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Drought in the Mediterranean

Recent developments

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Authors: Dorothea August and Martin Geiger (WWF Germany)

Editorial staff: Buket Bahar Durmaz (WWF Turkey), Francesca Antonelli (WWF Mediterranean Programme Office), Martin Döpke (WWF Auen-Institut Germany), Panagiota Maragou (WWF Greece), Sara Gillet (WWF France), Sergey Moroz (WWF European Policy Office), Meryem El Madani (WWF Mediterranean Programme Office, Morocco), Marianna Karivali (WWF Greece), Galena İş, (WWF Turkey), Alberto Fernández Lop (WWF Spain), Lucia de Stefano (WWF Spain)

Contact: Martin Geiger, WWF Germany, geiger@wwf.de; Dorothea August, WWF Germany, august@wwf.de

Layout: Astrid Ernst, Text- und Webdesign, Bremen

Cover photos: © Isaac Vega / WWF Spain

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Executive Summary

In 2006 WWF published a first report about drought events and their consequences in the Mediterranean region, and called for action to address the problems related to water management and policy in those countries.

However, drought effects have continuously aggravated over the past two years with more severe impacts on natural resources and biodiversity as well as human wealth and economy. Different reports and information available confirm this trend towards growing water scarcity in the region, which together with the accelerated climate change poses a serious economic, social and environmental challenge in the short and medium term future.

Neither EU legislation especially WFD, nor scientific assessments and international instruments such as UNEP "Plan Bleu", Barcelona Process or the Mediterranean Strategy of 2005 were able to improve significantly water and natural resource management.

The use of water in irrigation agriculture doubled in the second half of 20th century and is further growing, while little was done to improve irrigation efficiency. Regional land and resource use plans to stop overexploitation and landscape degradation were also not made available nor implemented. Ongoing management both in agriculture and in other sectors is often based on illegal water use and groundwater extraction on large scale, where it directly affects the hydrological situation. Large water infrastructures such as dams and reservoirs are still considered as major management tools, but can't cope with both increasing water demand and the reduced availability triggered by climate change. In addition, water transfers, both national and international, are also gaining importance. Another recipe applied are desalination plants, which are regarded as the main technology to solve supply problems for all sectors. All these technological solutions are helping to mitigate symptoms, but only in very few cases can cure the underlying problems of water scarcity and water mismanagement.

Both, water quality and quantity are at stake. Deficits in water management are leading for example especially in Northern Africa to water pollution and the continuous degradation of the water dependent ecosystems. Already now 30 million people in the Mediterranean don't have access to potable water according to the UNEP's "Plan Bleu", which means that we can foresee increasing pressure from growing population demands and market needs in Northern Africa.

WWF calls for immediate action from governments, private sector/ companies and funding institutions and more awareness and sensitivity of consumers at the other side. Performant and rigorously applied law enforcement is urgently needed. A demand driven management planning, cost-effective water pricing across all sectors and comprehensive need assessments for desalination plans, water transfers and irrigation planning is necessary, before any major decision on the construction of infrastructure or any additional water use is licensed or approved.

Currently much attention is given in the European policy to develop a specific water scarcity and drought policy and strategy for the Mediterranean countries, rather than to focus on effective implementation and enforcement of already existing and well conceived regulations, like the Water Framework Directive or the environmental guidelines of the Common Agriculture Policy, applied to EC subsidies. The European Commission and the national and regional Governments should not give way to shortterm driven sector driven policy demands.

1 Introduction and Definitions

According to various assessments the 2005 drought period was considered the worst ever affecting the Mediterranean region until then. WWF analysed the situation of the drought 2005 to 2006 in a study published in July 2006. Since then very little was done to tackle in an integrated manner the consequences and impacts of droughts in the field of water and land management and thus impacts caused by drought of either origin are continuously accumulating and still worsening the situation in the Mediterranean region.

1.1 Rationale and Baseline of the Report

Drought is a normal, recurrent feature of climate although often erroneously considered an unexpected and extraordinary event. The origin of every drought is a reduced precipitation over an extended period, usually one season or more. As a consequence of climate change, rising temperatures and decreasing precipitation in many parts of the world are increasing the frequency and severity of drought events.

Operational definitions distinguishing between meteorological, agricultural, hydrological and socio-economic drought can help to identify a drought‘s beginning, end, and degree of severity.

Water scarcity is a permanent characteristic of chronic water deficit as a result of human water demand and activities.

Drought is a natural hazard and as such cannot be fully controlled or prevented, water scarcity, on the other hand, can often be alleviated by changing water management practices and balancing water demand with water availability.

The current dry weather conditions and the over-time accumulating effects of drought in the Mediterranean are again leading to extremely high cost and heavy impacts in 2008. Combined with the lack of real action from the European Commission, the Governments concerned and the regional and local authorities, WWF considered it necessary to review the current situation and to provide an update of our 2006 report. The aim of the report is to help waking up the decision makers at various levels to take their long-term “water future” into their hands.

This WWF study exemplarily analyses the situation of 5 Mediterranean countries, namely France, Greece[1], Morocco, Spain and Turkey (Figure 1), which are affected by water scarcity and droughts. The report takes both an agricultural and a climatic point of view. Even though this report does not want to provide an exhaustive assessment and does not pretend to be a complete survey for the Mediterranean basin, its aim is to showcase existing and in particular in the near future happening water challenges in the region, requiring immediate attention. If they are not properly addressed, droughts and thus water scarcity will develop into a chronic “disease” spread amongst many countries, with extremely high costs for the societies and economies concerned.

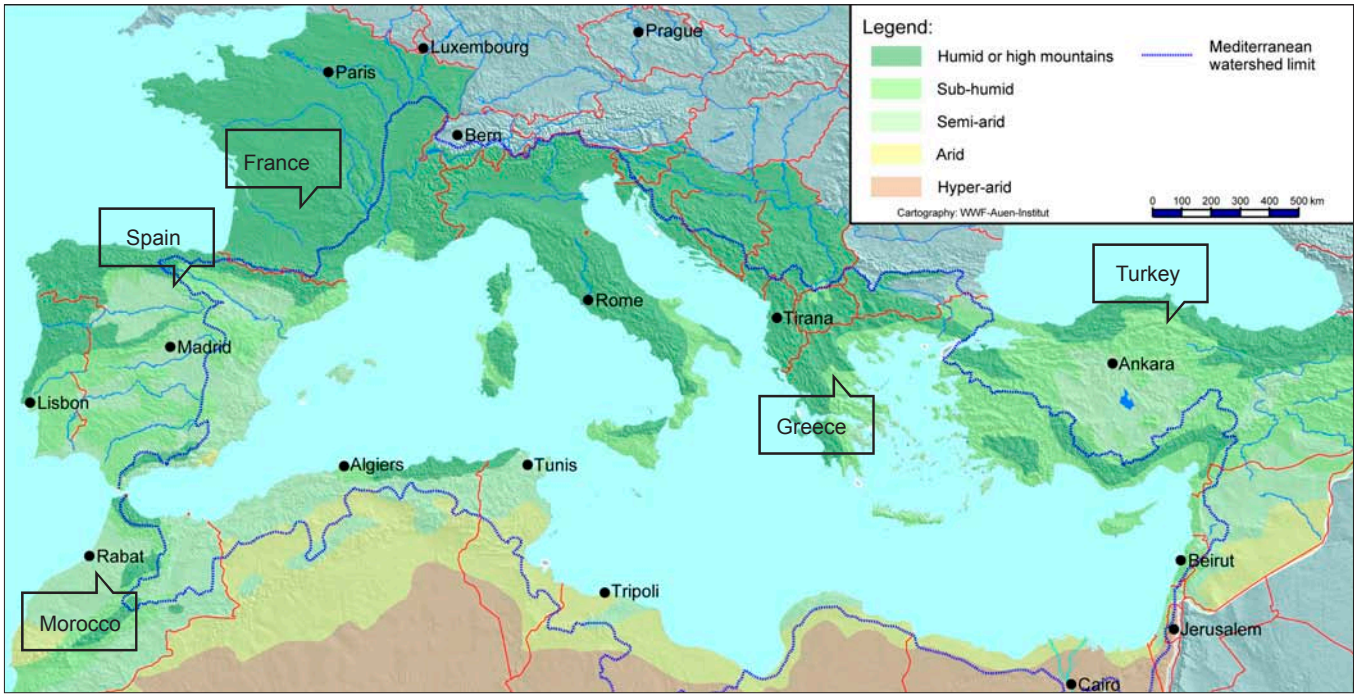


Figure 1: Mediterranean countries considered in the 2008 drought report © Martin Döpke / WWF Germany

This year assessment sets the focus on the agricultural sector as main water user and a key driver for the construction of water infrastructure for irrigation and hydropower purposes. These infrastructures are responsible for considerable changes in the water and sediment flows and the river and groundwater dynamics, which are summarised by the technical terminology of hydromorphological alterations. These changes have long lasting impacts on water quality, quantity and future water use opportunities, as well as on rivers, lakes and wetlands. This report does not want and cannot replace extensive data collection required, because this is an elementary task of the water management and environmental authorities in those countries, as well as the European Commission for the overview.

Given these parameters and conditions the report uses publicly available material and experiences from WWF project work to evaluate both the impact of droughts and mechanisms set up to cope with it since first report in 2006.

1.2 Missing change in drought management

Key messages of the former WWF Drought report from 2006 were the following four findings:

1. Drought is a natural phenomenon in the Mediterranean and will appear more frequently.
2. If water is not managed wisely, both in rainy and in dry years, drought will become ‚chronic' (water scarcity) and its impacts will increase
3. Key examples of unwise water management are the increased irrigation in agriculture due to subsidies in EU countries, while for non-EU countries it is the low efficiency in irrigation.
4. To avoid drought becoming chronic, governments have to engage in a three fold approach: a) manage demand, b) increase efficiency, and c) apply integrated and sustainable water management. Just increasing water supply without going first through step one to three is not an option.

A review of the current approach to droughts in the Mediterranean shows that these four former findings from 2006 are still fully valid and applicable today and that the prolonged drought has led governments to heavily promoting two additional technical solutions to increase water supply: new water transfers and desalinisation plants. New desalination plants are being planned and constructed in order to rapidly solve water supply bottlenecks and to secure water supply services. The planning of new water transfers is meant to ensure public water security too. Both technical solutions, however, often fail to meet the requirements of an integrated water resources management in line with European legislation and other international treaties, e.g. in terms of full cost recovery of the water services or the maintenance of suitable in-stream flows in the donor areas of the water transfer. For example, most recipient areas have not shown yet any best practice in water management efficiency and water savings, careful integrated planning of water use for various economic sectors or a serious commitment to eradicate illegal use of water.

That shows that drought effects do not only depend on meteorological parameters, namely precipitation and temperatures, but are very much influenced in their frequency, duration and intensity by human water management practices developed over decades and approved by legislation.

2 Drought situation and management approaches

The detailed knowledge of water resources, their management and use are the baseline to understand the interactions between the identified factors for increasing severity of droughts and consequent impacts in the Mediterranean region.

Droughts are not just a matter for water sector managers. They have a direct impact on citizens and a wide range of economic sectors which use and depend on water, such as agriculture, tourism, industry, energy and transport. Water scarcity and droughts also have broader impacts on natural resources at large through negative side-effects on biodiversity, water quality, increased risks of forest fires and soil deterioration, in many cases even leading to desertification.

2.1 Water consumption in general

The picture drawn down from available data on water use patterns (Tab. 1) shows water distribution and allocation by sectors and thus provides a first indication of where drought effects and its severity can be influenced by changing water consumption in future towards an integrated management system in the considered countries.

Agriculture is the most water consuming sector in all the surveyed countries except for France (because only 20% of France surface are in the Mediterranean zone). For this reason agriculture is the most vulnerable to drought and thus the economic sector on where it is necessary to act in order to modify current water consumption trends.

As shown by the following Tab. 2, the share of households (between 3 and 15 % of the total water consumption) is quite small. This share seems to be stable in Northern Mediterranean countries, but may further increase in North African countries.

2.2 Assessment of drought affected areas

Agriculture is an important economic sector in the whole Mediterranean. Developing markets and growing population leads to more intensive production, which again increases the dependence on irrigation schemes. The extension of irrigated agriculture and their water management determine the impact of drought events in the region.

France

The Rhone-Mediterranean basin is the French part of the biogeographically Mediterranean region. It covers little less than one fourth of the territory of France (23%) with an overall population of 14 millions people (Tab. 3).

Already in May 2008 temperature up to 3°C higher than normal was measured in the region. While the aquifers and rivers in same parts in the upper Rhône basin profit from some rain in May, in the northern zone of the region river levels were already low, though the situation in south-western Languedoc-Roussillon was different

Tab. 1: WWF country information about water consumption by sector

Country	Percentage of water consumption from total		
	Agricultural use	Urban/ domestic use	Industrial use
France	35 (15)	42 (18)	23 (10 + 57 energy)
Greece	86	11	3
Morocco	92	6,9	1,1
Spain	79	16	5[2]
Turkey	72	18	10

Tab. 2: domestic water consumption and total losses

Country	Drinking water consumption in l/d/capita	Total in million m³	Lost due to leaks in %[3]
France	n.a.		
Greece	175	6,833	40
Morocco	n.a.	8,405	50
Spain (2005)	166[3]	4,873	18[4]
Turkey	200[5]	5,300[2]	50[6]

Tab. 3: Water consumption in France in general according to France métropolitaine

In millions m³ and %										
	Drinking water		Industry		Irrigation		Energy		Overall utilisation	
Surface water	2 275	38%	1 903	58 %	3 886	75%	19 225	~100 %	27 289	81%
Groundwater	3 743	62%	1 383	42%	1 262	25%	37	~0%	6 425	19%
Total	6 018	100%	3 286	100%	5 148	100%	19 262	100%	33 715	100%

In June first restrictions to water use were set in a number of departments (DPM, districts). Two DPM approved specific drought action plans in spring 2008. The other 23 DPM in the Rhône-Mediterranean basin are benefiting from the drought framework decree issued in 2007.

Following the monthly information service 6 out of the 25 DPM were under special observation regarding water restriction measures in early June, followed by further alerts from others. At least in one of the DPM with drought action plan (Var) the warning level of the situation has moved from continuous observation over winter and spring to a more critical level. Most affected are so far the catchments of Sègre, Tech, Têt and Agly in the DPM Pyrénées-Orientales, which are rated on crisis since mid may.[7]

Greece

The drought of 2007 in Greece was marked by severe meteorological conditions. According to the last survey (October-March 2007), the indices of the National Technical University of Athens (NTUA) show that the areas that are in a middle of a drought period are East Thessaly, East Sterea Ellada, East Peloponnisos, Kyklades islands and Northeastern Crete. Drought seems to be more intense in Thessaly, Sterea Ellada and Peloponnisos and less severe in Kyklades and Crete.

More specifically, 2006-07 and 2007-08 are considered semi-dry years for Attiki (the area surrounded Athens). Due to this reduced precipitation, the replenishment of the groundwater reservoirs, has been reduced at a rate of 25%. Similar to this a decrease of 5-7% of the groundwater level has been recorded during the period 2006-07 in Thessaly.

Generally, it is observed that Thessaly and some areas of East Sterea Ellada are more vulnerable to severe droughts (Tsakiris, 2008). This concerns a landscape with large agriculture coverage, facing water scarcity problems which are again associated with inadequate management of water resources.

Morocco

The individual water consumption depends very much on the region: staying below 500m³/hab/year in Sahara region, as well as the south-Atlas regions Souss-Massa and Tensift and going up to until 800 m³/hab/year in the catchments of Sebou, Loukkos, Tangérois and along the Mediterranean coast[8]. Forecasts from the national water plan are seeing the natural resources disposable per person decreasing and reaching a threshold near 500m³/person/year in 2010 already.

According to the National Drinking Water Agency (ONEP)[9] drinking water for urban centres is drawn to 64,4% from surface water, 35.3% groundwater and 0.3% seawater desalination plants. Further to this, further quantities up to 50% have to be somehow compensated, which are lost due to obsolete and badly maintained pipe system for distribution and allocation (Tab. 2).

Picture 1: Parched Distos Lake at the Greek island Evia (Region of Stera Ellada) © K. Paragamian / WWF Greece

Spain

The current drought cycle lasts since hydrological year 2004-2005, and affects different areas of Spain with different intensity. In particular, the Upper Tagus River Basin, the Guadalquivir, the Jucar river and its tributaries have experienced their fourth consecutive drought year. At the beginning of spring 2008 the Catalan basins experienced a relatively short but very severe emergency since the water reserves available implied that water shortage was very likely occur in autumn in Barcelona. The peak of emergency in this hydrological year was in February 2008.

Restrictions have been set both to the irrigation and the urban supply sectors. In agriculture, the water authorities had to set strict limits to the water resources available for irrigated agriculture in the areas affected by the drought. In several urban areas, e.g. Barcelona, Girona, Malaga, Segovia, Valencia, local authorities issued special orders to limit the water use for complementary activities, such as filling in private swimming pools, street cleaning or garden irrigation.

Spring rains have significantly improved the situation for most of the country, making it possible to rule out any possible urban water shortages in the autumn in Catalonia and to apply lower restrictions to agriculture in the above mentioned river basins during the current irrigation season.

Turkey

In terms of meteorological drought Turkey had the largest decrease in precipitation in the Southeast Anatolian Region, where it dropped by 44%, in Eastern Anatolia Region by 18%, and 15% in Mediterranean part of Turkey.

Further to the fact that agriculture is the most important user of water of all sectors (72%), the main problem in agricultural water use is related to the efficiency of irrigation methods. On only 6% of the total irrigation area the water efficient sprinkling and drip irrigation technologies are used[10], in the majority of fields (94 %) there is inefficient and highly water consuming surface irrigation. (see Tab. 5)

Uncontrolled groundwater extraction is prevalent in regions where agricultural irrigation and industrial production is intense (Central Anatolia, Marmara, Aegean, and Thrace). By April 2008, 92,000 wells were identified in Konya Basin by a study of which 66,000 are illegal[11]. In a period of 33 years, a decrease of 14.3 meters in the groundwater level in Konya Basin has taken place, with 80% of this fall during the last 10 years[12]. 46.9% of the water supplied to Organized Industrial Zones of Turkey was drawn from groundwater resources[13]. (2.5)

Secured urban water supply systems are a very challenging task for Turkey, whose population increased from 28 million in 1960s to 68 million in 2000. By 2030, Turkey's population is expected to reach 100 million to be supplied under water scarce conditions with by that time drastically reduced natural water reserves.[14] Several wetlands are used as sources of drinking water such as Beyşehir Lake, Eğirdir Lake, Uluabat Lake and Sultan Marshes.

According to the 2004 "Municipality Drinking and Utility Water Basic Indicators Results" the average drinking and utility water network loss, calculated as the difference between the amount of water supplied to the network and that received by the end-users, was at an incredibly high loss rate of 55%[15] and remains without any improvement until today. Most of the problems in urban areas are concentrated in slum areas. Providing drinking and potable water to these areas is harder and more expensive compared to similar investments directed towards areas where development, settlement and construction plans are being implemented.

Droughts affected water availability in reservoirs substantially especially for the big cities. The two major cities, Ankara and İstanbul, are mostly affected by the recent and drastic droughts, because of the small water storage rate of the reservoirs, being far below the already scarce water resources last year. (2.6)

2.3 Main Environmental and Economic Implications of Droughts

2.3.1 Environmental Implications

Currently a coherent monitoring scheme for drought effects on the environment across the region is missing. Drought records are mainly based on meteorological parameters and hydrological data, such as groundwater level and recharge, eventually flows as well. Impacts and consequences for vegetation patterns, population developments of either mammals, amphibians, birds or others are not directly registered and there is no feedback loop to meteorological and hydrological information. In recent years some report schemes, such as for droughts were developed by the European Union, ministered by the European Environment Agency[16], but only few countries did support it at all and when they do, in many cases it is with poor and incomplete data. Thus it is difficult to assess the direct impact of decreased flows and floods, deterioration of water quality and changes of river dynamics immediately, though some effects are obvious and very tangible, other consequences may occur only after a lag of time. The following examples from Morocco and Turkey just show the peak of the ice berg of environmental implications on surface waters and their ecosystems. The impacts on groundwater is less known, though likely equally or even more severe.

Morocco

In Morocco about 70million m³ of waste water are reused in agriculture without considering any sanitary standards/ aspects[17] every year. Especially around major cities untreated water is being reused, due to the strong concentration of populations, the lack of waste water treatment facilities and the respective demand for basic agricultural products. The archaic way of reutilising untreated water bears the sanitary risk for the riparian populations as well as the pollution risk for the groundwater connected with soil degradation. The Upper Water and Climate Council (CSEC) has estimated the area irrigated by untreated water of vegetables predominantly at 7.235ha.[3, 18]

Turkey

Turkish observations estimate that approximately 1.3 million hectares of wetlands of Turkey have lost their ecological and economic character over the last 40 years due to drying, filling and other interventions to the water systems. Amik, Avlan, and Suğla lakes; Kestel, Gavur, Yarma, Aynaz, Hotamış and Eşmekaya marshes are among the areas affected. All major wetlands are exposed to drying and pollution.[19] Due to decreasing rainfall and overuse of water resources, water levels in most of the lakes, rivers and other wetlands have fallen substantially. Almost half of the famous Salt Lake has dried out due to drought and continuous water withdrawal for irrigation. The same conditions affect the Eregli Marshes and Bafa Lake further worsened by construction of dams upstream. The Beysehir Lake, the largest freshwater lake in Turkey, reached 25 years ago the depth of 24 meters, which is now reduced to just 9 meters.

Situation in Turkey's 12 designated Wetlands of International Importance (Ramsar Sites)

- Sultan Marshes have lost 90% of their water due to overuse of ground and surface water by agriculture.
- Amount of water flowing into Yumurtalık Lagoon is decreasing due to upstream dams.
- Gediz Delta is continuously being polluted by industrial waste water.
- Uluabat Lake is under the pressure of agricultural, industrial and residential water uses.
- Water level has been decreased by 20 meters in Kızören Obrouk.
- Turkey's biggest lagoon, Akyatan Lagoon, is filled with pesticide residues, manure and alluvium.
- Lake Meke, which used to have the depth of 12 meters in the past, has today just the depth of 1 meter.
- Kızılırmak Delta faces water pollution due to agricultural pesticides and untreated industrial waste waters.
- Goksu Delta is being polluted by industrial, agricultural and urban wastes discharged.
- Seyfe Lake is draining due to extensive agricultural and urban use, esp. extensive groundwater extraction.
- Burdur Lake is threatened by industrial pollution and construction of dams preventing fresh water flow.
- Major problem in the Manyas (Kus) Lake is extensive industrial pollution.

2.3.2 Forest and Fires

Mediterranean forests are extremely threatened to fires because of their vegetation and climatic conditions. Over the last decades forest fires increased continuously in their frequency and intensity in the Mediterranean countries and are leading more and more to the degradation of landscape structures, vegetation patterns and ecosystem networks. There are at least 50,000 fires recorded every year, burning in average 700,000 to 1 million hectares of woodlands according to FAO information. Particular concerned are the "EU 15" countries including Greece, Italy, Portugal and Spain. (WWF 2007)[20]

Even if fires are not directly correlated to drought, the high extraction of ground and surface water has partly led to the increase of fires in past years, very much depending on land-use patterns, management conditions, fire prevention planning and implementation of such mechanisms in the respective countries.

Greece

Last summer's fires (2007) were the worst in decades and scorched approximately more than 275,000 hectares of forest and farmland (including protected areas of NATURA 2000 network) (WWF, 2007).

The weather conditions (drought, high temperatures, decreasing rainfalls of 2007, high winds) and the consequent heat wave, as well as the low ground humidity are the main causes of big fires. These are also the causes that led to the big and catastrophic forest fires of the summer of 2007 (Pilio, National Park of Parnis, Peloponnisos) (Tsakiris, 2008).

Furthermore, there is a large percentage of forest fires in Greece that are set due to „unknown causes". Intentional fire-setting with the aim to change land use, accidental fire-setting, no management of forests and accumulation of large quantities of inflammable material, the nature of ecosystems and the type of vegetation are additional reasons that led to forest fires (WWF Greece, 2007).

Turkey

In the period 2003-2007 summer fires scorched approximately 33,340 hectares of forests. Based on the data from General Directorate of Forest, in the last 25 years more than 47,000 forest fires took place and scorched approximately 296,000 hectares of forests.

Due to increasing severity in droughts in 2008 the number of forest fires as well as the area that is affected by the fires seems to be increased. Fire that took place in August in Antalya (Manavgat and Seriv Provinces) scorched nearly 10,000 hectares of forests. This nearly equals the average annual area of forest fires (12.000 ha/year). Moreover, 2,500 hectares of forests have been ruined due to fire in Canakkale, Marmaris, Alanya and Cankiri. At two peak days in August 2008 already 39 forest fire cases have been recorded in whole Turkey. These indicators point to the severity of the droughts and the attention that should be paid to the links between climate change, droughts and natural resources.

2.3.3 Economic Implications in the Agricultural and Water Sectors

Agriculture contributes considerably to regional wealth in the Mediterranean by its share of agriculture in GDP, where it can reach a significant percentage in many regions, notably in Greece and in much of Spain, and peaks at 34.5% of GDP in Thessaly, compared with a European Community average of 2.6%. In addition, there is an important share of employment in the agricultural sector. In the Greek regions of Peloponnese, Western Greece, and East Macedonia and Thrace, agriculture provides more than 40% of employment. The trend in agricultural employment is also fundamental. The high number of small agricultural holdings suggests that in the Mediterranean areas agriculture has a significant role as a social buffer.[21]

The European Commission estimates the overall economic impact of drought events in the last 30 years to a total of 85 billion Euros for the area of the former EU 15 countries. In most recent years an average of 5.3 billion €/ year was reached, with an exceptional cost of 7.5 billion € in 2003. (DG Environment 2007)

Further to the direct losses, additional indirect costs occur due to drought impacts and effects, such as for additional water transport, additional energy needs for cooling systems and overall compensation of deficits caused by droughts.

Budget allocations and investments into emergency measures do not ensure a better implementation of existing legislation, which could contribute to sustainable development and mitigation of drought impacts on long terms.

Greece
Drought, though mentioned as one of the "natural extremes" that may justify subsidies to farmers has, not actually been accounted for and recorded and no specific agricultural insurance was provided until 2007.

According to the European Water Directive 2000/60, by the 1st of January 2011 the aid for damage that will be caused by drought will be iussed, only if article 9 of the Directive is completely applied in the sector of agriculture in Greece and only if the government has established a system that will ensure that the cost of water supply services in the agriculture is recovered via sufficient contribution of the respective sector (State Financial Support Regulation, 2008).

During 2006 there were no demands for compensations to farmers due to droughts. On the contrary, in 2007 there were up to 30 demands concerning compensations for different crops. In particular, the Regions of Central Macedonia, Thessaly, Sterea Ellada, West Greece, Ionian Islands, Peloponnisos, Crete and North Aegean asked for compensations. The crops that have faced problems due to drought were cereals, olive trees, grapes and mastic trees (*Pistacia lentiscus*).

It is interesting to observe that the regions that have demanded expenditures due to drought do overlap in a big percentage with the areas that face drought problems (e.g. Thessaly, Sterea Ellada, Crete). The demands for compensations will be checked and approved by a European Committee and the compensations are expected to be given in two years (Hellenic Agricultural Insurance Organization, 2008).

Morocco
There are strong impacts on the crop production[22], amongst which water depending cultivation such as crop, leguminous, tree cultures and some industrial productions are the most affected. Morocco has lost its agro-food balance more than 30 years ago. Though the surface of wheat production has been extended, national needs can't be satisfied anymore and Morocco depends on imports, while the country did still export wheat until early 1970ies.

Droughts also affect animal production[23]. A downfall of livestock is leading to an increase of the mortality rate, due to lacking water and provided lower fodder quantities.

Such drought effects are also applying to other sectors following to agriculture, such as industry (fertilisers, selected seeds, plant protection agents, veterinary products and services etc.), banks, assurances, agricultural materials, transport and finally consumers too, what was not yet assessed at such scale.

Spain
It is still too soon to have official figures about the economic impacts of the drought for hydrological year 2007-2008, mainly because the irrigation season is still ongoing. Water authorities, however, have invested or committed to invest significant budgets to mitigate the impacts of drought. For instance, in the eight Spanish transboundary (interregional) river basins (Norte, Douro, Tagus, Guadiana, Guadalquivir, Segura, Jucar and Ebro), managed by the central government, the budget committed for emergency water works in 2007-08 was 38.729 Million Euro.[24] Similarly, in Catalonia only, the regional government committed 300 Million Euro for short-term increase in water availability.[25] In March 2008, the Ministry for Environment also attributed to the drought a commitment of 769 Million Euro for the period 2009-2013 to improve water management and water infrastructures[26].

During droughts, the most vulnerable economic sector is agriculture and the public authorities try to mitigate the negative impacts in agriculture with several actions. For example, farmers can subscribe a public agricultural insurance that covers damages due to drought. In 2008, the budget of the Central Government to support agricultural insurances including drought effects is of 280.26 Million Euro[27]. Moreover, in autumn 2007 the Central Government issued a Royal Decree[28] to waive the payment of water fees in agriculture or for the use of water transfer infrastructures in some river basins affected by the drought and it is possible that a similar measure will be taken also for this year.

Turkey
In 2007 Turkey faced temperatures not recorded since 1935. Inadequate precipitation affected the agricultural production and farmers negatively. According to the report of Union of Turkish Agricultural Chambers, the total cost of the drought for the agricultural sector is estimated to be 2.5 billion €[29]. Imports of agricultural products increased by up to 60%, with serious economic consequences.

Productivity in wheat production fell by 13.9%, grain production by 23.5%, maize and paddy production

by 7.2% and 6.9% respectively, olive production by 39.1%, pistachio production by 33.3%, fig production by 27,6% and sunflower production by 23.6% as well as pulse and tobacco at lower rates and cotton production and cultivation area by 10.8%.[30]

This year the Ministry of Agriculture and Rural Affairs declared that the cost of droughts in 2008 for the agricultural sector amounts to 1.5-2 billion € approximately, with 435,000 farmers being affected severely by the droughts. Major production losses are seen in cereals and lentil production. In Southeastern Anatolia Region, production losses are estimated to be 90% for wheat and grain, and 60% for red lentil. Again, 90% loss in grain production has already by now impacted on the starting conditions for the next season. Droughts in the region do also affect livestock production due to drought affected meadows and thus fodder production. Moreover, breeding is hampered due to fall in grain, wheat and bait production. Some farmers had to sell their livestocks under these circumstances. Besides Southeast Anatolia Region, droughts affected every part of Turkey. Production of grape in Elazig, cherry in Izmir, cereals in Konya, Muş, Polatli and Cankiri, apricot in Malatya are negatively affected due to the droughts.[31]

2.3.4 Implications for the Tourism Sector

The Mediterranean is one of the main tourist destinations in the world with millions of people every year. There is strong increase in water demands for tourism facilities, which is coinciding with the already water scarce season, when also all the other sectors request high water quantities, putting both the natural water resources and supply systems under increased pressure.

Greece

In Greece, most islands of the Aegean Archipelago as well as eastern and central Crete face regularly water scarcity problems, mainly due to tourism needs as summer population increases on average 10 times and water needs may increase as much as 30 times. For example in the island of Rhodes domestic consumption is around 40% of the total and of that quantity 82% is used in the north of the island due to the high population density and tourism. In its turn, tourism in the island increased from 230,000 visitors in 1970 to over a 1,800,000 in 2007.

Conflicts between local farmers and municipalities are frequent in tourist areas since domestic water supply is priority and water consumption is up to 30 times higher in summer season in tourist places. Water consumption is also increased due to the large number of secondary (vacation) houses almost everywhere in Greece. Moreover, illegal housing constitutes a very acute problem.

Even tough golf is not particularly common in Greece, golf courses belong to much appreciated leisure facilities as they are supposed to increase tourism period and also attract high income tourists. Currently, Greece has six golf clubs with total area of 322.5ha, all of them located in in coastal areas, including Athens. On the other hand these facilities are especially water wasting. Exemplary for the high water wastage is the 60 ha large Afandou Golf Club at Rhodes which uses 190,000 m^3/ year for the irrigation or the Porto Elounda de luxe Resort with pick season usage of 400 m^3/ day for the irrigation of the 5ha area. Further plans for new golf courses are always connected with the construction of hotels, apartment complexes etc. adding up to higher water demands.

In May 2007 the government presented the “Sectoral Spatial Planning for Tourism” for Greece. This plan provides for the development of alternative forms of tourism, including the promotion of golf. Indeed additional golf courses are in different stages of planning and are also included in the recently (2007) presented “Spatial Plan for Tourism”. It must be stressed that all new golf courses are surrounded by extensive real estate infrastructure (luxury and condo hotels, large apartment complexes etc.) increasing even more the water demands. The spatial plan makes reference to possible negative impacts of golf courses, such as the increased pressure in water resources and energy consumption. However, given the lack of comprehensive studies on water availability, uses and needs at the River basin level, it is doubtful whether these new golf courses and the surrounding infrastructure will guarantee wise water management.

Spain

Spain is the second world tourist destination (about 56 million tourists) and the annual income from the tourist industry corresponds to 11% of the Spanish GDP.

The tourist activity is concentrated during the dry season and in areas where water resources are scarcer, like the Mediterranean coast and islands, which hosts 75% of the hotel availability during the summer and 66% during the rest of the year. Altogether water

demands of the tourism sector follow a very high seasonality. While in August water use for tourism represents 22% of water demand for urban supply countrywide, in November it drops to just 6.5% of total consumption. In some regions water consumption due to tourism represents between 30% (Canary Island) and 40% (Balearic Islands) of the overall urban water use. Average per capita water consumption in tourist areas is often substantially higher than in non tourist urban areas: for instance, in the Guadalquivir the average consumption in tourist destinations is 270 l/hab/day while in the rest of the basin it is only 180 l/hab/day.

Golf courses are a highly valued asset in tourist resorts along the Mediterranean coast and currently in Spain there are about 317 golf courses that consume together about 122 Mm^3 water per year, or individually the annual water supply of a city with 15,000 habitants. During spring 2008, the Catalan Water Agency filed sanctioning records to 13 golf courses for breaching the restrictions established in April for the drought emergency. In particular seven golf courses will be fined for using groundwater for irrigation[32].

Turkey

Golf tourism is expanding rapidly in Turkey, especially in the Mediterranean coast. Currently, there are 9 golf courses in Turkey, 6 of them are in Antalya-Belek. It has been planned to establish 100 more golf courses in the coming 4 years. However, once the problem of water scarcity in Turkey is taken into consideration such a massive initiative would clearly be lead to destructive processes to environment.

2.4 Drought and Water Scarcity Related Legal and policy framework

The European Union provides an overall strategic and legal framework for its member states, what applies to France, Greece and Spain, but also provides direction and criteria to assess the situation in Morocco and Turkey which are linked with the Union by thematic programmes, projects and respective pre-accession regulations.

The overarching mechanism for the assessment of the situation relevant to water resources relies on the implementation of the Water Framework Directive (WFD, EC/2000/60), which has been transposed into relevant national legislation and is being implemented, with greater or less success and often great delays by all Member States over the past years.

2.4.1 Most relevant EU policies and Water Framework Directive

Some EU policies and related funding instruments contribute very partially and sometimes not at all to addressing the challenges of water scarcity and droughts.

The European Union Water Framework Directive (WFD) 2000/60 provides the baseline for an integrated water resources management with the overall goal of achieving good ecological status of all water bodies within the European Union by 2015.

Thus the **EU WFD** provides the general framework for water management in a way that all water uses (domestic, agricultural, industrial and ecological) and water availability are taken into account. The WFD introduced a shift in regulatory approach from multiple instruments with separate (but overlapping) objectives to one overarching instrument providing an integrated framework covering all water, all water uses, and all variables affecting the status of water bodies (both qualitative and quantitative). It also allows Member States flexibility of adoption of measures according to the problems faced whether it is shortage or excess of water (Art. 4.6 on prolonged droughts). Overall, the WFD objectives of "good ecological and chemical status" and "no deterioration in status" of the water bodies cannot be achieved if water quantity issues are not addressed. More specifically, the WFD advocates a number of tools that can be used to address both water scarcity and drought such as water pricing policies that provide incentives for the efficient water use, cost recovery principle including environmental and resource costs, supplementary plans/long term strategies to address droughts, systematic control over water abstractions, choice of measures that ensures a sustainable water balance and the minimum ecological flow supporting the ecosystems.

The **EU Common Agricultural Policy** (CAP) is another important mechanism, which is influencing resources management via subsidies that have led to increased water consumption and provoked irrigation of traditionally rain fed crops or replacement of the rain-fed crops with irrigated cultivation of maize and sugar beet among others regardless of water availability.

Additionally, EU Rural Development funds are used in some cases to enlarge irrigation areas or to support "thirsty" crops such as cotton with agro-environmental

schemes. This enhancing of irrigated agriculture furthermore stimulates the policy of water transfers and the construction of dams. On the other hand, EU Rural Development funds have been used to modernize the irrigation systems which has lead to water savings. However this 'saved water' is often used to support further enlargements of irrigation areas or to cultivate more "thirsty" crops, which does not help to alleviate the impacts of water scarcity. It is therefore important that the budget of rural development is not only increased but that it is then also used to help use less water overall by investing in water saving technologies.

Although the CAP reforms in the last few years have introduced new approaches for EU agricultural funding (decoupling, cross compliance), in practice national implementations are weakening these changes. Current compliance application in Spain for example is not impeding illegal water users from benefiting from CAP payments. Most importantly, water quantity issues are not part of the cross compliance system.

The **EU Regional policy** and associated funding mechanisms still continue subsidizing the construction of major dams and other infrastructures, although these degrade the status of water bodies and do not increase water security. Many actions to save water and manage water demand are potentially eligible for EU Structural or Cohesion Funds, however, it is still uncertain to which extent the opportunities provided by these funding instruments will be used.

Regarding **Communication on water scarcity and drought** the European Commission presented its initial policy orientation for future action to address the challenges of the water scarcity and droughts in July 2007. WWF supports the integrated approach presented by the Commission to promote the full implementation of the WFD, improved water savings and efficiency and adequate water pricing and cost recovery. WWF also supports the suggested hierarchy of measures with water-saving measures at the top and creating new water supplies as last option. According to the Commission, the EU's estimated water-saving potential is on average 20%, but increases to 45% of 2025 demand in Mediterranean countries, and exceeds 43% for agriculture and industry, and even 100% for electricity. It is only logical that this potential should be fully exploited before opting for capital and energy-intensive engineering solutions to increase water supply which, owing to their high environmental, energy and social costs, do not increase water security.

The EU policy orientation, however, lacks specific measures to deal with the agricultural sector. Although the Commission's analysis highlights the problem, it shies away on the issue of proposing substantive measures to allocate water and water-related funding more efficiently, and the only suggestion is a policy debate on further progress in sustainable agriculture.

2.4.2 Regional instruments

Beyond legally binding European instruments, there are some more, but rather incentive driven policy and funding instruments for the whole Mediterranean region, that are considering the water issue very differently.

The "**Plan Bleu**"[33] is a regional activity centre of the UNEP Mediterranean Action Plan (MAP), which was initially created and funded in 1977 by all riparian countries and the European Community. It analyses the environmental and development situation and acts as Mediterranean observatory for sustainable development.[34] Amongst the environmental monitoring for sustainable development, agreed within the Mediterranean Strategy from 2005, water builds a priority issue. The centre collects and provides data for the whole region, which could be definitely used in a wider and more efficient manner.

In 1995 the **Barcelona Process** started as a partnership of 39 governments with the aim of strengthening relations between Europe and whole Mediterranean. Since then 16 billion Euros were made available to move forward the process without any tangible results until today.

Most recently these partnering countries met in July 2008 reorganising themselves in the "Union for the Mediterranean region" to agree on six large projects for mutual economical and political beneficial use. Since this new partnership does not have an own budget, funds will be made available from the EU driven Barcelona process, initiated to strengthen cooperation amongst Mediterranean countries. Vast amounts of budget have already been spent with the main focus on economic growth, but outputs are hardly visible. Key issues such as land use and spatial planning, including water resources management are not yet properly taken into account. Thus agriculture appears in the whole process just as a free trading factor, without making any reference to capacity and management of natural resources or water.

2.4.3 Development of drought specific country regulations

Summary of key developments in the field of water legislation and regulations recorded since 2006 with relevance to droughts

Country	Level of decision	New regulations
France	Regional	Framework decree with inter-annual vigour. Establishment of drought committees. Decree regarding limitation of water use and set up of limitation levels for water use according to geographic situation.
Greece	National	Land registry law amending in 9.1 and 13 the Greek WFD transposition Law 3199/2003 to allow interbasin transfers and diversion of Acheloos river in particular (2006). Special Framework on the Spatial Planning and Sustainable Development for Renewable Sources of Energy including definition of basic environmental flows (2008 - not approved yet).
Morocco	Regional	Decrees regulating river basin specifically the implementation of water exploitation and limitation regulated by the national water act (1995).
Spain	National Regional	Government approval of the water transfer from Ebro to Barcelona (2008) – derogated in June 08. Elaboration and approval of special drought plans for each river basin (2006). Establishment of provincial/regional drought commissions/ committees in some areas. Elaboration of municipal drought emergency plans for urban areas with more than 20,000 inhabitants (on going) .
Turkey	National Regional	Decision on the reduction of agricultural credits and promotion of modern irrigation systems (April 2007). Ratification of the Kyoto Protocol (June 2008). Establishment of provincial drought Commissions (June 2007) for the preparation of Drought Action Plans.

Greece

Emergency actions are managed by Civil Protection Agencies or some legislative acts referring to recovery from natural disasters. Regarding droughts, the lessons learned during past ten years with droughts have shown the inadequacy of the legal systems, fostering towards planning of drought mitigation measures and the substitution of subsidies to cover damages in agriculture with insurance schemes (Drought Management Guidelines, 2007).

Drought is being referred to only as a definition in the existing legislation, while the necessary institutional and legal framework elements and operational capacity for handling droughts and water scarcity are missing. Many projects have been implemented in order to achieve appropriate management but did not show any obvious results. Surprisingly the Acheloos river diversion (see 2.7) is promoted as such a project to cope with drought effects too (WWF Greece 2006). In February 2008 the Ministry of Environment presented the "Master Plan of Greece regarding Water Resources Management and Protection". Despite these positive attempts, the EC is observing Greece very closely concerning the implementation of the Water Framework Directive or lack thereof.

EC legal procedures and EC judgments against Greece

January 2008, judgment on failure to implement articles 5(1) and 15(2) of the Directive 2000/60 (case closed).

June 2008, new legal procedure on failure of Greece to implement articles 8 and 12 of the Directive 2000/60 (monitoring mechanisms) (open)

Letter of concern, following complaint of Greek NGOs regarding the Acheloos Diversion and potential violation of the WFD by Law 3481/2006 (the complaint also regards violation of the Directive on the Strategic Environment Assessment) (case closed)

Morocco

The main objective of the drought warning project (Système Maghrébin d'Alerte à la Sécheresse or short SMS), which, started in 2006 is to prevent environmental degradation caused by drought and to further environmental and sustainable development strategies for the three Maghreb countries Algeria, Morocco and Tunisia within the course of three years.

Morocco is working with the Commission for the Sustainable Development within the Mediterranean region on the improvement of irrigation systems[35], including e.g. mechanisms for the adaptation of tariffs for irrigation water, programmes for the rehabilitation of irrigation networks and promotion of participatory management amongst others. Especially the stronger involvement of stakeholders within the context of participatory management could contribute to development of more sustainable agriculture. Other projects and programmes are focussing on education, and especially the improvement of water sanitation, both the access and quality of drinking water as well as of wastewater treatment.[36]

Spain

Special Drought Plans for each river basin were elaborated and approved in 2006 and should be complemented by municipal drought plans for urban areas with more than 20,000 inhabitants. The Special Drought Plans are a useful tool to manage droughts, although they still consider very marginally the importance of protecting aquatic ecosystems during drought periods.

In spring 2008 the Central Government passed a Royal Decree to approve the construction of a water transfer from the Ebro river to the Barcelona metropolitan area[37]. The Royal Decree was derogated in June 2008 due to the intense rains in the area that supplies Barcelona with freshwater. However, the construction of the pipeline will continue because it will be used to transport desalted water from Barcelona to Tarragona (it has been conceived as reversible transfer scheme).

In October 2007 and February 2008, the central Government also passed two other Royal Decrees[38] to establish extraordinary measures to deal with drought in most of the Spanish transboundary river basins (Ebro, Tagus, Segura, Jucar, Guadalquivir and Guadiana). These includes financial aids for water users, the authorization to use water transfer schemes for water transactions and the authorization for the River Basin authority to take exceptional actions to manage the drought. Regional Water Agencies such as the Catalan Water Agency also issued special orders to apply restrictions and other exceptional measures.

In spring 2008 the Jucar River Basin Authority issued two bids to lease water rights from farmers with the objective of ensuring a minimum instream flow in the Jucar (the overall budget for these bids was 17.5 M Euro).

Turkey

Since drought impacts in 2007 the Turkish Government has taken several decisions to tackle the water-drought subject. Thus provincial drought Commissions were established in June 2007 by decree, which also provides the baseline for possible compensation to farmers affected by the weather conditions depending on area and production. Furthermore it was decided to set up provincial Drought Commissions and to prepare Drought Action Plans.

With new regulations for agricultural credits at the Agricultural Bank, set from the Council of Ministers, new incentives for the development and installation of modern drip irrigation systems were put in practice in spring 2007. Another support towards a better integrated management of water resources was the integration of the State Hydraulic Works (DSI) into the Ministry of Forestry and Environment in August 2007, followed by the preparation for a National Water Law.

In February 2008 the Turkish Grand National Assembly (TGNA) agreed on the creation of a "Research Committee for the Effects of Global Warming and Sustainable Water Resources Management", inviting relevant institutions and organizations (including WWF-Turkey) to the Assembly and to work together on the preparation of an comprehensive report to be presented then in the National Assembly.

Picture 2: Drought in the Burguillo reservoir, in the Alberche River (Tagus watershed). © Isaac Vega / WWF Spain

2.5 Irrigated agriculture and illegal water use

The EC funded Project "Indicator Reporting on the Integration of Environmental Concerns into Agriculture Policy" (IRENA) running from 2002 to 2005 provided some data for France, Italy and Spain, but showed significant gaps regarding water use for agricultural purposes. According to the report the irrigable area increased in France, Greece and Spain from 5,8 million ha to 7.4 million (29%) between 1990 and 2000.[39]

The available data do not permit a specific evaluation, because exact figures are missing. Still it shows the huge spatial dimension of irrigated agriculture and the increasing water request for irrigation water. Therefore the conclusion from this information is a clear call for stronger land-use and regional planning schemes and regulations.[40]

Agriculture and especially those crops, vegetables and trees produced in intensive cultivations in the Mediterranean are very much depending on irrigation systems. The rapid development and guiding framework conditions of large scale agriculture have provoked over-exploitation of both surface and ground-water, extracted from increasing numbers of illegal wells in the past decade. (Fig 2)

Irrigation planning is often stronger linked to water allocation systems in form of water infrastructures, such as dams and reservoirs (see 3.5) and does not consider in adequately possible improvement through implementation of modern technologies to reach an increased irrigation efficiency and to evaluate overall trends for water use in agriculture. (Tab. 4)

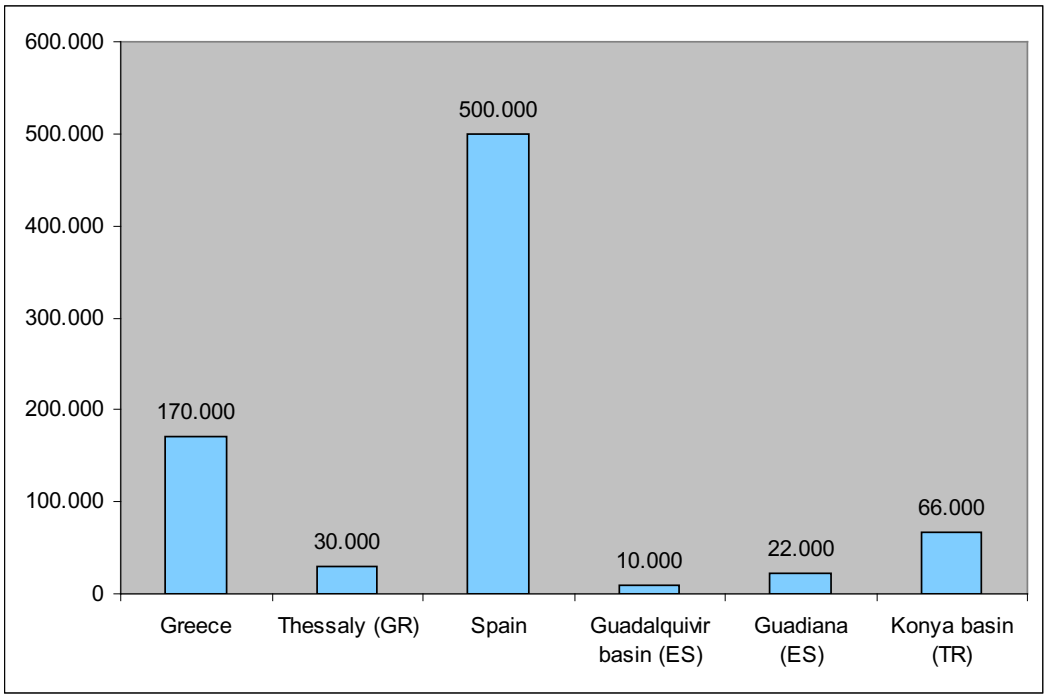


Figure 2:
Number of illegal boreholes exemplary at country and regional scale

Tab. 4: Irrigation technologies used in Mediterranean countries[a]

Irrigation technologies	Greece	Morocco	Spain[41]	Turkey
Surface of irrigated agriculture in km²	14,000	14,582	30,000	48,900
Surface/ flood irrigation in %	25.1	81	45.3	94
Sprinkling irrigation in %	52.9	10	21.5	6 (incl. drip irrigation)
Drip irrigation in %	21.9	9	33.2	See above.

[a] Reference surfaces: Mallorca 3.640km², Sicily 25.702km², Switzerland 41.285km²; Luxemburg 2.586km²

France

With a share of just 15% of totally used water irrigation plays a minor role in France, but it has to be kept in mind that irrigated agriculture is not equally distributed all over the country and mainly concentrated in the Mediterranean zone. The impact of the extraction for irrigation purposes is still critical, in particular because the main irrigation season takes place, when water levels are already at lowest level.

Irrigation water amounting to 4.7 Million m³ are taken at 77% from surface waters and 23% from groundwater. Deep boreholes are hardly used and considered not efficient for irrigation agriculture. While herbaceous are the most irrigated cultivations in Spain, 60% maize is covering 60% of the irrigated area in France. Besides other Mediterranean countries, France admits difficulties to evaluate the exact water volume exploited for irrigation due to not fully trustworthy registrations of water extractions.[42]

Greece

Agriculture is by far the largest water use in Greece consuming up to 86% of water and as such is also the sector most sensitive to drought. Almost 90% of the total water allocated to agriculture is used for irrigation. The phenomenon of the increased water use for agriculture is mainly caused due to the exceeding irrigation methods, the old irrigation networks that lose up to 40% of water and the use of systems that consume big quantities of water for surface, sprinkler irrigation and other practices (WWF Greece, 2006, 2007).

The eastern regions Thessaly, Thrace, East Sterea Ellada and East Macedonia are the biggest users of agricultural water. Among them, Thessaly is using the biggest amount of water for irrigation purposes (23%) in Greece (University of Thessaly, 2008). Furthermore, the water that is used for irrigation in Thessaly comes up to a percentage of 90% and only 10% is used for the other sectors, such as domestic use and industry (Tsakiris, 2008). The overall water consumption for irrigation in Greece comes to about 6,833.4 m³/ year/ ha.[43]

The irrigated area of about 1.4 million ha can be further distinguished by types of cultivations. Thus in Greece 900,000 ha of crops on arable land are irrigated, 100,000 ha of garden crops, and even 350,000 ha of tree cultivations. Key crops are wheat, cotton, oil, tobacco. The most water-demanding crop, if we consider both plants needs and overall area of irrigated cultivations is cotton, guzzling more than 20% of Greece's water, highly subsidized by the European Commission. It has to be stressed that in the majority of the existing common irrigation schemes, farmers pay a standard and usually very low overall fee based on the area they irrigate, and not according to the volume of consumed water.

Water can be abstracted following the issuing of a permit by the regional water services. However, effective controls are lacking and as a result there are numerous illegal wells. There are estimations of around 30,000 illegal wells only in Thessaly (for irrigation reasons). Similarly, in the region of Attica 69% of the existing 1,230 wells are illegal (WWF Greece 2006). In general, illegal wells constitute an important problem in Greece and according to Greek Institute of Geology and Mineral Exploration (IGME) there are about 170,000 all around Greece.

In the past, because of the socioeconomic conditions, water was mainly taken from wells and boreholes. During the last years, the Ministry of Rural Development is encouraging the construction of large reservoirs in order to cover different uses, including irrigation.

It is clear that agriculture is the sector getting mostly affected by drought periods, first because it is the most important consumer of water in the Mediterranean countries (86% in Greece) and secondly, because of the extremely low efficiency in water use and the largest elasticity in the demand. Consequently, during a drought it must be the first goal to save water in agriculture.

Leaks in irrigation networks and insufficient methods result in locally significant losses of water (WWF Greece 2007).

Thirteen Water Regions (Tab. 5) have been established by law with local administration services according to administration borders, requesting cooperation between the units for transboundary river basins between Water Regional Directives for implementation process. Most of the Water Region Directives have inadequate numbers of personnel and are not active in data collection. In 2007 even the Minister of Environment declared that the Water Region Directives are not properly working due to lack of staff and that also the main Water Authority needs to be further strengthened in order to execute their legal obligations.[44]

Tab. 5 Water management and irrigated agriculture in Greece

Administrative water region[45]	Summary of regional situation
East Macedonia Thrace	- Approximately 70-80% of water is used in agriculture - Dams established to solve water efficiency problems and to control floods - Unknown number of legal/ illegal wells, steps to control illegal wells
Central Macedonia	- No data available
West Macedonia	- Approximately 80% of water is used in agriculture - Big pressures at the water resources of the area - Approximately 600 legal wells, tries to close illegal wells.
Ipiros	- More than 70% of water is used in agriculture - observed increase of drilling wells (mainly illegal) - Brackishness of water in coastal zones
Thessaly	- Approximately 30.000 legal and illegal wells
Ionian Islands	- 06/2007 until 06/2008 requests for the opening of 30 legal wells
West Ellada	- Water use in North Peloponnisos to 90% in agriculture and in West Sterea Ellada to 94%
Sterea Ellada	- 86% of water is used in Agriculture - From 1997 until 2008, more than 7.000 new legal wells
Attiki	- No data available
Peloponnisos	- Unknown number of legal and illegal wells. It is estimated that the illegal wells are “a lot”. - Problem with the water consumption in agriculture
North Aegean	- No data available
South Aegean	- Water efficiency problems since 1980s parallel to growth of tourism at the islands. The absence of water infrastructure, as well as the construction outside city zoning boundaries has led to the drilling of many illegal wells. - 80% of water is used in irrigation agriculture
Crete	- Unknown number of legal and illegal wells, but estimates are high (mainly for agriculture), since 80% of water is used in agriculture. - Problematic wasteful water consuming agricultural practices, even for traditional Mediterranean cultivations such as Olive trees. - Considerable imbalance of water resources between west and (poor) east Crete - Small dams and reservoirs are constructed for agriculture purposes

Since a national water monitoring system (as required by the WFD) is still lacking and as there are still no guidelines on management plans or other measures issued by the central Water Authority, the regional services cannot really work and elaborate at their local level to serve their needs.

Morocco

The agricultural sector is by far the most important water user in Morocco, with slight decreases in relative terms. While irrigation covered about 92% of water used in 1990, it was estimated to 83% in 2001 and is expected to be about 80% in 2020. This relative decrease is not coming from an absolute decrease of demand for irrigation water, but is due to an increasing demand of potable water and additional demand of water for industries.[46] The highest demand stems from large scale irrigation, which represents about 52% of the total surface irrigated in 2003, while in 1961 only 18% of the area was covered from irrigation agriculture. The growing agriculture sector brings further out the huge regional disparities in water use by irrigation. In 2007 the potential area for irrigation agriculture was evaluated at 1,664,000 ha (Tab. 6), equivalent to 16% of the total agricultural surface, dividing into 880,000 ha fed from large dams, 484,000 ha by small and middle sized dams and 300,000 ha by seasonal means and distribution of flood water.[47]

Tab. 6: distribution of extracted water for agriculture in Morrocco

	Actual demand (Mm^3)	Actual volume provided (Mm^3)		
		Surface water	Groundwater	Total
Large dams	5,748	2,784	420	3,204
Small and middle sized dams	2,501	2,011	490	2,501
Private	2,700	325	2,375	2,700
Total	10,949	5,120	3,285	8,405

Spain

Irrigation is responsible for 78% of the overall water consumption in Spain in average (2006) ; but in several river basins (Guadalquivir, Duero, Segura, Ebro and Guadiana), agriculture represents more than 90% of the total water consumption.

Taking into account the drought lasting since 2004, in 2006 the Government approved a special plan for the modernization of irrigation systems in 866,898 hectares, which should benefit 291,024 irrigators. The plan foresees to save, at least in theory, up to 1,162 million cubic meters[49]. However, there is no evidence so far that there has been a net water saving as the saved water belongs to the farmer who can use it to cultivate "more thirsty" crops or increase the cultivated area, rather than to save it for the "nature". It will be possible to use this water to increase drinking water supply security or to feed environmental flows only if water authorities decrease the water rate per hectare after the modernisation (this option is foreseen in the Spanish Water Act, but rarely applied). The total budget of the plan is 2.344 billion Euros.

In some Spanish regions the estimated number of illegal boreholes far exceeds legal ones: for example, in the Upper Guadiana River, official sources acknowledge that there are 22,000 illegal wells, in contrast with 16,000 authorized ones. There are no recent overall official figures about illegal ground water extraction, but already in 2006, estimates by the Spanish Ministry for the Environment spoke about approximately 510,000 illegal wells in the whole country.[50]

Since aquifers are more resilient to drought than surface reservoirs, dry meteorological conditions increase incentives for drilling illegal boreholes to access water for irrigation or recreational uses (e.g. golf courses). For instance, the newspapers recently reported a significant increase of illegal wells in the Guadalquivir, as in 2007 the river basin authority filed a legal record to 607 illegal wells while in 2006 it filed only 159 records. The interviewed officer explains this increase saying that the drought has already lasted 4 years and there are no more surface water reserves to face the prolonged drought[51].

Picture 3: Contrary irrigation systems: Wasteful (left) and water efficient (right) irrigation systmes. © WWF Turkey

Turkey

Uncontrolled groundwater extraction is prevalent in regions where agricultural irrigation and industrial production is intense (Central Anatolia, Marmara, Aegean, and Thrace). 92,000 wells were identified in the Konya Basin by a study in 2008 of which 66,000 are illegal[4].

In a period of 33 years, the groundwater level dropped by 14.3 meters in the agricultural centre of the Konya Basin, out of which 80% incurred during the last 10 years[5]. 46.9% of the water supplied to Organized Industrial Regions of Turkey was drawn from groundwater resources.[52]

Total arable land in Turkey is 28 million ha and 8.5 million ha of this area is suitable for irrigation. Currently, Turkey's dams provide water for 4.89 million ha of arable land. It is estimated that by 2030 total irrigated arable land will increase and reach 6.5 million ha.[53]

Picture 4: Illegal ground water extraction in Konya basin.
© WWF Turkey

2.6 Large water infrastructure

Water infrastructure developments are serving different interests and needs in each of the country, but their main purposes are for hydro-electronic energy production, agriculture irrigation and domestic use. (Tab. 7)

The myth that more water infrastructures solve water supply demands of any sector still prevails in the decision making processes in the Mediterranean countries. In Turkey droughts affected water availability in reservoirs in 2007 and 2008 substantially, especially for the cities of Ankara and İstanbul (Tab. 11). Monitoring with different scope and follow up presentation show similar situation for dams and connected reservoirs in Morocco (Tab. 8) and Spain (Tab. 10).

2.6.1 National water infrastructure systems

Greece

The Greek Public Power Corporation (DEI) has constructed 15 big dams for hydropower production (big hydroelectric plants), with total installed capacity of 3017.8 MW (Tab. 7). Their annual energy reward is 4.16 billions kWh. Water inflow for the period October 2007 – February 2008 was 3.038 million m^3. Moreover, DEI has programmed to set into operation during the next 5 years 7 more plants with total capacity of 649.1MW. Their total energy reward will be 1.67 TWh anually. Government mainly gives its effort at the future operation of Mesohora (161MW) and Ilariona (153MW) plants, both in region with large scale agriculture. Compared to this small hydroelectric plants only have a capacity of 147 MW.

Tab. 7: Overview water infrastructure information

Water resources and impacting infrastructure	France	Greece 2008	Morocco 2004	Spain	Turkey
Number of large dams	57	46	110	1,200	555 (210 in construction)
Capacity of reservoirsin Mill. m^3	n.a.	5,823.5[b]	15,800	54,308	139,500
Hydropower plants (HP)	n.a.	15 large and 250 small[c]	26		142
Capacity of HP plants	n.a.	3,165MW[54, d]	1,192 MW	12,818MW[55]	12,788 MW

[b] Information for hydropower plants only, data on other dams are not available

[c] Hydropower plants in different stages of construction

[d] Additional 430 MW will be added from the planned small plants

The dams and reservoirs are mainly situated at the Region of Western Greece at the Regions of Ionian Islands, Peloponnisos, East Macedonia and Thrace as well as on islands in North Aegean, South Aegean and Crete. The geographical pattern of dam and reservoir distribution is connected to the unequal distribution of both water resources (western Greece is richer in water due to the geomorphologic structure of the country) and water uses. The majority of population, the largest agriculture plains and tourist aggregations are situated in the eastern mainland and the usually arid islands. Since the 1960s 17 dams and 33 reservoirs have been constructed. Additional to this studies for 87 dams and reservoirs have been approved. Currently 7 dams and 4 reservoirs are under construction.[56]

Despite the environmental impacts these water infrastructures have on the river dynamics and flows, there are also new habitats created by the reservoirs themselves, e.g. the reservoirs at the Aegean islands, created new rare habitat types and are relevant for sustaining the migration of birds.[57] If natural surface waters are seriously threatened and disappearing, these reservoirs might represent the last, though likely only temporary refuge for the water dependent species.

Morocco

Within the dams' programme of the Government 2005-2007[58] construction and extensions of 11 dams are being completed. For a minimum of 5 dams the main purpose is seen in the provision of irrigation water, but also drinking water and partly as flood protection.

Tab. 8: Reservoirs in Morocco

Storage capacity of 51 big dams in Morocco	**15,000 Mm³**
Average storage in July 2008	6,623 Mm³
Storage rate	44%

Within another programme of the Ministry for internal affairs and the state secretary for Water on the development of small and middle sized dams a similar number of dams are also constructed for the same purposes.

Further to the current water infrastructure plans the programme on groundwater extraction and mobilisation is carried out by the State Water Agency (French: Sécretariat d'Etat Chargé de l'Eau) to assess and improve the knowledge about groundwater. Aquifers are considered a strategic reserve to be used during drought periods for drinking water supply in zones without surface water resources. Thus it was planned to drill 900 boreholes in the period 2005-2007[59], the current state of implementation is unknown.

But it has to be noted that the level of certain aquifers has already been decreased over the past 20 years, a number of them due to water pumped for irrigation. (Tab. 9)

Beyond demands for domestic and agriculture use the energy sector[60] is a significant water user. In total 26 hydropower plants, connected to dams with a total power in the range of 1,200 MW, produce in average 2,000 millions KWh annually, supporting mainly requests during peak hours. While the hydropower generated energy is about 17% of normal energy consumption, it reaches 30% during peak hours. Taking into account the drought years, the average production was well below this in the past 20 years, because of the low water flows characterising this period.

Spain

According to official figures, Spain has about 1,200 dams with an overall storage capacity of about 54,308 Mm³. About 68% (36,917 Mm³) of them have as their main objective the supply for water consuming uses and about 32% (17,391 Mm³) are primarily devoted to hydropower production[61].

Tab. 9: Level of some heavy decreasing Moroccan aquifers

Name of Aquifer	**Total decline over past 20 years (m)**	**Avarage annual decline (m/year)**	**Purpose for water extraction**
Souss	40	2	Irrigation developpement
Haouz	30	1 – 2	Irrigation developpement
Saïss	60	3	Irrigation developpement Exploitation for drinking water supply
Ain Béni Mathar	40	2	Irrigation developpement

Tab. 10: Percentage of stored water in the Spanish peninsular reservoirs[62]

Reservoirs	Storage rate in July 2008	Storage rate in July 2007	Average storage rate past 5 years	Average storage rate past 10 years
Mediterranean rivers	57.4 %	49.7 %	50.7 %	52.4 %
Atlantic rivers	56.2 %	63.6 %	62.4 %	63.5 %
Total	56.5 %	60.1 %	59.1 %	60.8 %

The number of new dams has sharply decreased after 1999. Indeed, according to official figures[63] 159 new dams were built in the period 1990-1999, while since 2000, only 15 new ones have been constructed, just little more than 1% of the existing dams. This decreasing trend can be explained in part by the fact that the majority of dams that were technically and economically viable have already been built in the past. Most of the remaining planned water infrastructures – the Spanish National Hydrological Plan foresees 117 more dams – have serious environmental, social, technical or economic constraints. For example, in the Guadalajara province (North-East of Madrid) the Central Government plans to build the Sorbe-Bornova water transfer that will affect an almost pristine river areas belonging to the Natura 2000 network, which is established under the EU Birds and Habitat Directives. WWF Spain strongly opposes the project as it believes that the justification for the transfer is based on overestimated future water demands. These overestimates foresee that the currently supplied population will grow by 230% by 2030 and consider a per capita water consumption of 344 l/habitant/day in contrast with the 280 l/habitant/day average water consumption rates in the area.

Since water authorities are aware of the limited potential for future dam construction and of the increasing social opposition of large water transfer and dams, they are boosting the construction of desalinisation plants on the Mediterranean coast to increase water supply (see chapter 2.7). Moreover, the Spanish government is fostering the use of market instruments to redistribute water volumes, both during drought and in normal conditions. Therefore, it has authorized exceptional water transaction between users in Central Spain and users on the Mediterranean coast.

Turkey

Total arable land in Turkey is 28 million ha and 8.5 million ha of this area is suitable for irrigation. Currently, Turkey's dams provide water for 4.89 million ha of arable land. Drinking water supplied by the dams amount to 2.96 billion m³. About 1 million ha are considered as flood control area.[64]

Tab. 11: Turkey's storage rate of reservoirs supplying listed cities

Reservoirs supplying cities	Average storage rate in 2007	Storage rate in 2008
Ankara	8.7%	2.6%
İstanbul	46.5%	below 30%
İzmir	35.1%	20.6%

Picture 5: No flows left at the dam at the Great Menderes River.
© WWF Turkey

Picture 6: Parched Burguillo Reservoir in the Tajo catchment.
© Isaac Vega / WWF Spain

There are 142 hydropower plants in total and another 41 hydropower plants are currently under construction. Further to this projects for additional 589 hydropower plants are prepared by now or are being in elaboration currently.[65]

The Turkish government gives priority to the issue of water storage in order to meet the demands of urban areas in the face of severe droughts. A five-year Action Plan is being prepared by the government for the provision of water to 81 cities of Turkey. In the first phase, the priority will be given to Şırnak, Sinop, Nevşehir, Erzurum, Çorum, Aydın and Ankara. According to the available data 71 cities suffer from water scarcity to a certain extent at the moment and 34 cities are expected to suffer from water scarcity from 2010 onwards.[66]

2.7 Water transfers

If water gets scarce and water shortages are looming, like recently in Barcelona, water authorities and decision-makers in the region are very often considering the technological solution of water transfers a) within and more often across river basins, b) sometimes transboundary or nationally. This occurs even if no real technological alternatives or demand management like improved water efficiency in agriculture, reduction of the irrigated areas or repairs of the leaking pipeline systems have been previously considered and applied. Beyond this terrestrial transport, freshwater is increasingly transferred by ships between different countries, such as from France to Spain, from Greek main land to islands as well as to Cyprus, as well as from Turkey to neighbouring countries. If there is no longer a direct spatial link to a respective "water donor" catchment and its water availabilities to water use and management in a recipient basin, there is a high risk, that easy solutions from the supply side are overriding any alternative considerations to reduce on the demand side, i.e. in the recipient basis. This leads to situations, where river basins like e.g. in the region of Murcia in Spain are heavily over-exploiting their own available surface and ground water and still asking for more water from neighbouring basins, rather than to ban any inefficient and wasteful water use "at home" and to restrict expansion of the water use.

France

At present the French government and administration does not support permanent inter-basin or international water transfers. Up to now all kind of permanent water transfers from the Rhône basin to Northern Spain could be prevented and the earlier planned project was abandoned in 2000. Nevertheless in 2008 France accepted to export freshwater from the Rhone basin near Marseille by ship to Spain as an emergency measure.

Greece

Drinking water for the Metropolitan Area of Athens is transferred from two different river basin districts, and at a longest distance of almost 200 Km away. Additional transfers have been necessary for the provision of drinking water for Thessaloniki, the second largest city of Greece, and the irrigation of Thessaly.

The planned pharaonic diversion of Acheloos is also planned to provide irrigation water, even though environmental and energy concerns reasons have been raised.

The case of the Acheloos river diversion

Important areas of the Acheloos River basin in Western Greece are part of the European NATURA 2000 Network, due to its exceptional ecological significance. The Acheloos diversion project of dams, reservoirs and tunnels is about a total of at least 600 million m³ of water to be taken to the other side of the Pindos mountain range to provide irrigation water for 240,000 hectares of agricultural land in the plain of Thessaly. The vast construction project will cause irreversible damage to ecosystems and will trigger the extinction populations of endangered and internationally protected species. Southern Pindos faces the prospect of destruction of its riverine habitats due to reduced flow. The rich fish fauna of the area will undergo the most serious negative impact, since the flow of its riverine habitat will be obstructed by the dams and part of the area will be turned into a lake. Currently the project implementation was stopped by the Greek Council of States after strong campaigning from WWF and other Greek NGOs.

The problem of water shortage is an almost permanent phenomenon in many areas and particularly in the small islands of Greece, such as Amorgos, Kufonisia, Kimolos, Iraklia, Schinussa, Folegandros, Sikinos, Thirasia and Milos that depend largely on water transfers from the mainland.

The following provides examples of water transfers, mainly by ships in order to serve Greek islands in order to overcome their water shortages:

- During summer of 2006, 510,000 m^3 of water had to be transferred to the above islands to cover the needs of local populations and tourists.
- During summer of 2006 the arid islands of Dodekanisa needed 655,311 m^3 of water to be transferred
- During 2007 the residents of the island Egina needed 900,000 m^3 to cover one third of their water needs.
- The water transferred at the islands of Cyclades and Dodekanisa from 1997 until 2006 amounts to 9,000,000 m^3 of water with a total cost of 48,000,000 Euros
- In June 2008 Greece agreed to ship 8,000,000 m^3 of water to drought stricken Cyprus. The available water resources in Cyprus are 17 million m^3 while their needs reach 66-70 million m^3.

There are also some other plans to transfer water between different River Basins, mainly for irrigation reasons. According to the Acheloos diversion plan, up to 600 hm^3/a are to be transferred from Acheloos river (2nd largest river in Greece) to the plain of Thessaly (important farming area). The project includes 4 dams and two diversion tunnels. The diversion, a pharaonic project of the early 1900s, was repeatedly stopped by Council of State, the country‘s highest administrative court. Additionally, the EU has refused to fund it. However, during summer 2006, the Minister of Environment bypassed the Court decisions by approving the project through a law. The same law opens the door for other water transfers and tries to ignore the EC Water Framework Directive but no concrete plans have been proposed yet (WWF Greece 2006).

Spain

During 2007-2008, the Central Government used two existing water transfers (Tagus-Segura, from upper Tagus to the Mediterranean coast and Negratin-Almanzora, from upper Guadalquivir to the Mediterranean coast) to provide additional water resources to the Mediterranean coast using water market mechanisms concerning water rights and leases. To do that, the Government approved the exceptional use of these water schemes to allow inland users to lease water to users on the coast.

In spring 2008, the Central Government approved as an emergency measure the construction of a new 61-km-long water transfer scheme between the Ebro basin and Barcelona to transfer max 50 Mm^3/year. This transfer was cancelled in June because the emergency situation in the Barcelona got under control due to the heavy spring rains in Catalonia. The construction of the pipeline, however, continues because the planned transfer scheme is reversible and will be used to bring desalted water from Barcelona to Tarragona.

In winter 2008 the Catalan regional government signed an agreement[67] for three months with several shipping companies to transport water (1.66 Mm^3/month), by ship from Tarragona (south of Barcelona, 665,000 m^3/month) Marseille (France, 551,700 m^3/month), and the Provence Channel (France, 442,500 m^3/month). This water volume represents about 6% of the urban consumption of the Barcelona area. The cost of the transport, done with six ships transporting between 19,000 and 42,000m^3, was about 22 Million Euro per month. The first ship arrived to Barcelona in May 2008 and no information is currently available on the shipping programme that might have been cancelled due to the abundant spring rains in the Barcelona area.

Turkey

In-Country Water Transfers:

The largest water transfer project in Turkey is the **Blue Tunnel Project**, an inter-basin water transfer project, which is revived recently in the face of severe droughts in Konya Closed Basin, with the goal transferring 10% of the Göksu River to the Konya Plain to irrigate a total area of 621,000 ha through a 17 km tunnel and three hydropower stations. The project has been initiated in 2007 and its contract for a sum of 90-95 million €. The Blue Tunnel Project is part of the wider Konya Plains Irrigation Project.

In response to the threat of water scarcity in Ankara, the inter-basin water transfer project, called the “**Kızılırmak Project**”, is proposed. It seeks to divert water from the Kesikköprü Dam to Ankara for urban use. When the project is finalized, 280-300 million m^3 of Kesikköprü Dam’s waters will be diverted through 3 pipelines that are 125 km long to Ankara. Currently, 2 of the 3 tunnels are operationalized. It is claimed that the project will guarantee safe water for Ankara for 20 years however, there are concerns concerning the water quality of Kızılırmak River.

Grand Melen Project is proposed for overcoming the water scarcity in İstanbul. At its initial stage the project aims to transfer 268 million m^3 of water annually from Grand Melen Stream for urban use in İstanbul

through a 180 km long transmission line. Once all 4 stages of the project are completed the Grand Melen System will provide 1.180 billion m³ of water annually. The project covers the establishment of a regulator, a conduction line, pump station, tunnel, elevation storage and treatment facility and the total cost of this project is estimated to be around 2.150 billion USD. 65% of the project is completed and it will be finalized in 2011. The project is expected to answer the water need of İstanbul until 2040. It is estimated that 1 town and 16 villages will be covered by water with the project.

International Water Transfer: Turkey – Cyprus

"Peace Water" Project plans were initiated in 1995 which targeted transfer of water from Turkey first to the Turkish Republic of Northern Cyprus (TRNC) and then to Israel. The project is initialized in January 2007 the cost of which is estimated to be around 300 million USD. Waters of the Dragon Stream in Antalya/Turkey will be transferred to TRNC through 78 km of pipe constructed in Mediterranean Sea (total depth of which is 1650 m) hanging in 250 m depth.Desalinisation and the technologies footprint.

2.8 Water demand and possible impacts of desalination plants

Water demand for population domestic use and progressive access to regular water supply and sanitation leads to increased use. Parallel high needs from irrigation sectors are adding to this and together it seems that all demand can be provided, enabled by using desalination technologies. This leads increasingly to concerns and conflicts with and in water management though the development seems not always to be based on proper calculations of the demand, often simply influenced from not sustainable economies, overall neglecting the potential for wisely managed freshwater resources.[68]

Desalination technologies consist in reducing the saline concentration to convert salty water suitable suitable for drinking or irrigation. The technology applies both to seawater, but also brackish water from aquifers. Commercial desalination technologies can split in two great groups: thermal and membrane separation, with very different energy requirements and emissions. Thermal processes are an ancient technique desalting in form of boiling or evaporation. The membrane system is called reverse osmosis (RO) membrane separation and is based on separating and filtering the water processed. With the present state of the art of the technology, desalination based on RO provokes significantly lower environmental load than thermal desalination (Tab. 12).[69]

Tab. 12: example for relevant airborne emissions produced by desalination systems (Tab. 2[57])

	Thermal Multiple effect distillation (MED)	Reversed Osmosis (RO)
Kg CO_2/ m³ desalted water	18.05	1.78
g. dust/ m³ desalted water	1.02	2.07
g. NO_x/ m³ desalted water	21.41	3.87
g. NMVOC / m³ desalted water	5.85	1.10
g. SO_x/ m³ desalted water	26.49	10.68

Tab. 13: overview of desalination capacity and technologies used by countries

Country	Number of plants	Total Capacity	Technology
France			
Greece (2005)	48	24,000 m³/ d[70]	1.3% thermal processes 98.7 % reverse osmosis (86.2% seawater, 13.8% brackish water)
Morocco (2006)		20,000 m³/ d[71]	
Spain	900	1.5 Mm^3/d	
Turkey	8	31,000 m³/d[e]	No specific data, but by majority reverse osmosis

[e] It is expected to reach 120.000 m³/ day by end of 2008

2.9 National plans and developments concerning desalinisation

Greece

Desalination is considered a very expensive technology. Nevertheless, during the last 15 years its cost has fallen a lot and the construction of desalination units has increased, mainly at the most arid Greek islands, such as in Cyclades.

The desalination systems that are used in Greece are those of the reversed osmosis and the water is for domestic use. Desalination units are also used in agriculture (irrigation of greenhouses), piscicultures, hotels, ships, hospitals and industry. The water that is produced from these plants does not cover the same quantity of needs in all islands. Desalination plants are constructed at the bigger islands or at the islands that face bigger water storage problems, e.g. Syros, Tinos, Mikonos, Sifnos and Serifos.

There are about 48 public operating desalination units in Greece plus many private units, mainly in hotels. From available data it can be deducted that the total capacity of the desalination plants is 24,000 m^3/d, their required energy is from 2.92kwh/m^3 to 4.90kwh/m^3 and their costs is oscillates from 2.70€/m^3 to 0.30€/m^3.

The costs of desalination systems using reverse osmosis depends on the capacity of the plant and on the water that it is used. While seawater desalinization costs between 0.5-1€/m^3 depending on the capacity of the plant, production/ conversion from brackish water remains between 0.15-0.5€/m^3.[70]

Emission data (CO_2, NO_x, SO_2, Solid Particles) from several types of desalination plants show that there are differences amongst desalination systems. Records show that less quantities of air pollutants, such as CO_2 emissions, as well as the NO_x, SO_2 emissions, (except form the Solid Particles) are produced using the Reverse Osmosis technology compared to the others systems.

An interesting experiment is "Ydriada" a Floating, Autonomous and Environmentally Friendly Desalination Unit, that has been set up in Herakleia island, South Aegean, Greece. This is a floating platform that uses exclusively energy provided from renewable sources (wind and solar energy) to produce daily up to 70,000 m^3 of drinking water. The project also received a Special mention from the RegioStars 2008 Jury[72].

Morocco

Morocco uses desalination technologies since more than 30 years with a production capacity of 20,000 m^3 / day today, supporting 2% of the national drinking water demand. According to information from the Sahara Regional Hydrological Directorate the annual quantities counts 2.8 Mm^3 per year. Key installations are placed in southern provinces, because of quasi missing of conventional water in these regions and competitiveness of desalination process. The Office National de l'Eau Potable (ONEP) has started to construct two more large plants to be put in operation in 2008 and 2009. Further large capacity facilities are in the planning process. Morocco assigns an important role to desalination plants in future, when costs are sinking and plants become more competitive with conventional water and see therein the only chance to solve conflicts amongst different users in the catchments where desalination was never considered to get any importance (Tensift, Oum Erbia, Bou Regreg).[73]

However, desalination is considered an alternative solution for periods of coming water shortage, when costs for conventional water supply system may increase. Again, water production through desalination processes has high costs in the range of about 2 €/ m^3, what comes up to 10 time higher prices per m^3 compared to conventional water. Overall the claim for this technology remains the last alternative chosen in the planning process for water mobilisation.[74] Despite this claim, there are three more plants under construction with a total planned capacity of about 105,000m^3/day, meaning an increase of 500% from production today.

Spain

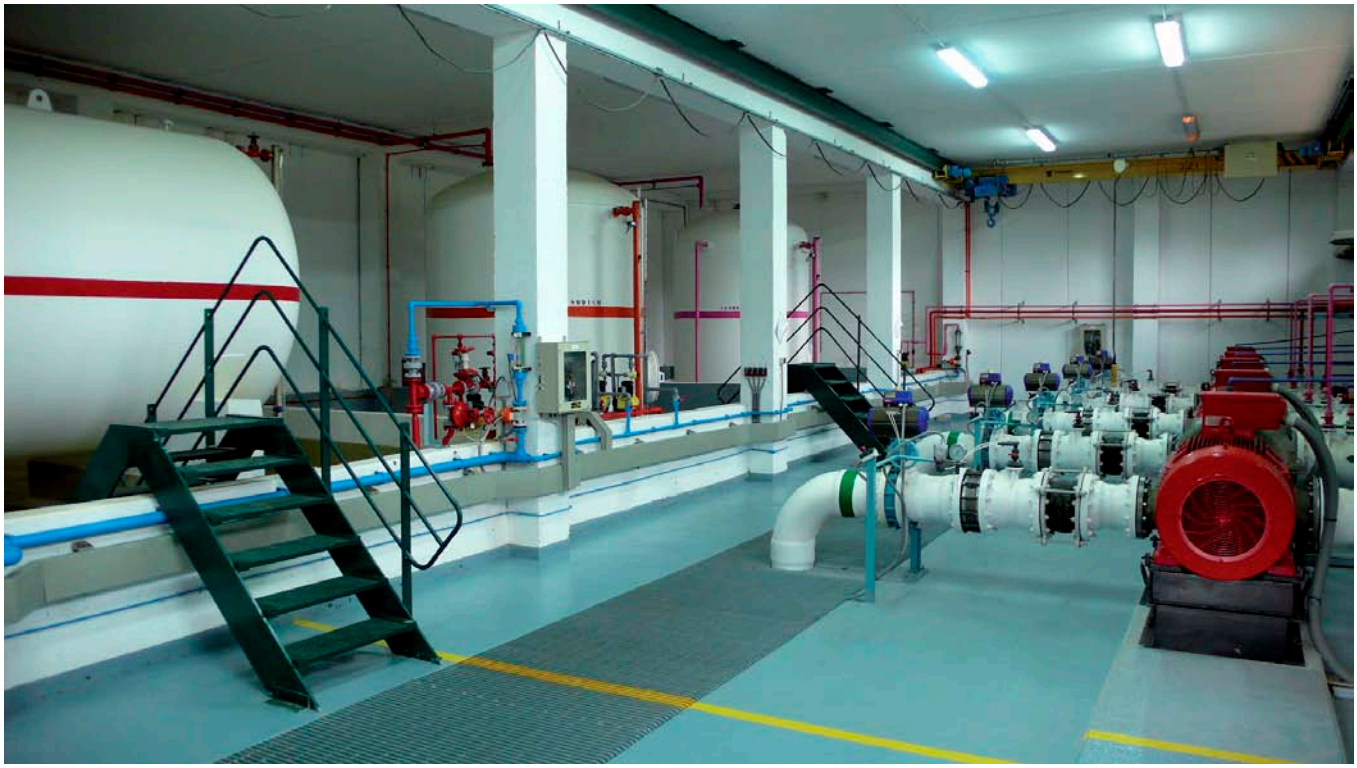
Spain is the fourth producer of desalted water in the world, with an average production of 1.5 million m^3 per day and about 900 plants in the whole country. This number is increasing due to the approval of the so-called Programma AGUA in 2004 by the Spanish Government that foresees to provide the Mediterranean coast with 621 Mm^3/y of additional desalted water.

In 2004, about 140 Mm^3/y of desalted water could be produced in the Mediterranean area. At the beginning of 2007, six new plants had been completed, with an additional production capacity of 176 Mm^3. Other 13 plants were under construction or been already contracted, to produce 374 additional Mm^3/y (676 Mm^3/y in total)[75]. These figures refer to the desalinisation production capacity: at present the lack of demand for desalted water or delays in the construction of the water distribution networks make that several desalinisation plants are working far below their full production capacity.

Available figures about the impact of desalinisation on energy consumption are not very consistent. According to official estimates[76] in 2004 desalinisation plants represented 0.25% of the Spanish CO_2 emissions and it is calculated that once all the currently planned plants will be operative (825 Mm^3/y in the whole country), this water sector will produce 1.01 million tonnes of CO_2 emissions.[77]

Turkey

Interest in the use of desalination technologies for drinking water production has increased in Turkey in recent years due to severe drought events experienced in last few years. Desalination technology is mostly used in Aegean coast by touristic facilities. While total capacity of desalination plants had been merely 3,600 m^3/day in 2002, today it is nearly 31,000 m^3/d. It is expected that before the end of 2008 total capacity will reach 120,000 m^3/d and this is expected to triple in 5 years.



Picture 7: Inside desalination plant in Alicant, Spain. © Isaac Vega / WWF Spain

3 Consideration of climate change

The Mediterranean region is strongly exposed to climate change effects as recorded in meteorological documentation, leading to increasing and chronic droughts and risk of desertification. According to the "Plan Bleu" project of UNEP about climate change the Mediterranean region is a "hot spot of climate change", predicting until the end of the century a temperature increase from 2 to 5°C, and decrease of up to 2.7 % of precipitation with increasing canicular days, fires and floods.[78]

Prognosis predict a temperature increase beyond the critical threshold of 2°C, what may additionally impact on ecosystems and biodiversity with unknown consequences for the entire land and resources management. Facing these natural risks, additional to possible salt water intrusion and the consequences of human made impacts, countries are recommended to engage in climate change adaptation and mitigation measures. Because of the direct relationship between climate change and higher risks for chronic droughts, water scarcity and desertification, it is important also to consider the contributions of the Mediterranean countries to reduce CO_2 emissions, because indirectly by ignoring climate change, they might counter any effective direct water management measures.

Targets of the Kyoto Protocol

The Kyoto Protocol under the United Nations Framework Convention on Climate Chance (UNFCCC) sets binding targets for industrialised countries to reduce their greenhouse gas (GHG) emissions, adding up to a total cut of at least 5% from 1990 levels in the "commitment period" 2008 - 2012. The Kyoto Protocol covers emissions of the six main greenhouse gases: Carbon dioxide (CO_2); Methane (CH_4); Nitrous oxide (N2O); Hydrofluorocarbons (HFCs); Perfluorocarbons (PFCs); and Sulphur hexafluoride (SF6).

Each Annex I Party to the UNFCCC has a specific emissions reduction target listed in the Annex B of the Protocol, which is set relative to the GHG emissions each industrialised country had in its base year. The Annex B emissions target and the Party's emissions of GHGs in the base year determine each Party's initial assigned amount for the Protocol's five-year first commitment period 2008–2012.[i]

Under the Kyoto Protocol, the European Community agreed to reduce its GHG emissions as a whole by 8% until 2012. This target is shared between the 15 EU old member States under a so-called "Burden Sharing Agreement", which sets individual differentiated emissions targets for each member state. As such, Greece and Spain can increase their emissions by 25% and 15% respectively by 2012 compared to their base year, while France has to keep its emissions at the same level as its emissions in its base year.

Morocco is a non Annex I country and it has not a specific target in the Kyoto Protocol. Turkey was not a Party to the UNFCCC when Kyoto Protocol was adopted in 1997[79], therefore there is no quantified emissions limitation or reduction commitment for Turkey yet.

Greece

Under the Kyoto Protocol, Greece is allowed to increase its emissions by 25% in 2012 compared to the base year level. In 2006, the emissions of Greece were already 24.6% above the base year levels. Emissions from Energy accounted for 81.8% of total GHG emissions (without LULUCF) and increased by approximately 35% compared to 1990 levels. According to the national action plan, Greece aims to achieve the target of the Kyoto Protocol mostly through the European trading scheme, the promotion of natural gas and renewable energy, as well as through the buildings directive and the landfill directive. However, the progress of Greece towards meeting its target is not significant, since many of the measures considered in the action plan, have either not been implemented yet or their implementation has been extremely delayed. Such examples are the buildings directive 2002/91, which has just been transposed to the Greek law in 2008 (2 years after the deadline) and the target for the renewable energy share in the national energy mix in 2010, which is most likely not going to be achieved. There are no specific information on whether and how droughts would affect the measures planned like hydropower use or desalination plans to abate GHG emissions in Greece today or in the future.

Tab. 14: Overview of annual differences in Spanish energy production, consumption and emissions

	Difference Nov 07/ Nov 08	Difference Dec 07/ Dec 08	Difference Feb 07/ Feb 08
Hydropower production	-50%	-70%	-63.9%
Energy consumption	+10%	+4.2%	+7%
CO_2 emissions	+42%	+49.8%	+18%

Spain

In 2007, greenhouse gases emission had increased in 52.3% since 1990, which implies that Spain is emitting 37.3% more than what it committed to do when signing the Kyoto Protocol (15% increase on the 1990 baseline).[80] In 2006, the energy industry was responsible for 78.5% the greenhouse gases emission.[81]

An important impact of drought on CO_2 emission is the decrease in the production of hydropower and the consequent increase in the use of less clean energy sources. For example, in November 2007, the hydropower production has been 50% lower than in November 2006, which, coupled with an increase of 10% in the consumption, implied an increase of +42% in CO_2 emissions in comparison with November 2006. Similarly, comparing December 2006 and December 2007: -70% hydropower production, +4.2% energy consumption, + 49.8% CO_2 emissions. The difference between February 2007 and February 2008 followed similar trends: -63.9% hydropower production, +7% energy consumption, and + 18% CO_2 emissions (Tab. 14).[82]

Turkey

Turkey's First National Communication Report was submitted to the UNFCCC Secretariat in March 2007. The report is an important document covering the Inventory of Greenhouse Gas Emissions, shedding light on policies, planned measures and future projections. According to the report, Turkey's total greenhouse gas emission has increased by 74% between the years 1990-2004, summing up to 286.3 million tons (Tab. 15, Tab. 16) and placing Turkey on 22nd place on the list of world greenhouse gas emissions.[83]

Turkish Council of Ministers decided in June 2008 the adoption of the Kyoto Protocol, but Turkey refrained from adopting the Protocol due to its special status. However, in the face of the recent developments concerning the post-2012 process Turkey needs to become a part of the Protocol and take a role in the process. The Protocol will be ratified by the Turkish Grand National Assembly as soon as possible.

Tab. 15: Overview of Turkeys Green House Gas

Turkey's Greenhouse Gas Emission Values	
1990-2004 Total increase in GHG Emissions (million ton CO_2)	126.5
Total Change in Emission (%)	74%
CO_2 Emission	231.0
Total GHG Emission	286.3

Tab. 16: Increase of Emissions per Sector in Turkey

Sector	Increase 1990-2004 (%)
Energy	72
Industry	102
Agriculture	18
Waste	331
Land/Forestry	70

4 Future Scenarios

The combination of climate change trends and impacts and often inadequate water governance and use described in the chapters above will define how "freshwater" future scenarios for the Mediterranean countries will look like. Will the economic growth be affected by water scarcity; is the countries energy security at stake, what environmental impacts will be there in the long run? The following paragraphs try to provide an overview of likely scenarios from an environment, economic and social perspective, both extrapolating existing trends in the region and also taking striking examples from another continent (Australia).

Environmental Scenario

The assessment of the current situation suggest that it is very unlikely that water management and in particular the irrigation sector will considerably improve over the coming years in the Mediterranean countries. The European Commission (EC) has just recently decided to continue with their harmful subsidies for irrigated cotton production in Greece and Spain, not conditioning them to better and more efficient water management practices, even though the reform of the Common Agricultural Policy is asking for it. This also applies for all other subsidies provided by the EC, which are not linked to improved and more efficient water management. Likely more dams will be built, to store the decreasingly rains. Deeper boreholes will be drilled and many of them illegally or without any control on the pumped volumes.

The Governments control of water used and the law enforcement will not be able to follow the pace of these developments, also because if they enforce efficient water management, they will then seriously impact their "own" local economies. Even though the risk of droughts are recognised and considered in the planning of programmes, the real implementation still does not adequately take into account and strive to mitigate their potential environmental impacts. As a consequence water abstraction will increase and rivers and wetlands will further dry out, below the levels needed to maintain at least a minimum flow. Also as a consequence, protected areas, both designated under national and European laws depending on that water will in future seriously suffer or loose the majority of their biodiversity values and species. All efforts to make sure that those protected areas are more drought resistant are in vain, if the overall water use for agriculture and other sectors will continue to increase or "only" be maintained at the same level, if the water availability continues to be reduced by the future climate change.

Economic Scenario

The current economic impacts of droughts are considerably, reaching several billions of Euros annually. If droughts are becoming a chronic phenomenon, then the countries will have to consider them in their economic growth scenarios, in particular if irrigated agriculture is getting more difficult or is no longer possible. In the Murray-Darling basin in south-east Australia, which is about the size of France and Spain together, a continuous drought since 2002 has reduced agricultural production by 25 % for whole Australia and is likely to reduce the economic growth of Australia in 2008 by up to one percent[84]. This provides just a short-term scenario for the agricultural production, but also other sectors like tourism, industry, energy supply and of course the supply of drinking water will be affected by chronic droughts and water scarcity by overuse of water. If tourists have to face rationing of water during their summer holiday, they will likely not return the next year. The reduced provision of hydropower already has had impacts on the energy supply in Italy and Spain in the last years, as well as the shut down of nuclear plants in France in 2003 due to the problems related to low water levels and the cooling water supply. Tourism represents a major share of the GDP of the Mediterranean countries, and if that is affected it might have equal economic impacts like on the agricultural sector.

Social Scenario

In the case of the Murray-Darling basin, many farmers go bankrupt, are not able to pay back their loans and leave for the cities. The rate of suicide amongst farmer has also increased considerably there. Agriculture is generally the backbone of the rural economy in many Mediterranean countries.

Already today, there is a trend of migration into cities, leaving the old generation back in the villages and countryside, with decreasing social services available to them. Traditions and the social network in the rural areas will seriously impacted by chronic droughts, directly by the economic impacts, but also indirectly by the younger generation fleeing to the cities and the job opportunities offered there. In the cities, this influx of rural migrants also stretches then further the social services, housing and the employment opportunities.

Picture 8: Irrigation expansion in southern Spain. © Dorothea August / WWF

5 WWF engagement in the Mediterranean region

The Mediterranean biogeography region supports eight types of ecosystems which were identified by WWF with the framework of an global assessment amongst the Global 200 types of ecosystems with specific importance for the global conservation of biodiversity.

5.1 Regional framework

For many years now WWF has been focusing its regional policy work on improving water management practices so that they can deal with increasing demands for water use and acceleration of climate change. In the framework of existing legislation WWF supports and works for the effective implementation of WFD and to foster water resources management. Supporting the Water Framework Directive implementation means also seeking law enforcement and critically assessing costly technical solutions either from desalination technologies or from other technical "one-way routes", such as water transfers.

Part of this engagement is also the participation in the EU Commission working group for the Common Implementation Strategy (CIS) on drought. In a broader context this engagement covers not only the legal water management, integrated land-use and agricultural planning processes, but also forest fires, infrastructure planning and the consideration of climate change adaptation and mitigation measures too.

While policy work builds the overall framework, field projects for the conservation and restoration of water related ecosystems and rivers are very much fostered and pushed forward, being essential for building up the resilience to drought of aquatic ecosystems and also for the supply of abundant and good quality water.

5.2 WWF projects and field work activities

WWF tries to combine the policy work at regional and national level with testing and implementing in the field of what we "preach", and learning lessons from the field to further refine our policy work. In the past years, experiences, threats and impacts caused by drought have pushed for and led to the development of more targeted mechanisms to better manage drought within the Mediterranean region[40], from 2006 to date, which are described in the paragraphs below.

Greece

WWF Greece is working on water policy issues in an effort to improve water management in the country and as a result, improve water efficiency in different water uses. To this effect, and regarding water resources, WWF Greece pursues the effective implementation and improvement of the existing legislation, which is the proper implementation of the EU Water Framework Directive, as a fundamental means and end for the achievement of an effective national environmental policy. Additionally WWF Greece focuses on specific key policy issues that require short or longer term coordinated lobbying and advocacy efforts. The overall targeting of this effort is decided in accordance with identified drivers and conservation change mechanisms. Currently and for the past few years, WWF Greece is fighting with lobbying, communications and legal tools against the irrational and destructive diversion planned for the Acheloos River.

Regarding freshwater management in general, WWF Greece also implements field projects, namely the survey and mapping of the network of small island wetlands and their biodiversity. Those wetlands are a valuable source of water for people and nature. In additional, WWF Greece is involved in activities related to the conservation of the transboundary Prespa Park, where coordinated activities for integrated water management is a top priority.

Morocco

The Mediterranean Programme (MedPO) of WWF is largely involved and implementing a number of site specific projects, besides the overall engagement in national and regional water and sector policies. It is part of the commitment to influence the European Neighbourhood Policy in Morocco towards contributing to the preservation of freshwater ecosystems and sustainable water management.

In collaboration with a consortium of partners MedPO is currently conducting a project on how to interface policy and research and take advantage of the experience in the EU in terms of integrated water management with a focus on water quantity problems. Thus the applicability of the WFD was tested with economical analysis in the Sebou river basin. The

project ended in April 2008 and results showed that if no actions are implemented by 2015, the Sebou basin will face problems of water quantity in some important aquifers such as Saïss and deterioration of water quality surface waters.

Rice Farming in Merja Zerga
Currently a project on the rice cultivation is being executed in the Merja Zerga region. Within this project the techniques of the System for Rice Intensification (SRI)[85] are being tested aiming to halve the water used in rice production, while still increasing productivity and yields with respect to local conditions.

Spain
There is a broad range of projects and policy work being executed and further developed by WWF Spain. WWF promotes net water saving mechanisms through a) the modernisation and optimisation of irrigation systems, b) fostering rain fed agriculture and more strategic planning for agriculture as well as c) training for farmers and agricultural professionals on specific water saving technologies.

This is embedded in larger policy work at national and regional levels and active involvement in water law reforms to strive for sound instruments to deal with drought. WWF is also deeply involved in the WFD planning process to have a suitable planning framework to manage droughts, including support of work alternatives to satisfy new water demands, either by proposing more environment friendly solutions or by pointing out the un-sustainability of the claimed water demands. Therefore WWF is closely involved in water markets debate to ensure the application of environmental constraints in the water transactions and in the fight against illegal use of water, e.g. by active involvement in special plans against illegal use of groundwater in Guadalquivir and Guadiana basins.

The creation of a national river restoration strategy to make rivers more resilient to drought stress is strongly supported by WWF, in line with dam decommissioning and removal, critical opposition of new water transfer schemes (e.g. Sorbe-Bornoba, close to Madrid) and active support of the definition of adequate instream flow regimes in order to enable rivers to cope with drought stress and to conserve their biodiversity.

Strawberry Farming in Doñana
Strawberry is one of the main crops – in terms of both cultivated surface and environmental impacts – of the Doñana area, in the Guadalquivir river basin (Andalusia). This area hosts almost 6,000 hectares of strawberry fields and produces about 60% of the Spanish strawberries. Since this cultivation is having important impacts on the quality and quantity of water in the Doñana Wetlands National Park, in the 2006-2007 strawberry campaign WWF Spain carried out Hidrofresa, a water saving project focused on strawberry farms. Hidrofresa applied the most advanced irrigation techniques to a pilot strawberry farm, to show local farmers that it was possible to save up to 30% of the normal water rate without affecting the quality of the production.

In parallel to this pilot project WWF Spain has established agreemenents with the private business sector to apply more strict water-related environmental standards to strawberry farming in Donana. In this way, WWF seeks to contribute to nature conservation in the area also through the creation of market demands for more sustainable products.

Turkey

The well established cooperation between the Ministry of Environment and Forest (MoEF) and WWF has significantly advanced and helped for the designation of 12 Ramsar Sites in Turkey with a total of 179.482 hectare. The Government with the assistance of WWF are preparing the designation of further 20 potential Ramsar Sites. Management Plans for the important wetlands were developed, in close collaboration with that Ministry which are already being implemented at Uluabat Lake, Salt Lake and Egirdir Lake; and are under preparation for Eregli Marshes, Bafa Lake and the Fırtına Valley.

Agriculture in the Konya Basin

The growing pressure from agriculture sector requests a strategic shift in the use and management of water resources in the Konya Closed Basin towards an Integrated River Basin Management. WWF-Turkey has conducted research on groundwater, agriculture and the socio-economics as an important basis for river basin management plan.

Further to this 18 pilot projects on modern irrigation methods in a total area of 27 hectares have been implemented and more the 1500 farmers were trained on agricultural water savings. In addition, an artificial wetland treatment project in Uluabat Lake was implemented. Management Plans for the Salt Lake and Eregli Marshes were prepared through several workhops with various relevant stakeholders in the respective regions. The implementation of the plans are coordinated by MoEF and WWF-Turkey. Within the Salt Lake Management Plan, waste water treatment plants and solid waste storage plants are under construction and will be completed in 2009.
Besides this specific nature protection was achieved by designation of 2 more Ramsar Sites: Kizoren Lake and Meke Lake.

Finally the agricultural water use, highlighted in WWF-Turkey's recent freshwater campaign, became nowadays one of the most important issues in the government agenda.

Picture 9: Field project in the Konya basin, Turkey. © WWF Turkey

6 Recommendations

Water is everybody's issue and it is a limited resource that has to be maintained, used and managed wisely. An integrated and sustainable water management in the Mediterranean does require immediate actions from all stakeholders, including governments, local decision makers, private sector, farmers and retailers, water management authorities and individual citizen.

6.1 Recommendations to National and Regional Governments and the European Commission

WWF urgently asks all Mediterranean countries to follow up and implement existing European and National Policies towards the management of water demands, increasing the efficiency in water use and applying integrated and sustainable water management schemes, based on the availability of their water resources. The following are the main recommendations to the Governments:

- **Legislation and Law Enforcement**: All efforts should be aimed at maximizing opportunities within the existing legal framework, and giving the highest priority to the ambitious implementation of the WFD, as well as rigorously integrating water concerns into relevant EU policies. The WFD will only be successful if other policies that have a major impact on freshwater ecosystems (land-use planning and agriculture, urban and industrial planning, etc), all work towards the same objectives. Laws should be effectively enforced and sanctions applied for those who misuse or illegally use water; Mechanisms for monitoring and control of illegal activities should be established together with regulations being developed to close illegal wells.
- **Attention to Water Scarcity and Drought Issues in Regional Consultations and Negotiations**: Water scarcity needs to be on the top of the priorities in bi- and multilateral relations among Mediterranean countries, as some of the river basins cross borders and water transfers happen across countries. The EU should ensure that water scarcity is on top of the priorities of the European Neighbourhood Policy (ENP) the regional strategy for the Mediterranean region. Funding for water scarcity and drought under the ENP Regional Strategy for the Mediterranean should be tied to cross compliance with environmental criteria and the wise use of water resources.
- **Demand instead of Supply Management and Incentives**: The management of water resources has to be developed in a more demand and no longer just supply oriented manner. Turning over the management should also change subsidise mechanisms, e.g. the EU funds via the Common Agricultural Policy towards efficient irrigation agriculture taking into account water availability and climate change impacts. Agriculture policy also needs to ensure effective compliance, excluding for instance those illegally using water from the list of subsidy beneficiaries.
- **Water Pricing**: Countries have to urgently approve and/or decidedly enforce regulations related to water use permits, water consumption measuring, and adequate water pricing;
- **Integration of Drought Management Plans into Other Regional, Sectoral and Water Management Planning**: Drought plans should be integrated into normal management plans, in particular the Water Framework Directive implementation plans, to ensure that exceptional situations are taken into account in normal planning. Exceptional and prolonged droughts due to meteorological conditions should be clearly distinguished from structural deficits due to an imbalance between increased water demand and available resources. All developments and planning should adopt an Integrated Water Resource and River Basin management (IWRM & IRBM), which incorporates an integrated, basin-scale and for water transfers also regional attitude towards the most efficient management of water resources.
- **Spatial planning and agriculture**: An overall framework for economic development in rural areas is needed. This should take into account in equal terms natural conditions, resource availability and social needs as well as economic potentials. Therefore it is necessary to establish mandatory land use planning regulations that look at the available water resources beside the overall framework.
- **Development of water infrastructure (dams, reservoirs, inter-basin transfers)**: Before considering the development and construction of new water infrastructures the natural capacities and values of water ecosystems, but also the potential of water savings through efficiency gains should be evaluated in a consistent manner. Water infrastructure projects should be based on

comprehensive demand calculations. All planned projects should have cost-benefit analysis taking into account the environmental, social and economic factors within a comprehensive Environmental Impact Assessment, also considering alternative development options and possible effects of climate change.

- **Desalination**: Technologies to desalinate either sea or brackish water can neither replace an integrated water management or compensate structural water deficits or cover up for inefficient water use that is caused by the over-exploitation of natural water resources. Therefore any desalination plant projects should be carefully assessed similar to any new water infrastructure planning;
- **Working with Nature and Environmental Protection**: Authorities should recognize the environmental services nature can offer concerning water quality and quantity, delivered by healthy ecosystems. These are central to delivering 'good water status' and are instrumental in mitigating the effects of droughts. Therefore restoring and conserving rivers, wetlands and floodplains should be an integral part of water management plans.
  - Impacts to protected areas caused by water deficits should be assessed and monitored, and cases where protected area legislation is violated should be sanctioned; the impacts on biodiversity outside designated protected areas (represented through habitats, connectivity, species and population trends) by water abstraction and use should be equally monitored and measures taken to reverse damages and prevent further deterioration;
  - Special restoration and rehabilitation programmes should be provided with sufficient financial support immediately to restore natural ecosystem functions and services.
  - Overall the economic activities have to adapt to the amount of water available locally and ensure that environmental flows are considered and secured.

6.2 Recommendations to the Agricultural Sector and Companies

WWF urges the agricultural sector to foster the development and implementation of policies that ensure a) an orientation of the sector towards the water availability in their region and water basin and b) a major improvement of efficiency in water use. All over the Mediterranean the agricultural sector still needs better guidance and investments for efficient irrigation networks and local plot management in order to save water, but also clear limits set for any further expansion of irrigation agriculture.

Integrated and sustainable agriculture should meet the following requirements:

- Legal access to irrigation water based on use permits issued by respective water management authority;
- Measuring of water use with flow-meters in order to monitor extraction;
- Installation of innovative irrigation technologies providing additional climate, soil and plant data to further reduce water waste;
- Consideration of environmental flows and minimum water needs to sustain ecosystem functions of rivers and wetlands;
- Further enlargements of irrigation areas or cultivation of crops with more water needs should only be considered if all measures concerning irrigation efficiency have been implemented and the availability in the respective river basin has been clearly identified, balanced with all other water users, including "nature" and potential donor basins; this means in almost all known cases a ban on further expansion or increased water use!

6.3 Recommendations to Consumers

Water management is not just a matter of governmental and market regulations, but also refers to individual and society awareness and consumption patterns. However, there are only limited choices currently available for consumers.

- **Fruits, Vegetables and other Agricultural Products**: All the agricultural products have an embedded virtual water use. However, there is no water certification scheme or any labels which helps consumers to choose those products with the lowest water footprint. The only option for Northern European customer would be to avoid buying their fruits and vegetables outside the regular season and to buy regional products. However, WWF's objective in the Mediterranean is about changing current water use management practices and to provide incentives for supermarkets and retailers to develop with their suppliers and the farmers in the Mediterranean the most water efficient production possible. If consumers address the water footprint with their supermarkets, then this will help to create the awareness and interest of those companies to shift towards a more water efficient agriculture.
- **Tourism**: Every individual who is travelling in the region should be aware of the water scarcity and impacts possibly caused by their water use. There are so far limited choices available for choosing environmental friendly hotels, but certainly playing golf should by preference done in Northern European countries, and not in the Mediterranean.

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Abbreviations

°C	Centigrade
CAP	Common Agricultural Policy
CIS	Common Implementation Strategy
CO^2	Carbon dioxide
DEI	Greek Public Power Corporation
DPM	Departement
EC	European Commission
ENP	European Neighbourhood Policy
EU	European Union
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GHG	Greenhouse Gas
Ha	Hectare
IGME	Greek Institute of Geology and Mineral Exploration
IRBM	Integrated River Basin Management
IRENA	Indicator Reporting on the Integration of Environmental Concerns into Agriculture Policy
Km	Kilometre
kWh	Kilowatt hour
L	Litre
l/hab/day	Litre per habitat per day
M m^3	Million cubic meters
MED	Multiple effect distillation
MedPo	WWF Mediterranean Programme
MW	Megawatt
NTUA	National Technical University of Athens
ONEP	Office National de l'Eau Potable – National Drinking Water Office Morocco
RO	Reverse Osmosis
SMS	Système Maghrébin d'Alerte à la Sécheresse
SRI	System for Rice Intensification
TGNA	Turkish Grand National Assembly
TWh	Terawatt hour
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Chance
WFD	Water Framework Directive
WWF	World Wide Fund for Nature

Legend

1 m^3	1,000 l
1 M m^3	1,000,000 m^3= 1,000,000,000 l
1 km^3	1,000,000,000 m^3 = 10^{12} l
1 ha	10,000m^2
1 km^2	1,000,000m^2 (100ha)

WWF Germany
Freshwater Programme

Rebstoecker Straße 55
60326 Frankfurt am Main
Germany
Tel.: +49 69 79144 - 10
Fax: +49 69 79144 - 231
E-Mail: geiger@wwf.de

WWF European Policy Office

168 avenue de
Tervurenlaan Box 20
1150 Brussels
Belgium
Tel.: +32 2 74388 - 00
Fax: +32 2 74388 - 19
E-Mail: wwf-epo@wwfepo.org

WWF Mediterranean Policy Office

Via Po 25c
00195 Rome
Italy
Tel.: +39 06 844 97227
Fax: +39 06 841 3866

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WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by
- conserving the world's biological diversity,
- ensuring that the use of renewable resources is sustainable and
- promoting the reduction of pollution and wasteful consumption.

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