SOUTH EAST EUROPE
Transnational Cooperation Programme

Programme co-funded by the EUROPEAN UNION

CC-WARE

climate change

transnational level

knowledge transfer

fresh water resources

ecosystem services

practical solutions

transnational strategies

Towards an Action Plan for the SEE-Region

Guidance for water resources under climate change

Jointly for our common future

CC-Ware is supported by means of the European Regional Development Fund and of the Instrument for Pre-Accession Assistance

Imprint

Owner and Editor
Lead Partner of the ETC/SEE project CC-WARE
Federal Ministry of Agriculture,
Forestry, Environment and
Water Management (BMLFUW)
Forestry Department
Vienna, Austria

Responsible for the content
Hubert SIEGEL
(BMLFUW, Forestry Department)
Elisabeth GERHARDT
(Federal Research and
Training Centre for Forests,
Natural Hazards and Landscape)

Further contributors
CC-WARE Project partners

Layout:
Barbara Veit

October 2014

CC-WARE

Table of Contents

Introduction

Water is a basic human right, what is confirmed by the UN Sustainable Development Goal on Water, today and for future generations. It is a precondition for human, animal and plant life as well as an indispensable resource for economy. Furthermore, water also plays a fundamental role in the climate regulation cycle. The protection of water resources and the related ecosystems needs to be maintained and enhanced in Europe.

In the South-East Europe (SEE) drinking water requirements are predominantly covered by groundwater resources, additionally karstic springs are utilised in many areas. However, bank filtrated groundwater closely connected to surface water systems is an important source in the large plain areas. The quality of these water resources is strongly dependent on the proper functioning of the ecosystems regarding buffering and purifying the inflowing waters.

Different evaluations emphasized that the EU has not been successful in integrating water policy goals into the Common Agricultural Policy (CAP), although pollution of water resources originates especially from agricultural pressures.

In addition observation records and climate projections provide abundant evidence that water resources are vulnerable and could be strongly impacted by climate change, with comprehensive consequences on human societies and ecosystems. Europe has to tackle two major water management challenges in the future: increasing water stress and related droughts, mainly in SEE, and increasing flood risk. The following problems with quantity and quality of water resources affect not only water suppliers, but also other sectors such as agriculture, industry, energy, biodiversity, tourism etc.

© Roland Koeck

Recently, the World Economic Forum identified the water supply crisis as one of the top five global risks during the 21st Century and the IPPC report on "Climate Change 2014: Impacts, Adaptation and Vulnerability" underlines, that many key risks all of which are identified with high confidence, are related to water. In this context sustainable water management is actually one of the main components of the EU climate change adaptation strategy to encourage more initiatives addressing water issues in key priority areas such as agriculture, energy, urban development, fostering resilience to extreme water-related events and ensuring domestic water services in changing climate situations.

The scale of these challenges requires rethinking in the climate mitigation efforts and climate adaptation strategies, including improved data collection and access to it, research regarding crucial uncertainties, better integration between sectors and an increased solidarity between different EU Member States for more coordinated joint policies and actions.

Managing water and land resources in an integrated sustainable way is important to ensuring access to clean drinking water, reducing water pollution, protecting biodiversity, controlling flooding and food security and to satisfy the competing needs.

In order to meet all these challenges CC-WARE was developing an integrated transnational strategy for water protection and mitigating water resources vulnerability under climate change, which builds the basis for an implementation of national/regional action plans. Not only the water resources vulnerability regarding quantity as well as quality and the drinking water availability under climate change and socio-economic conditions, but also the potentials of ecosystem services, possible land use changes, opportunities for improved water use efficiency and economic incentives for water management in the SEE region (with considerably differing areas) were evaluated and assessed in detail.

Different water management options for water supply systems, with special regard to ecosystem services of various ecosystem types, and land use regulations to define their impact on drinking water resources were analysed.

Based on these results recommendations for adaptive management concepts in water protected areas considering different climate regions and ecosystems to secure the supply of pure drinking water in appropriate quantity and quality were highlighted. The achieved and developed knowledge and resulting measures have to be transferred into the regions and on local level by means of national/regional action plans to strenghten the institutional capacity and human resources at national, regional and local level. After evaluating and analysing existing legislation and policy for drinking water supply and protection as well as land use on EU level, national level and on regional level a proposal for a framework for the implementation of national/regional action plans was developed taking into consideration the Danube Region Strategy, the EU Water Framework Directive as well as other relevant EU policies. Due to the interdisciplinary CC-WARE team, composed of governmental bodies, regional authorities, local water suppliers and external experts from different institutions, the implementation of innovative and practice-oriented results into the national/regional action plan strategy was guaranteed specifying the necessary interventions for water resources in time and space.

The local and regional application of the knowledge, solutions and recommendations generated by the partners of the CC-WARE project within this guidance will not only contribute to a sustainable development of the SEE-Region and benefit the people living in this area or searching for recreation there, but also facilitate the challenging tasks of local and regional decision makers in future.

Vulnerability Assessment

Concern about the potential effects of climate change on water supply and water demand is growing. Water resources vulnerability is a critical issue to be faced by society in the near future. Current climatic variability and future climate change are affecting water supply and demand over all water-using sectors. Consequently, water scarcity is increasing.

Vulnerability is the degree to which a system (water resources) is susceptible to adverse effects of climate change, including climate variability and extremes (IPCC 2007, UNEP 2009, Local Government Association of South Australia 2012). Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity (Figure 1). The methodology applied in CC-WARE builds on this description of vulnerability by examining the exposure (predicted changes in the climate), sensitivity (the responsiveness of water resources to climatic influences) and adaptive capacity (the ability of land cover types with relation to water resources to adapt or modify to cope with the climate changes) of a range of indicators in a SEE region (Figure 1).

An example of water resources sensitivity in terms of quantity is the substantial reduction of water availability in a small watershed due to decreasing of precipitation in the future. Examples of natural systems with low adaptive capacity are those with over extraction of surface and groundwater resources, salinity or environmental pollutants that do not have the resilience to adapt. When the adaptive capacity of a system is reduced, it is considered to be more vulnerable to the impacts of climate change.

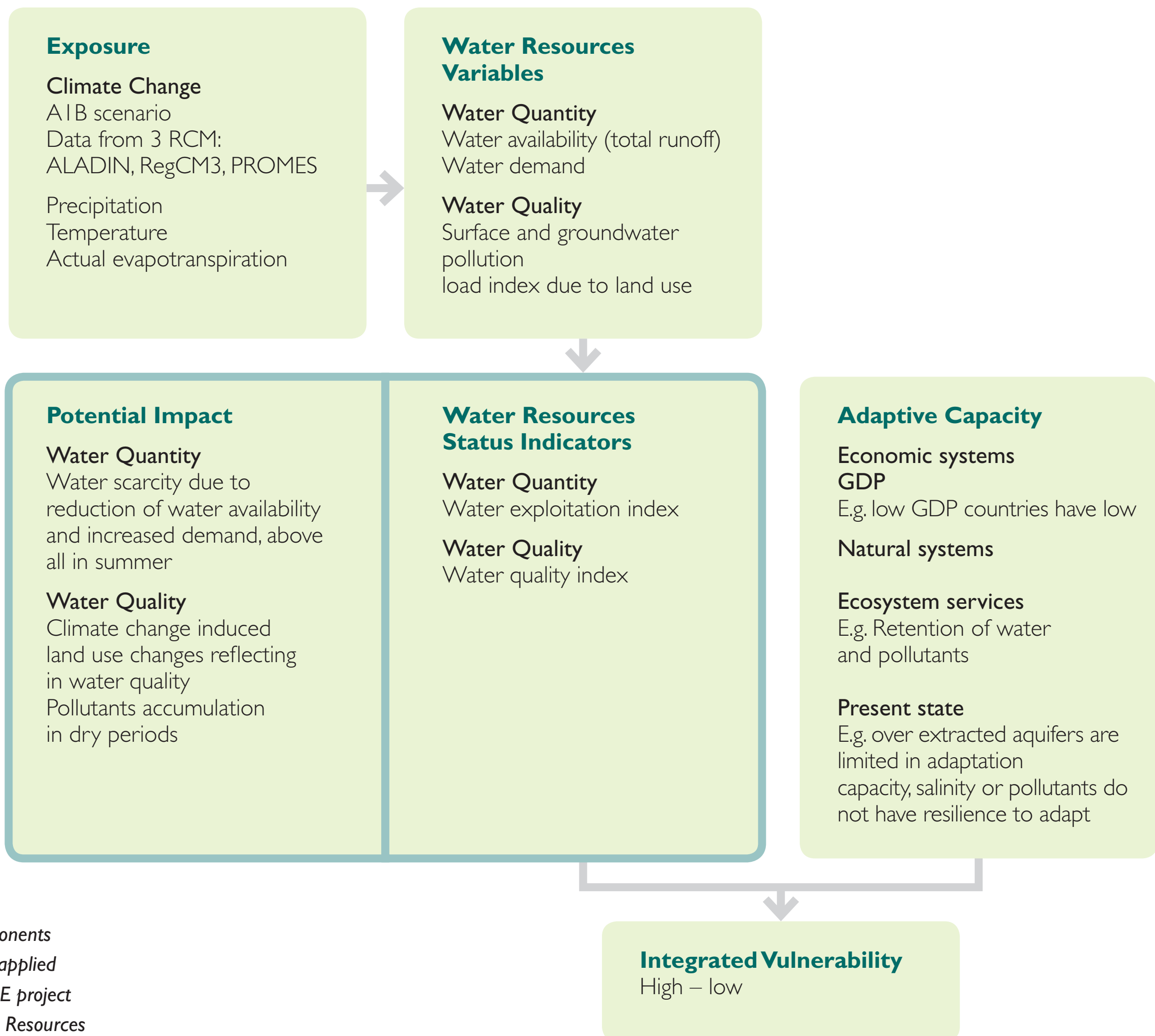
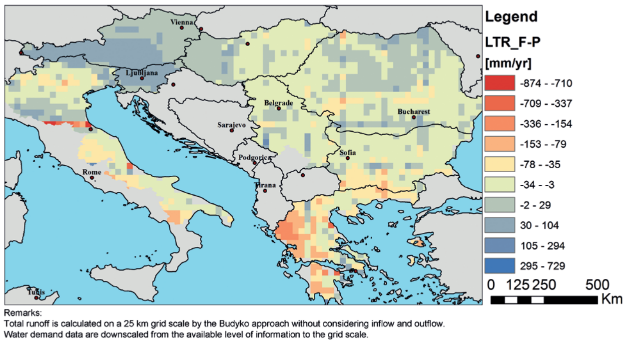
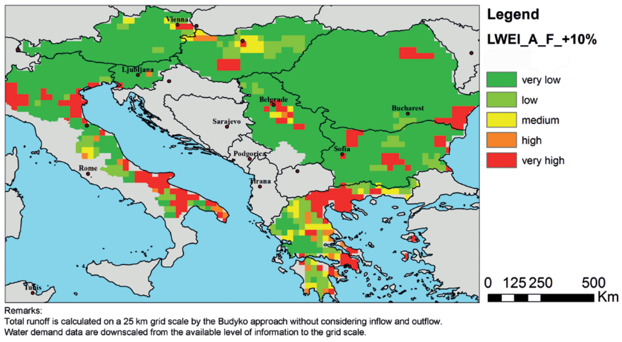


Figure 1: Components of Vulnerability applied in the CC-WARE project from the Water Resources Perspective

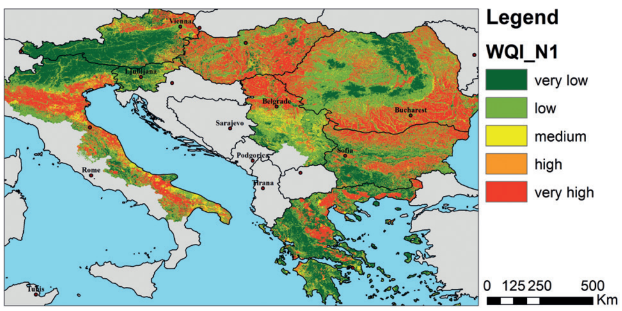
By classifying the water resources vulnerability, critical areas can be identified, where water resources stay under risk. The knowledge of the areal distribution of vulnerable water resources is an important prerequisite for sustainable management of the relevant areas.



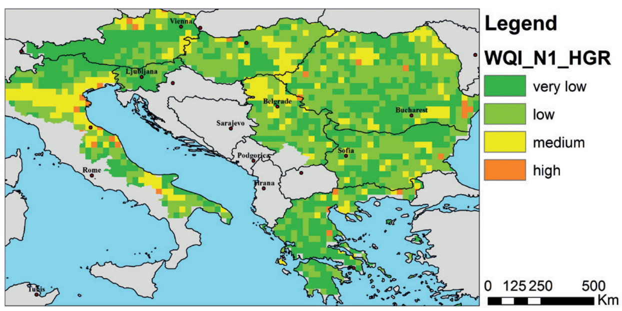
Change of Local total runoff (LTR, in mm) according to ensemble of RegCM3, ALADIN and PROMES models shows that in mountainous areas of the Alps and Carpathians the local total runoff will arise in the future, whereas in western part of Greece, southern Bulgaria and some part of Italy it will decrease and there will be less water available.



Annual Local Water Exploitation Index (LWEI; relation between water demand and local total runoff) for future climate and water demand scenarios for CC-WARE countries within SEE area shows that there is a high water stress on annual level in southern Italy and the Po region, around large cities, in western Greece and other areas. The resulting map is actually indicator for measures to be applied in a region with high stress. In some cases measures had already been applied some centuries ago: e.g. Vienna has high stress (LWEI), but transfers water for drinking from the mountainous area in the southwest. High water stress in the northeastern part of Greece is solved by using surface waters.



Potential surface water pollution index for surface water (surface water quality sensitivity WQISW) is based on land use activities, which are reflecting in the water quality stress. Areas with higher potential water pollution index are mostly in lowlands, where there are intensive agricultural activities, industrial areas and large cities. It is not necessary that in these areas qualitative water status is bad. In particular areas water body status could be good, but is still sensitive to pollution because of the land use.



Potential groundwater pollution load (groundwater quality stress) is presented by water quality index for groundwater (WQIGW) and is based on land use activities and hydrogeological characteristics, which are reflecting in the groundwater quality stress, which is the largest in agricultural areas in karst regions.

Qualitative Description of Ecosystems

Ecosystems provide provisioning, regulating, supporting and cultural services that contribute directly and indirectly to human well-being and prosperity. In the past century, increasing human population and advancing levels of social and economic development have led to a rapid increase in the demand for freshwater provisioning and regulating ecosystem services.

Unfortunately full value of ecosystem services has not been recognized by development practices in the past and human activities have often led to degradation of important water related ecosystem services. In addition, the effects of climate change on water supply related ecosystem services can be manifested in many different ways. If climate change projections of more frequent and extended extremes in SEE are correct, then this trend has the potential to have a large impact on water supply in SEE. Increasing source variability and declining raw water quality, combined with increased demand and increased competition between different users will create new challenges. At the same time, changing preferences in developed and developing economies in favour of preserving and enhancing the role of ecosystem services for the benefit of society imply a profound need for the appropriate and adaptive management of ecosystem services. In this context one of the challenges we will face in the future is adequate valuation of the ecosystem services to allow for responsible and appropriate management strategies and policies.

Ultimately, any development of water sector will involve a trade-off between provisioning, and the cultural, regulating and supporting services. With water as a critical component in the provision of ecosystem services, it is necessary to ensure its proper use and governance.

Ecosystem services have the capacity to provide adequate answers to the above challenges and experience from our management of water related ecosystems to date are that:

- Continued provision of ecosystem services for human welfare is dependent on sustainable and properly functioning ecosystems
- Water security is at the core of management of sustainable ecosystems.

It is high time to recognize the fact that many of today's problems are the result of yesterday's solutions. Our challenge is to learn to avoid sowing the seeds of tomorrow's problems. Nature has provided us with the answers to all of our questions and it is up to us to use these solutions and set the foundations for a better future. In this context it is educational to consider the potential value of ecosystem services for water supply in SEE and use it for the development and enhancement of governance in the water sector in this region. An indicator of this value is mapped in Figure 2 below. It is crucial to note that ecosystem services can be vastly improved in the major part of SEE.

The ecosystem type specific issues are summarized in the following sections.

It should be noted that the biggest potential for improvement is in the areas where sources of water supply are typically located while smallest potential is in areas of intensive agricultural production unless the agricultural land uses are converted to less impacting land uses. Implications are profound and require appropriate political interventions.

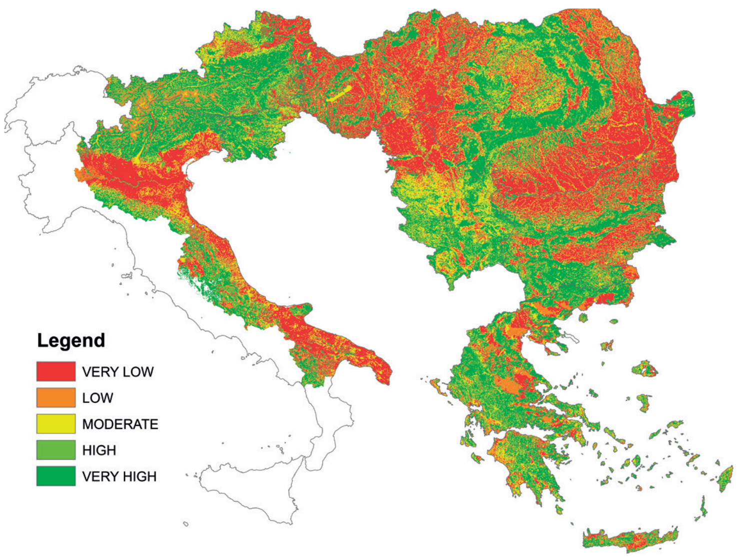


Figure 2: Relative potential of ESS to improve Water Supply in South East Europe

Forest Ecosystems

Many cities and rural communities on our planet derive their drinking water supply from forested areas. Forest ecosystems are renowned to support the protection of drinking water resources in a very effective way. This can be explained by the specific water protection functionality of forest ecosystems. But what constitutes that?

- Forests have an excellent water storage function: Water storage takes place in the trees themselves, as they intercept (= catch) water on their leaves or needles and branches. The second area of storage is given in the forest soils, where water is stored in the humus layers and soil pores. During winter seasons forests can provide snow storage.
- Forests provide good infiltration conditions for precipitation water: Water infiltrates into the soils instead of running off on the surface and producing floods.
- Forests stabilize the soil and humus formations: Where stable and dense forests are growing, the soils are protected by the dense root network of the trees.
- Forests prevent or mitigate erosion processes: A dense and stable forest cover can mitigate erosion processes like rock falls, landslides and avalanches and in some cases even prevents them.
- Forests filter the precipitation water: The typical forest soils with their humus layers and organisms filter various substances from the precipitation water and hence provide a first and natural water cleaning system.

  All those functions of forests contribute to their capability for drinking water protection.

Wetland Ecosystems

Wetlands present environments that are highly connected to water (surface and groundwater) and have therefore often an important role in providing and maintaining the hydrological and ecological state of an environment. Their unique characteristics provide the environment for specific vegetation types adapted to its special conditions and, moreover, represent ecosystems with a high biological diversity. Comparing different types of land use (agriculture, forest, grassland, etc.) the ecosystem services of wetlands represent effective areas for reducing the vulnerability and protecting the natural state of water resources. Therefore one of the most important functions of the wetlands is to assure the water regime (state and fluctuations of surface and groundwater). Besides, they are also extremely effective to detain and even reduce pollutants. The filtering potential of wetland plays an important role in maintaining the quality of water, therefore wetland are often used as treatment plants for purifying different waste waters. Due to such a broad role in ensuring the quality and quantity of water, additionally to naturally occurring wetlands also artificial ones are important.

Wetlands and their ecosystem services play a number of important roles in the environment. The main functionalities for quality and quantity of drinking water protection are: water regulation, flood control, provision of groundwater, water purification and sediment and nutrient retention. In addition, wetlands effectively help in reducing the impact of climate change, although they are also sensitive to climate change. Therefore, the proper management and protection of wetlands is crucial to maintain the water quantity and quality status as well as mitigating the impact of climate change.

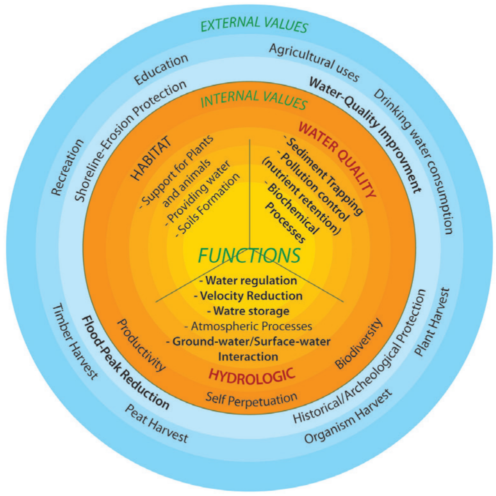


Figure 3: Wetland functions and values / benefits which maintain or sustain the wetland itself (internal) and are extended to the surrounding ecosystems (external) (modified by Novitzki et al. USGS)

Grassland Ecosystems

In general, grassland is a land covered by herbaceous plants evolved naturally, artificially (by sowing or planting), or by combination of both. Inside grasslands the species associations are determined by climate, topography, morphology, soil and human activities (grazing, mowing, burning, sowing). From the perspective of ecosystem services (ES) promoting protection of drinking water resources, the focus is not on the species composition, but rather on the conditions ensuring long-term functioning, namely maintaining the ability of retaining water and pollutants. Grass as a continuous soil cover is able to

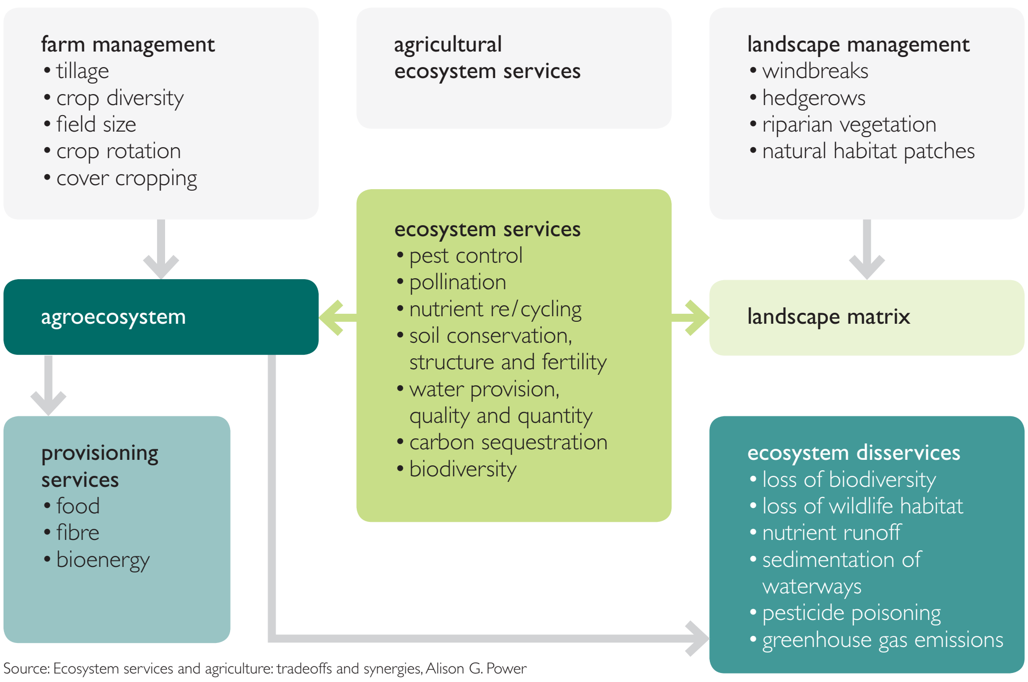
- buffer precipitation, promoting recharge to groundwater,
- prevent erosion, consequently reducing pollution of the recipient surface waters and slowing down sedimentation of reservoirs
- filter pollutants from runoff and infiltration, contributing to good quality of water resources.

The relevant status indicator is the biomass, which basically influences the retention capacity. Biomass is mainly determined by species composition and cover density, thus it shows high variability in space and time. Detailed evaluation is a local task, but its dynamic stability can be considered as a general target for every grassland ecosystem in drinking water protection areas. Another principle is that this target will be achieved more likely, if the state is as close to natural one as possible. Non-sustainable management and more frequent droughts due to changing climate (in particular in areas with limited water availability) may hamper achievement or maintenance of the requested dynamic stability. Gradual change in species composition (including occurrence of invasive species) may lead to decreasing biomass, resulting in smaller water and pollutant retention capacity. Overuse of nutrients (fertilizer, manure) and chemical weed control may reduce the buffer capacity or in a worse case turns the grassland into a source of pollution.

Agricultural Ecosystems

Agriculture is a dominant form of land use practices globally. Agricultural ecosystems cover nearly 40 percent of the terrestrial surface of the Earth (FAO 2009) and are highly managed to meet human food, fiber and fuel needs. In addition to these services, agricultural ecosystems can provide a variety of regulating and supporting services, such as soil conservation, regulation of water quality, nutrient cycling, carbon sequestration, support for biodiversity and cultural services. At the same time, productivity of agricultural ecosystems depends on neighboring ecosystems and their services including pollination, biological pest control, and preservation of soil characteristics.

Depending on management practices, agriculture can also be the source of numerous disservices: land degradation, loss of habitat and biodiversity, nutrient run-off, sedimentation of waterways, pesticide poisoning, and emission of greenhouse gasses contributing to climate change (Figure 4).



Source: Ecosystem services and agriculture: tradeoffs and synergies, Alison G. Power

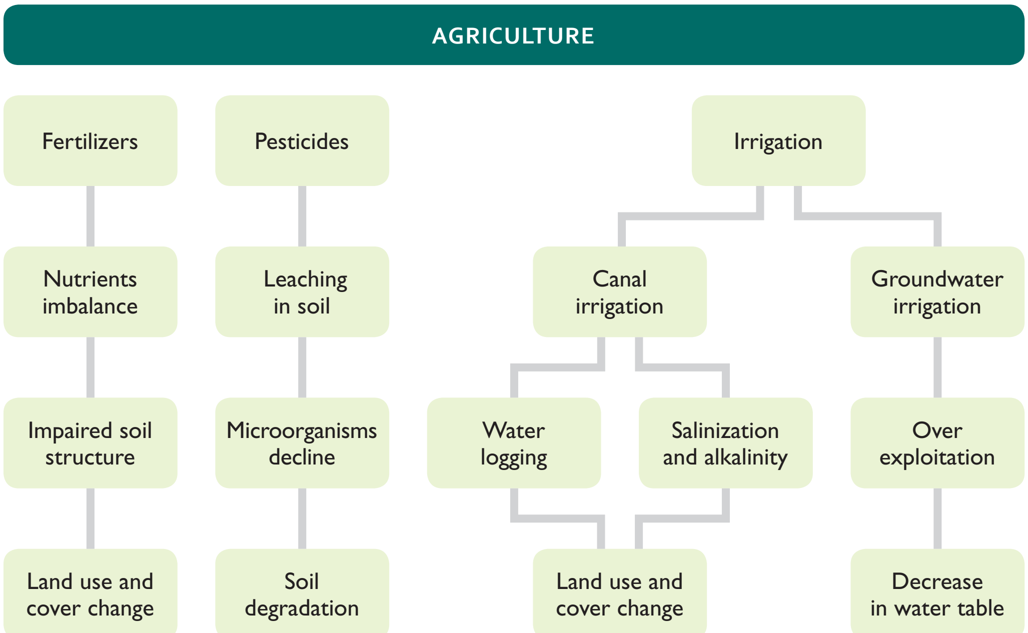
Figure 4: Impacts of farm management and landscape management on the flow of ecosystem services and disservices to and from agroecosystems

Agricultural activities are one of the major pressures on water quality and water quantity. Water withdrawal for irrigation may generate significant decrease in water table level, and result in changes in stream flows and infiltration rates.

The impact of agriculture on water quality mainly concerns the presence of excessive levels of nitrogen and phosphorus, heavy metals, active pesticide ingredients, acid substances and soil sediments in surface and groundwater.

Excessive nitrogen and phosphorus levels from fertilizer application lead to eutrophication which can diminish fish populations. High levels of heavy metals in water, originating from fertilizers, can enter the human food-chain through absorption by fish. Toxic contamination of water from pesticide use can result from leaching or enter directly when spraying takes place close to surface water. Acidification of water may originate from fertilizer and fossil fuel use, and biomass burning. Soil sediments, washed by wind and rain from cropland and overgrazed pasture, can generate water turbidity and reduce sunlight and dissolved oxygen availability for aquatic plants and fish, thus reducing fish and shellfish populations. Sedimentation reduces water storage capacity in lakes and reservoirs, clogs streams and drainage channels, increases the frequency and severity of flooding and damages water distribution systems.

Agricultural practices that degrade soil quality contribute to eutrophication of aquatic habitats and may necessitate the expense of increased fertilization, irrigation and energy to maintain productivity on degraded soils (Figure 5).



Source: Modified Sonak, 2004

Figure 5: Processes by which agriculture has an impact on ecosystem services

Adaptive Management Measures – Best Practices for 4 different Ecosystems

Forest Ecosystems

In order to keep the before explained water protection functionality of forest ecosystems on a high level, forest management has to adapt the related overall purpose. A high water protection functionality of the forests means, that a high quality standard of the related water resources (springs or groundwater) is secured. Also groundwater and spring-water recharge can be supported. This is basis for the provision of the ecosystem service drinking water protection.

Which Best Practices have to be applied within the context of adaptive management for forest ecosystems in drinking water protected areas?

- Clear-cuts have to be avoided within drinking water protected areas (DWPA), as those can cause the erosion of soil- and humus substances, which can lead to the contamination of water resources.
- As alternative a continuous cover forest system has to be established. This guarantees that forest cover is given over space and time. Regeneration techniques focus on the creation of small-scale openings within the forest cover, hence providing both light for young trees and also protection functionality of the forest stands.
- Forest ecosystems within DWPA have to be very stable. The best level of stability can be provided, if the tree species diversity of the forest stands is high and is in line with the natural forest community. This means that instead of e.g. homogeneous conifer plantations natural forests have to be established. The tree species diversity depends on the site, where the forest is growing (mountains or flatlands, etc.).
- Structure also enhances forest stand stability – hence the forests have to be uneven-aged, multi-layered (tall and small trees are growing together at one site) and diverse in tree species. These also are basic conditions for continuous cover forests.

© Roland Koeck

- The successful natural regeneration dynamic is the precondition of forest stability and has to be given over space and time in each part of the forest ecosystem. Young trees which can grow vitally and without hindrances are essential for water protection.
- In order to guarantee the regeneration dynamics of all tree species within a DWPA, the wild ungulate density has to be balanced at a forest-ecologically sustainable level. If there are too many wild ungulates (like e.g. red deer, roe deer, etc,), they create browsing, bark-peeling and fraying damages. Hence these species should only be present in rather low densities. Also the presence of wild predators like e.g. Lynx helps to balance wild ungulates.
- Old and stable tree individuals of autochthonous species are important for forest stability, as they provide their excellent gene pool for natural regeneration and also provide nutrients for smaller trees via their mycorrhizal network (tree roots are interconnected via the network of mycorrhiza fungi). Those old and stable trees have to be kept within the forest stands.
- Silviculture has to be carried out very cautious. For regeneration purposes only small openings are cut into the forest cover, like gap cuts or group selection cuts, which have a maximal diameter of one tree length. Also soil preserving techniques like cable-crane logging have to be applied instead of heavy tractor skidders. Also the limitation of forest road constructions (should only be possible if they are indispensable) is of crucial importance.

If these Best Practices (essential examples out of a more detailed catalogue) are applied, the water protection functionality of the forest ecosystems can be improved.

Wetland Ecosystems

Wetlands play an important role in preserving the natural and healthy state of the environment as well as provide important habitats for many wild plants and animals. Among many functions of wetlands, the purification ability (retain and even attenuate pollution) and regulating water (surface and groundwater) are the most important for preservation and provision of adequate quality and quantity of drinking water. Wetland areas are also often subjected to land use changes and transformations i.e. agricultural lands, forests, dumps, settlements etc. All these types of land uses are strongly connected with water and may influence on water hydrological regime as well as water quality. Therefore, the water management of wetlands in terms of protection of drinking water quality and quantity is essential.
Among many measures, best practices or management options on wetlands, creation, restoration and enhancement of natural as well as artificial wetlands are crucial to protect and provide an adequate quantity and quality of water resources within the processes of climate change adaptation. In term of planning the creation and/or restoration of existing wetlands, it is necessary to pay attention to the meaning and functionality of the measure itself.
The placement of additional ecosystems (i.e. wetlands) in the environment with natural self-recovery may cause the deterioration of the environmental conditions.

In the context of the creation, restoration and enhancement of the condition of wetlands to ensure the proper status of the water resources (potential drinking water) the following measures are needed within different environments:

- preservation and revitalisation of wetlands on floodplains (Figure 6),
- creation and maintenance of riparian wetlands (Figure 7),
- establishment of constructed wetlands for water treatment (Figure 8).

Figure 6: Flooded area of Ljubljana moor (www.ljubljanskobarje.si)

Figure 7: Riparian area along the stream on Ljubljana moor (www.ljubljanskobarje.si)

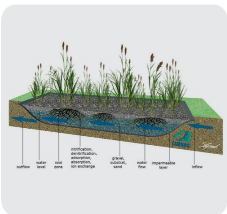


Figure 8: Schematic cross-section field constructed wetland (www.limnos.si)

The most important functions of these measures are to assure the appropriate water regime of the particular area and to maintain the quality status of water. They cover all main factors (water provision, water quality and water quantity regulation) that are important for the general healthy state of the environment.

Grassland Ecosystems

Management of grasslands with respect to ecosystem services for drinking water resources has three basic objectives:

- restoration or establishment of grasslands in different safeguard zones of drinking water protected areas according to legislation and recommendations,
- maintenance of grasslands in good, stable status able to provide ecosystem services within the protection zones and beyond
- control of the use of chemicals and manure in order to avoid pollution and to safeguard natural purification capacity.

In the inner and outer safeguard zones natural management of grassland is the appropriate option, even if it was established by restoration. In extended protection zones or in other recharge zones there is no special request, any management goal (natural, agricultural, sport and leisure) can be applied in harmony with landscape management, with the corresponding good practices.

Good practices depend mainly on the management goal and at less extent on the regions defined by climate and topography.

Nevertheless, the following group of good practices is valid for all goals (except artificially established and maintained parks, sport and leisure areas):

- promoting regeneration, even in case of meadows or pastures, where human exploitation may periodically need sowing
- removing invasive species for improving stability
- promoting species which are adaptive to climate change
- chemical weed control only if really needed and under strict rules
- burning in very exceptional cases only
- local management plans considering appropriate water and nutrient balance and respecting the rules for the use of chemicals

In case of natural grasslands some of the previous requirements are stricter, e.g.

- enhancement of the ability of self regeneration
- complete removal of invasive species
- only mechanical weed control
- no burning
- no sowing
- no use of fertilizer and no transported manure
- no artificial drainage and promotion of regular but short flooding if appropriate
- in case of semi-natural grassland extensive type of mowing and grazing

Exploitation of grasslands for agricultural goals (forage production and animal husbandry), beside the general prescriptions, involves special best practices for maintaining the dynamic stability of the grassland and so its ability of protecting water resources:

- oversowing only if needed,
- suitable alternation of grazing and mowing
- mowing frequency in harmony with blooming,
- during mowing leaving stubbles for eliminating erosion,
- appropriate treatment of the mowed material,
- local grazing plans: appropriate number and mixing of grazers, frequency of rotations.

Urban parks, leisure areas (recreation and playgrounds) and sports grounds (ski, golf) are artificial sowed or planted grasslands, where maintenance is determined by the utilization of the area regardless of the natural plant community of the region, but respecting the "no pollution principle" while establishing infrastructure and using nutrients and chemicals.

The above listed best practices in grassland management ensure the proper functioning of the favorite ecosystem services of grasslands with respect to protection of drinking water resources, in harmony with the different goal of grassland management, like nature conservation, agriculture or sport and leisure.

Agricultural Ecosystems

Managing agricultural lands is crucial to increase sustainability of agricultural ecosystems and to decrease the environmental damage which may accompany intensive agriculture.

Management options that promote sustainable agricultural activities could help to protect and enhance the quality of water resources, have several objectives:

- to reduce the application of nutrients and chemicals to agricultural land and optimize the use of fertilizers and pesticides
- to improve soil structure and fertility, thus reducing the risk of nutrient leaching and sediment loss
- to reduce risk of surface run-off and erosion, thus reducing the transfer of pollutants from agricultural land to watercourses
- to optimize the use of water and improve water availability

Land use changes measures – such as afforestations or conversion to grassland (suitable for marginal and high erosion risk arable land), or increasing the heterogeneity, biodiversity and mosaic-like character (e.g. hedges, beetle banks) of agricultural land – improve water balance and reduce the risk of erosion and surface run-off of polluting particles.

Creating buffer strips (grass and/or forests) around watercourses play major role in reducing the amount of diffuse pollutants. They distance agricultural activity from watercourses reducing direct pollution stemming from fertilizers and organic manure additions and can restrict direct livestock access to watercourses. They are also able to intercept surface run-off from agricultural land acting as a sediment trap and filter for nutrients.

Implementation of sustainable cultivation techniques (e.g. reduced/no-till cultivations, cultivate and drill across the slope) can retain soil surface organic matter and preserve good soil structure, improving water infiltration rates and thereby reducing loss risks of particulate phosphorus and sediment.

Adjusting the timing of farm operations, like early harvesting or cultivation of land in spring rather than autumn, reduce soil structural damage risks and associated sediment and nutrient losses in surface run-off. Also, establishment of cover crops in autumn enables the crop to take up nitrogen before the onset of over-winter drainage and provides good vegetation cover over the

winter months protecting the soil from rainfall induced surface run-off and associated erosion.

There are several approaches in agricultural practices which can be used to decrease the amount of nutrients and toxins that enter the soil and lead towards surface and groundwater pollution.

These approaches focus on: decreasing the amount of applied fertilizers (e.g. using a fertilizer recommendation system to plan time and amount of fertilizer applications to all crops), controlling the area and extent of grazing activities, farm slurry management (e.g. installation and improvement of sealed slurry storage capacity to improve timing of slurry applications), organic farming and integrated plant production which promote efficient use of chemicals.

To optimize the amount of water abstracted for irrigation existing systems should be maintained in good condition or converted from open channels to pressured pipe networks respectively upgraded to more efficient ones, i.e. to spray or drip systems.

Water availability could be improved by increasing storage capacity, such as the creation of artificial water tanks (pools, reservoirs, lakes) to enable even distribution of water throughout the year.

Within identified vulnerable areas, especially drinking water safeguard zones, it is of high importance to restrict or even prohibit agricultural activities in order to preserve quality of water resources. Application of chemical fertilizers, pesticides and manure should be limited to adequate amount or restricted completely in these areas.

Grazing should be restricted or at least number of livestock per hectare limited in order to reduce the amount of nutrients reaching the aquatic environment. Creating buffer strips around sensitive areas protect water resources by reducing the impact of nutrients and other chemicals in water.

Framework for National/Regional Action Plan

According to the findings of CC-WARE partners after an overview of national/regional legislations and policies there is a gap between strategic visions and daily practices. Most of the countries have outstanding and strict regulations to ensure safeguarding of drinking water resources, or to manage forests properly, but the implementation of good practices is lower than expected.

Although water suppliers are responsible for drinking water, which should meet drinking water quality standards, they have no influence on pollution sources in the safeguard zones. The European Union and many countries have launched strategic documents (green paper, white paper, Blueprint, Europa2020, etc.) on adapting to climate change. More and more projects are busy to find appropriate solutions for mitigation, thus CC-WARE project exploited the opportunity to find a link between strategic objectives and feasible applications due to the gained experiences.

These findings are condensed into a coherent transnational drinking water management strategy. Hence, the established framework empowers involved countries/regions to produce or improve their own action plans by using the guidance elaborated in CC-WARE.

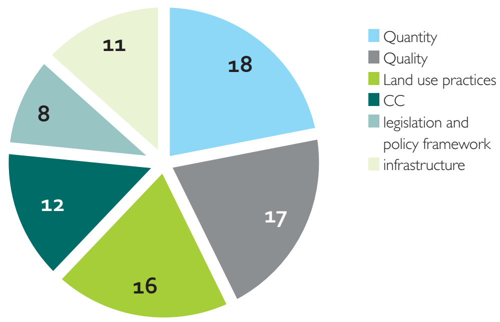


Figure 9: Main drinking water supply issues

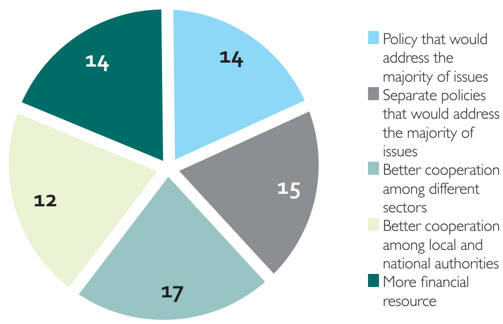


Figure 10: Solutions for cross-cutting issues

Numbers presented in figures are sum of all rankings (1 the most significant, while 5 is the least significant) for the issues and solutions.

Stakeholder involvement by CC-WARE project

During a "Knowledge Transfer Workshop" in Italy (Modena, March 19.–20., 2014) a questionnaire was distributed to gain information about legislation, policies, state/regional institutional structures and main discrepancies not only in EU-countries but also in pre-accession countries.

Based on the feedback provided in questionnaires the most significant drinking water supply issues recognized by stakeholders are exhibited in Figure 9 and the most efficient solutions for cross-cutting issues are depicted in Figure 10.

Water quality is ranked as the most significant DWS issue followed by water quantity and land use practices. With respect to solutions for cross-cutting issues the most significant is policy that would address the majority of issues, followed by better cooperation among different sectors. Answers provided by participants stressed that cross-cutting issues relevant for DWS[1] ESS[2], LU[3] practices and CC[4] should be more integrated, that existing policies and legal framework at national and EU level address cross- cutting issues but improvement is needed.

Even field of expertise among participants is different, majority of them (53%) have moderate knowledge on ESS and ESS role is judged

1 DWS (Drinking Water Supply)
2 ESS (Ecosystem Services)
3 LU (Land Use)
4 CC (Climate Change)

Figure 11: Participants feedback on specific topics for cross cutting issues

TOPIC	ANSWERS (%)		
Familiarity/ knowledge with ESS	37 Comprehensive	53 Moderate	11 Deficient
Ecosystems importance for DWS	72 Significant	22 Moderate	6 Insignificant
More integrated ESS, DWS, LU and CC cross cutting issues	95 Yes	0 No	5 Neutral
ESS, DWS, LU and CC cross cutting issues addressed by EU legal framework & policies	21 Yes	63 Yes, with improvements	16 No
ESS, DWS, LU and CC cross cutting issues addressed by national legal framework	12 Yes	47 Yes, with improvements	41 No
Familiarity/ knowledge with CC impact on WR[5]	55 Comprehensive	35 Moderate	10 Deficient

(72%) as important for DWS within South Eastern Europe. Climate Change impact on Water Resources awareness is evident e.g., over 50% of participants have comprehensive knowledge and 35% rated their familiarity as moderate. Integrated approach (95%) rather than sectoral (5%) is crucial for cross cutting issues with respect to ESS, DWS, LU practices and CC according to provided answers.

Approximately 21% of participants estimate that the existing EU legal framework reflects cross cutting issues while majority of them (63%) underline the necessity for improvement. On contrary, 16% of them judged that existing framework do not consider cross cutting issues.

Diverse actors and actions are indicated to be significant for the improvement and integration of DWS, ESS, LU and CC at national level, e.g. governments (national and local), funding, political will, capacity improvement, water suppliers, better application of the existing policies, appropriate subsidies, improved monitoring, national water strategy that would address cross cutting issues deliberated within the scope of CC-WARE, etc.

With respect to DWS, ESS, LU and CC participants indicated following topics they would like to be more familiar with: how to implement at local level, CC and water management (supply and protection), impact assessment on ecosystem management, how to reduce impact on water resources and ESS, more comprehensive economic measures for ESS, etc.

Some of additional comments suggest that results of CC-WARE project might be useful for the next RBMPs[6]. Finally, all participants – except one – rate this type of workshop as very useful.

Feedback provided by participants on significant topics for cross cutting issues within the scope of CC-WARE project reveals necessity for legal framework improvement.

In summary, based on the questionnaires outputs the problems identified in CC-WARE project are significant for DWS, ESS, land use and CC in the SEE, and beyond.

5 WR (Water Resources)
6 RBMP (River Basin Management Plan)

Guidance to prepare National/Regional Action Plan

Based on the results of the previous work steps (vulnerability assessment and possible adaptive management measures) within this and former projects a proposal on an integrated trans-national strategy for drinking water protection under climate change in SEE countries was developed as "CC-WARE Strategy". To facilitate the national/regional strategic planning process a possible methodology for the implementation of a respective action plan on national/regional level is outlined in this guidance.

It is hard to achieve anything without a plan. Whether we are driving through a known city, cooking for a party or running a drinking water supply system, we need a "strategic" plan. A good action plan considers all things and focuses on priorities. It also helps governors or policymakers determine where to spend or invest more time and money, strengthen human capacities.

Developing a strategic plan might seem like an overwhelming process, but if you break it down to a few steps, it is easy to tackle. There are many approaches for strategic planning processes, but most of them are cyclic. In this guidance we unfold planning process into 5 steps.

1st step: situation analysis

Determine where you are!

There are a lot of useful tools for strategic planning like SWOT analysis (Strengths, Weaknesses, Opportunities and Threats), the Problem Tree Analysis or DPSIR (Driver-Pressure-State-Impact-Response) scheme relating human activities to the state of the environment. The analyzer should pay attention on natural, social, economical, institutional and legislative situation as well. Horizontal principles, i.e sustainable development, equality should also be appraised.

Information and data on existing legal framework and policies within the scope of CC-WARE project at EU and national/regional level were gathered. Analysed outputs, gaps and recom-mendations are valuable inputs to significant transnational issues with respect to drinking water supply, including management of land use and ecosystem services (ESS) and taking into account the impact of climate change.

Despite the great number of EU directives, international conventions, and various legislation at national level, numbers of issues and gaps still exist with respect to DWS, ESS, LU and CC.

Although the services of ES are im-portant for drinking water supply and protection existing legal framework is deficient in interlinkage among them. The same applies to climate change and land use practices. Figure 12 below exhibits summary approach applied in legislation and policies assessment.

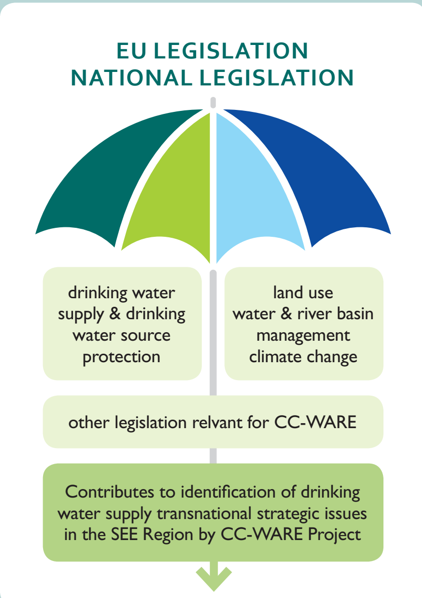


Figure 12: Summary on legislation assessment within the scope of CC-WARE (adapted after: Relevant legislation analyses for improvement of land use and water management regulation and policies within the scope of CC-WARE project – joint report WP 4 (act.4.1) and WP 5 (act.5.1), 2014)

Despite the transposition of targets defined in EU Water Framework Directive into national legislation, the full implementation of protection measures are indicated due to utilization demands, lack of funding, discrepancy with national legal framework, coordination and harmonization among different sectors, etc.

In majority of countries the drinking water protection legislation is not implemented properly, like illegal development within the water safeguard zones perimeters, existing legislation of significance for drinking water sources is not unitary and practical implementation might be confusing. Although, climate change is addressed in different national documents there are gaps that should be solved.

Diverse and numerous legislation and polices are recognized as significant for land use by project partners, however, interlinkage is not always comprehensive. With respect to ESS and water management, deficiencies in integrated and common approaches are identified. As an example, the Water Protection Plans do not include details regarding how to account for climate change and the role of ecosystem services.

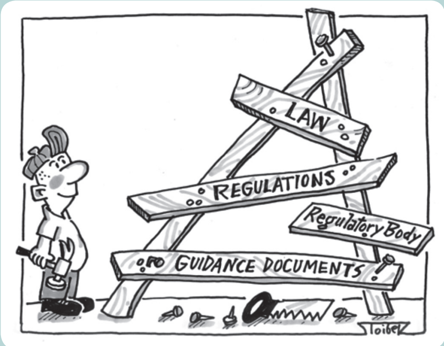
The new policies are rarely assessed with respect to practical implementation.
In addition, the opportunity exists by coupling specific issues that would generate better results and interlinkage.

Among other issues and gaps at EU level the preventive environmental risk management in drinking water supply systems does not exist. Moreover, EU BLUEPRINT III Impact Assessment indicated insufficient use of economic instruments, lack of support for specific measures, poor governance, and knowledge gaps in EU legislation.

As a result of Legal Framework assessment within the scope of CC WARE project, an improved, more applicable legal framework integrating specific subjects of relevance for drinking water supply (DWS), ecosystem services (ESS), land use (LU) , climate change (CC) is needed.

Open questions that still persist are:

- Do we regulate too much?
- Do we need just improvement of existing legal framework?
- Do we need new legal framework and and plicies?



2nd step: vision statement

Identify what is important!
From this analysis, you can determine the priority issues that the strategic plan should focus on. Statements of vision tend to be quite broad and can be described as a goal that represents an inspiring, overarching, and emotionally driven destination.

The CC-WARE vision statement is that **drinking water in sufficient quantity and quality will be available for the whole population of the SEE area.**

Taking into account the strong commitment for implementing WFD, it is assumed that all principle aims of the WFD will be achieved under climate change as well, among them those related to drinking water supply.

- **Sustainable use of water resources,** which means the consideration of ecological water demand – essential for enhancing the role of ecosystem services in water management.
- **Healthy drinking water for the population,** which implies to comply with all quality standards: drinking water quality, surface water quality used for drinking water supply.
- As a basic element of the precaution, water bodies providing drinking water should be considered as **protected areas** or protection zones shall be designated.
- Need of **regular monitoring** of the quantitative and qualitative status inside protected areas.
- The **deterioration of the water resources is not allowed.**
- Safe operation of the water works is supported by the application of **cost recovery principle,** which allows considering the costs of the maintenance and the protection as well.

3rd step: goals to achive

Define what you want to achieve!
Define the expected objectives that clearly state what you would like to achieve addressing the priority issues. Most of strategic objectives are

- Measurable: There must be at least one indicator (or yardstick) that measures progress towards fulfilling the objective.
- Specific: This provides a clear message as to what needs to be accomplished.
- Appropriate: It must be consistent with the vision and mission of the institution.
- Realistic: It must be an achievable target within the organization's capabilities and opportunities in the environment.
  In essence, it must be challenging but doable.
- Timely: there needs to be a time frame for accomplishing the objective.

The task of CC-WARE project is to find transnational issues and look for integrated solutions to achieve common objectives through SEE region. In this section the difference between transnational and transboundary terms would be clarified.

Transnational issues: occur similarly in several countries.

Transboundary issues: e.g. in case a river builds the border of countries, occurring problems are common, or the border crosses river, lake or groundwater body and the upstream country significantly influences the quantity or the quality of the shared surface and/or groundwater resource.

Transnational issue: On the following map the highly productive fissured (including karst) aquifers (by IHME1500[7]) are highlighted due to CC-WARE findings. Common problems are temporary water shortages during droughts and pollution

7 IHME 1500 – BGR & UNESCO (eds.) (2014): International Hydrogeological Map of Europe 1 : 1,500,000. Digital map data v1.0. Hannover/Paris.

trough bacteria and turbidity of drinking water caused by torrent rainfalls. Both are already observed in the last decade in several countries of SEE region and expected to be more frequent due to increasing meteorological extremes related to changing climate.

Transboundary issue: The map shows the transboundary groundwater bodies (GWBs) of Danube basin-wide importance by ICPDR[8] Maps of the Danube River Basin District Management Plan 2009. These GWBs have different hydrogeological characteristics, significant problems and status, etc. In some cases transnational and transboundary aquifers/GWBs are overlapping.

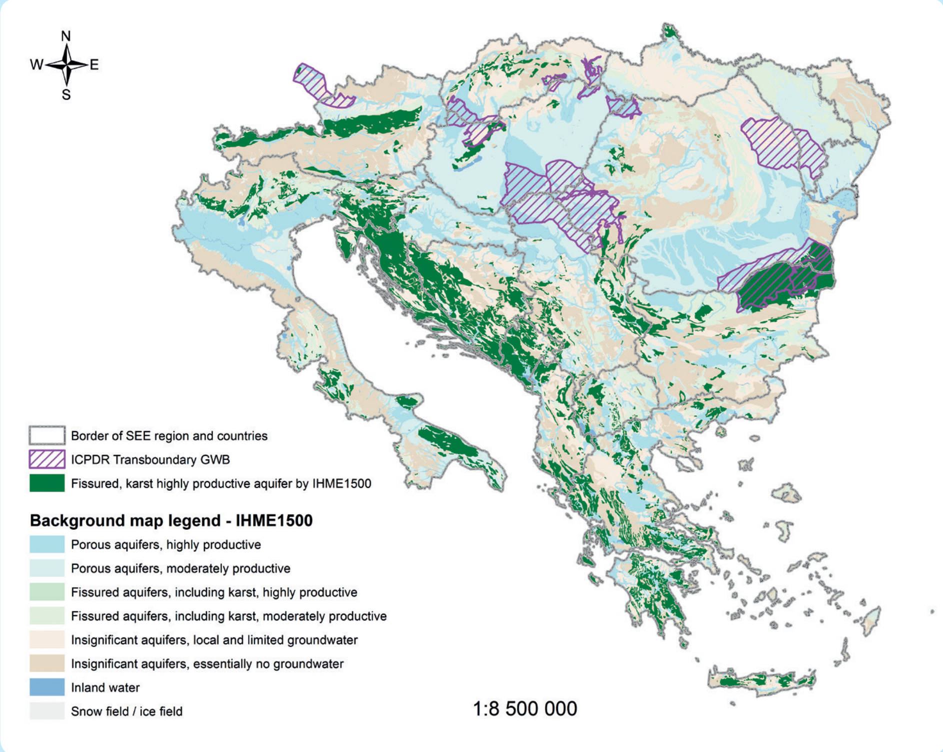


Figure 13: Transnational and transboundary aquifers in SEE region according to IHME1500 and ICPDR

8 ICPDR – International Commission for the Protection of the Danube River/www.icpdr.org

4th step: roadmap of actions

Determine the roadmap!
This is how you are going to get where you want to go. The conceptions, strategies, action plans, and budgets are important milestones in the process that effectively communicates how you will allocate time, human resources and money to address the priority issues and achieve the defined objectives.

5th step: review results

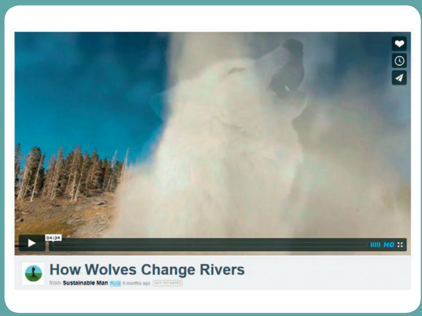
To ensure that your plan works as it was designed, you should monitor indicators and regularly hold scheduled formal reviews of the process and refine when necessary. In case of a strategy to adapt to climate change this step should be emphasized, because of uncertainties of future climate scenarios and missing knowledge about several natural processes.

A good national/ regional action plan should

- be consistent with the selected thematic objectives (the actions are reflecting the identified national or regional challenges and needs and are in line with the Europe 2020 objectives and targets);
- be internally and externally coherent (the causal links between the different actions will lead to the expected outputs, and these outputs are effectively helpful to reach the planned results);
- meet horizontal principles (steps are made to meet equality between men and women as well as prevention of discrimination and to consider cross-cutting principles of sustainable development).

Although CC-WARE project will not have the chance to check the performance, as the project objective is only to establish a framework for action plans but not a "real" strategy, it will support the Danube Region Strategy and take into consideration the EU Water Framework Directive, the EC White Paper on Adaptation to Climate Change, the EC Communication on Water Scarcity and Droughts, EC Blueprint to safeguard Europe´s waters and the Europe 2020 strategy as well.

Watch the George Monbiot video on How Wolves Change Rivers by Sustainable Man: http://vimeo.com/86466357



When wolves were reintroduced to Yellowstone National Park in the United States after being absent nearly 70 years, the most remarkable "trophic cascade" occurred. What is a trophic cascade and how exactly do wolves change rivers? George Monbiot explains in this movie remix.

Think about!

- Phrase of John Muir: "When we try to pick out anything by itself, we find it hitched to everything else in the Universe."
- Why is this case important from CC-WARE point of view?
- What is the link between this video and reviewing of action plan?

Partners supported by the European Regional Development Fund (ERDF)

Lead Partner BMLFUW
Federal Ministry of Agriculture, Forestry, Environment and Water Management
Forestry Department
Vienna, Austria

Project Partner 1 MA 31
Municipality of the City of Vienna
Municipal Department 31 – Waterworks
Vienna, Austria

Project Partner 2 MWY
Municipality of Waidhofen/Ybbs
Waterworks
Waidhofen an der Ybbs, Austria

Project Partner 3 UNILJ
University of Ljubljana
Ljubljana, Slovenia

Project Partner 4 JP VO-KA
Public Water Utility Ljubljana JP Vodovod-Kanalizacija d.o.o.
Ljubljana, Slovenia

Project Partner 5 NeKI
National Institute for Environment
Budapest, Hungary

Project Partner 6 ROMSILVA
National Forest Administration
Bucharest, Romania

Project Partner 7 NMA
National Meteorological Administration
Bucharest, Romania

Project Partner 8 EFA
Executive Forest Agency
Sofia, Bulgaria

Project Partner 9 EYATH SA
Thessaloniki Water Supply and Sewerage Co sa
Thessaloniki, Greece

Project Partner 10 DAMT
Decentralised Administration of Macedonia and Thrace,
Water Directorate of Central Macedonia
Thessaloniki, Greece

Project Partner 11 ARPA ER
Regional Agency for Environmental Protection in the Emilia-Romagna region
Bologna, Italy

10% Project Partner 1 HEIS
(sponsored by ERDF budget)
Hydro Engineering Institute
Sarajevo, Bosnia and Herzegovina

10% Project Partner 2 HGI-CGS
(sponsored by ERDF budget)
Croatian Geological Survey
Zagreb, Croatia

10% Project Partner 3 South RDA
South Regional Development Agency
Cimislia, Moldova

Partners supported by the Instrument for Pre-Accession Assistance (IPA)

IPA Partner 1 IJC
Jaroslav Cerni Institute for the Development of Water Resources
Belgrade, Serbia

Associated Strategic Partners

EU ASP 1 NIHWM
National Institute of Hydrology and Water Management
Bucharest, Romania

EU ASP 2 SEA
Ministry of the Environment and Spatial Planning –
Slovenian Environment Agency
Ljubljana, Slovenia

CC-WARE and South East Europe (SEE).

The South East Europe programme (SEE) is a unique instrument which, in the framework of the Regional Policy's Territorial Cooperation Objective, aims to improve integration and competitiveness in an area which is as complex as it is diverse.

The programme is supporting projects developed within four Priority Axes: Innovation, Environment, Accessibility, and Sustainable Growth Areas - in line with the Lisbon and Gothenburg priorities, and is also contributing to the integration process of the non-EU member states.

More information about CC-Ware and SEE

www.ccware.eu

www.southeast-europe.net