation - Payment for envt services programs - local subsidies	d d d	d d ?	d d ?	
Tourism	- # tourists visiting area/year - % ecotourists	i d	d (d)	d (d)	

'i' = increase, 'd' = decrease, 'fluct' = fluctuations, '=' = equal

Figure 3 Result of scenario Global Orchestration (blue colour: clean water; brown colour: polluted water)

In the TechnoGarden scenario population remains stable and freshwater consumption per capita decreases. Sustainable agriculture increases so that water consumption diminishes in rural areas. Tourism increases, in particular ecotourism: water consumption remains stable because the effect of a higher number of tourists and extreme events is equal to the effect of an increase in sustainable use of the area. So overall water demand decreases. Water quality will remain similar given new areas under conservation, ecotourism, improved attitude to the environment and more sustainable agriculture (see Fig. 4).

current situation



Drivers	Indicators of importance for the water sector	trend	quantity	quality	
Climate change	-Temperature (°C) - Precipitation - Extreme events	i (small) d i	= d fluct	= d d	
Demographics	- total population - Proportion of year-round residents	= i/=	= d/=	= d/=	
Land use and management	- % land in agriculture - % land in urban development - % agriculture sustainable	= i i	= d i	= d i	
Lifestyle	- Freshwater consumption per capita - Attitude/values towards the environment	d i	i i	i i	
Policy	- % land area under conservation - Payment for envt services programs - local subsidies	i i d	i i ?	i i ?	
Tourism	- # tourists visiting area/year - % ecotourists	i i	d (=)	d (d/=)	

'i' = increase, 'd' = decrease, 'fluct' = fluctuations, '=' = equal

Figure 4 Results of scenario TechnoGarden (blue colour: clean water; brown colour: polluted water)

In the Order from Strength scenario the number of tourists and year-round residents increase, as well as the consumption per capita. Agricultural and urban areas are developing. Therefore the overall demand of water increases. The quality decreases due to this growing agriculture and people's attitudes towards the environment get worse (see Fig. 5).

current situation



Drivers	Indicators of importance for the water sector	trend	quantity	quality	
Climate change	-Temperature (°C) - Precipitation - Extreme events	i d i	d d fluct	? d d	
Demographics	- total population - Proportion of year-round residents	= i	= d	= d	
Land use and management	- % land in agriculture - % land in urban development - % agriculture sustainable	i i =	d d =	d d =	
Lifestyle	- Freshwater consumption per capita - Attitude/values towards the environment	i d	d d	d d	
Policy	- % land area under conservation - Payment for envt services programs - local subsidies	= i	= ?	= ?	
Tourism	- # tourists visiting area/year - % ecotourists	i d	d (d)	d (d)	

'i' = increase, 'd' = decrease, 'fluct' = fluctuations, '=' = equal

Figure 5 Results of scenario Order from Strength (blue colour: clean water; brown colour: polluted water)

In the Adapting Mosaic scenario the population and the number of tourists, as well as the freshwater consumption per capita is decreasing. The agriculture sector moves towards sustainability (overall cultivated land is stable). This leads to an overall decrease of water consumption. Attitudes towards the environment of local people and tourists improve. Together with a more sustainable agriculture the quality of the water will improve. All these in combination with an increase of payment for environmental services lead to a general positive situation regarding water quality and quantity (see Fig. 6).

current situation



Drivers	Indicators of importance for the water sector	trend	quantity	quality	
Climate change	-Temperature (°C) - Precipitation - Extreme events	i d i	d d fluct	? d d	
Demographics	- total population - Proportion of year-round residents	d i	i d	i d	
Land use and management	- % land in agriculture - % land in urban development - % agriculture sustainable	= = i	= = i	= = i	
Lifestyle	- Freshwater consumption per capita - Attitude/values towards the environment	d i	i i	i i	
Policy	- % land area under conservation - Payment for envt services programs - local subsidies	= i i	= i ?	= i ?	
Tourism	- # tourists visiting area/year - % ecotourists	d i	i (i)	i (i)	

Figure 6 Results of scenario Adapting Mosaic (blue colour: clean water; brown colour: polluted water)

In figure 7 the summary of all the scenarios is shown.

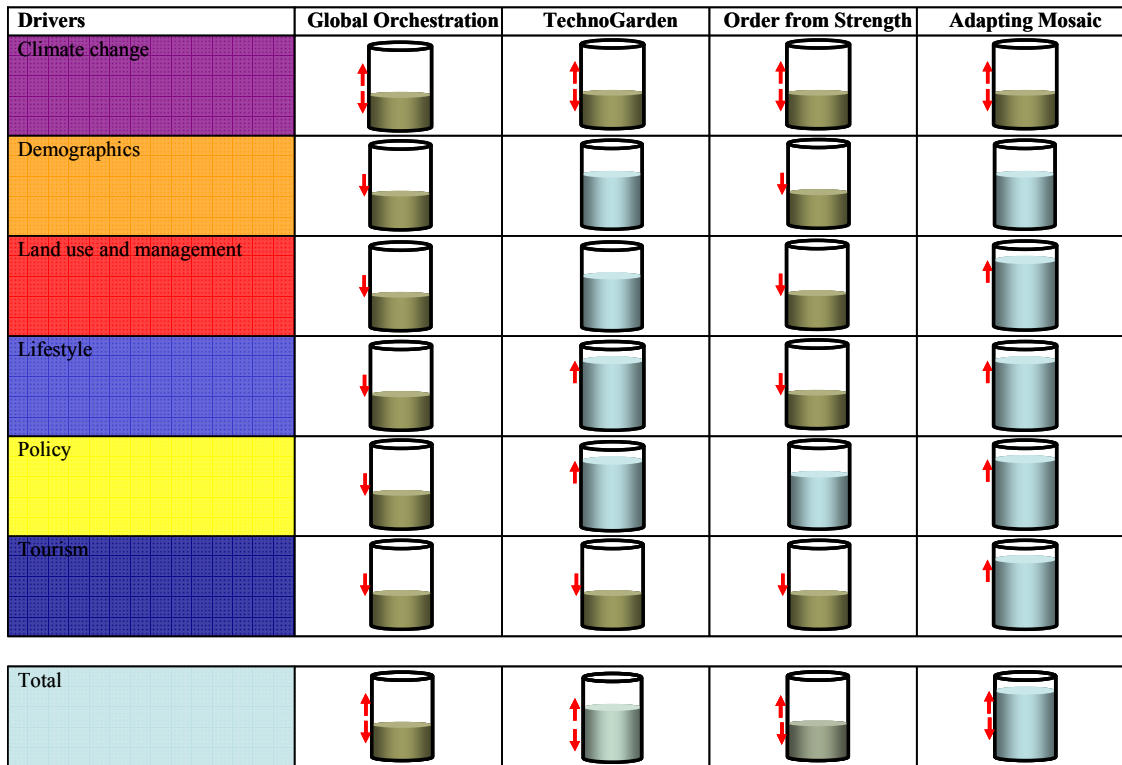
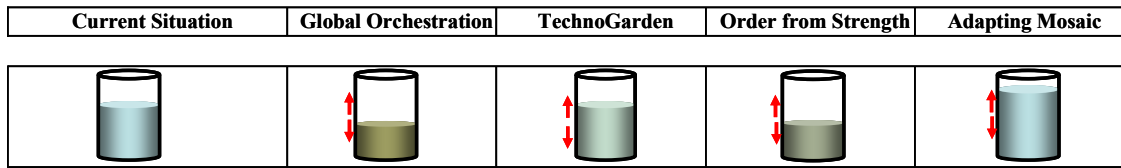


Figure 7 Summary of the results of the scenarios (blue colour: clean water; brown colour: polluted water)

## 5. Discussion

### 5.1 Synergies and trade-offs between stakeholder demands for ecosystem services

For the four MA scenarios, the synergies and trade-offs differ largely (see Fig. 8). In the Order from Strength scenario the EU directives can possibly be met, however the requirements of other stakeholders can probably not be met. In the Adapting Mosaic scenario most stakeholders can be satisfied.



<b>Opportunities for stakeholders</b>				
<b>Water</b>				
- reservoir	impossible	doable	not recommended	feasible
- water plants	impossible	doable	not recommended	feasible
- water recycling	highly recommended	recommended	highly recommended	recommended
<b>Farmer</b>				
- irrigation	not recommendable	feasible	not recommendable	feasible
- preserve current status of agriculture	impossible	doable	doable	feasible
<b>Developer</b>				
- construction of <u>new houses</u> , that requires more and qualitatively good water	not recommended	feasible	not recommended	feasible
- <u>no investments</u> for water infrastructure	not recommended	not recommended	not recommended	not recommended
<b>Nature Conservation</b>				
- more water for nature	impossible	feasible	impossible	feasible
- more qualitative water	impossible	impossible	impossible	feasible
<b>EU</b>				
- implementation of water framework directive	highly recommended	feasible	possible	feasible
- habitat directive	impossible	possible	possible	feasible
- bird directive	impossible	possible	possible	feasible

Figure 8 Opportunities for stakeholders (blue colour: clean water; brown colour: polluted water)

## 5.2 Adaptation strategies

The future scenarios of Global Orchestration, Order from Strength and TechnoGarden depict a future in which freshwater quantity and quality will decrease to varying extents. If these scenarios will materialise, adaptation strategies should be made according to the scenarios.

### Lifestyle – education:

Changes in lifestyle and consumption habits may contribute to the reduction of the water consumed by citizens and tourists. This may be accomplished through educational campaigns and participatory approaches, informing citizens about water problems in their catchment and solutions at different scales. This should aid in forming social responsibility and foster proactive behaviour.

### Irrigation:

In agriculture, gravitation and sprinkling irrigation are the most prominent techniques used at present. A promising technique however is that of drip irrigation. It is initially more expensive to install, but it greatly reduces the quantity of water consumed. Collected rainwater could also be used for agricultural purposes.

### Pesticides:

With a lower flow velocity in rivers, the negative impact of pesticides on the water quality is aggravated. Converting traditional farming to “reasoned farming” and/or to organic agriculture, in which the amount of fertilisers and nutrients are applied in significantly lower quantities, has a potential to reduce the amount of pesticides.

### Households:

Households are the second greatest consumers of water. To reduce the consumption of water per household, the following incentives could be applied: 1) the installation of water metres, so that families can make a conscious and observable effort to reduce their consumption, 2) water use efficient washing machines, laundry machines and toilets replacing inefficient ones and/or 3) the collection of rain water in containers to be used for flushing toilets.

### Reuse of water:

Water used in agriculture can be reused to furnish those household purposes that do not require drinking water.

### Infrastructure:

The downstream part of the catchment has the highest density of industries and the largest population. The water pipes furnishing industries and households with freshwater

is worn out, resulting in a 15% leakage. Replacing old outdated water pipes with newer ones would solve the leakage problem.

#### Heterogeneity of landscapes:

Retaining a certain degree of open landscapes is desirable, because trees consume great quantities of water, and increase the risk of wildfire. Sheep and goat herding is arguably a better strategy for promoting open landscapes, since it demands less water inputs than farming activities.

#### Buffer zones:

The regulating services of the water sector can be improved by creating buffer zones between agricultural holdings and the watershed. To protect from soil erosion, buffer zones around watersheds in the upper part of the catchment are useful. Larger buffer zones, such as wetlands in the lowest part of the catchment, could also serve remove excess nutrients and pollutants and diminish the risk of flooding in an increasingly dry environment.

#### Social cost pricing:

As long as the price of water is low, failing to reflect the true social costs, the depletion of this resource will continue. Adequate pricing of this resource, at the level of the individual household, would change the attitude towards the use of water and most probably reduce the water usage. The price of using water should not only be the cost of pumping out of the ground, but also the social cost of habitat fragmentation and the diminished opportunity for future uses (so called scarcity rents).

#### *How will the water sector affect biodiversity?*

High pressure on water demand, whether downstream or upstream compromises biological diversity. Dams, hydropower plants, and high drainage of surface water results in degradation and fragmentation of remaining habitats to the detriment of freshwater plant and animal communities. River continuity must be maintained between seas and riverine spawning areas. If not, the composition of freshwater plant and animal communities will favour fewer but more stress-tolerant species. Larger amount of households being connected to sewage results in discharges of organic waste and nutrients into surface water. Since organic pollution leads to rapid de-oxygenation of the river, aquatic communities are adversely affected by human population pressure.

To maintain a high quality of water, and thus a high biodiversity, it is important to implement the Water Framework Directive.

### 5.3 Discussion on the methods

The results are achieved in an interdisciplinary group. We merged our knowledge and background into a reasoned judgement for the water sector in the Var catchment. Although we missed some field experiences to find the weakest links we were able to write a consistent report. To our opinion the results can hardly be translated to policy options, due to a lack of clear guidelines. To reach a more practical result we would need more time to structure the assignment in sub trajectories with interdisciplinary specialist groups and to work with a strict project management.

Personally we learned to collaborate in a multi-cultural setting with many different opinions and expertise. We had a critical view on our own functioning as a group member as well as a scientist. It has been a very valuable experience for future projects.

## 6 Conclusions

Society is very water depend and is therefore vulnerable to changes in water services. However future water supply and demand are uncertain and therefore it is hard to get insight in future perspectives for stakeholders. Policy makers can take different measures depending on the development of society as described by the storylines of the MA and our results.

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