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Water and the green economy : challenges, risks and opportunities around the Mediterranean

Alba SERNA

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This synthesis «**Water and green economy : challenges, risks and opportunities aound the Mediterranean**» was performed by **AIba SERNA**, student in the AgroParisTech-ENGREF specialized master "Water Management" (post-master degree) in Montpellier.

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SYNTHESE TECHNIQUE

Water and the green economy : challenges, risks and opportunities around the Mediterranean

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DWS	Drinking water supply
AFD	French Agency for Development
CC	Climate Change
CMI	Center for the Mediterranean Integration
ESE	Ecosystem Services Evaluation
EU	European Union
GDP	Gross Domestic Product
IRSTEA	National research institute of science and technology for environment and agriculture
IWRM	Integrated Water Resources Management
MDG	Millennium Development Goals
MWI	Mediterranean Water Institute
OECD	Organization for Economic Co-operation and Development
PAC	Common Agricultural Policy
PPP	Private-public partnership
R&D	Research and Development
SEMC	South and East Mediterranean Countries
WFD	Water Framework Directive

ABSTRACT

The environmental dimension of development – considered one of the most durable development pillars along with economic and the social ones – has been completely ignored up to date, with natural resources being exploited both irrationally and exhaustively. The green economy is presented as the necessary changes to be implemented in current economic modeling in order to reconcile developmental and environmental pressures within a multi-sectoral approach (including agriculture, tourism and industry sectors) through resource efficiency. Water is one of those resources considered as key for development. However, water availability is increasingly limited with future prospects discouraging.

The Mediterranean basin region perfectly illustrates the challenges of world sustainable development, specifically in the water sector. Mediterranean countries' economies are highly influenced by water and soil resources and, as a consequence, significant differences in terms of development are being created between North Mediterranean Countries and South and East Mediterranean Countries (SEMC), resulting in a more severe vulnerability for SEMC. In 2010, the Arab Spring highlighted the desire for change by SEMC citizens towards a new model in which development becomes more participative, inclusive and sustainable.

The aim of this paper is to analyze the stakes, risks and opportunities for the transition towards a green economy in the Mediterranean Basin in order to understand the fluctuating investment dynamics and their impacts in Mediterranean countries.

KEYWORDS

Green Economy, Water, Mediterranean, Water efficiency, Water Supply Management, Water Demand Management, Ecosystems.

RÉSUMÉ

La dimension environnementale du développement – un des trois piliers fondamentaux avec l'économique et le social - a été négligée jusqu'au présent, en exploitant les ressources naturelles de manière irrationnelle et exhaustive. L'économie verte est conçue comme le changement requis dans le modèle économique actuel pour réconcilier le développement avec l'environnement sous une approche multisectorielle (incluant les secteurs agricole, tourisme, industrie et services) sens l'efficience. L'eau fait partie des ressources clef pour le développement. Par contre, la disponibilité en eau devient de plus en plus limitée.

Le bassin Méditerranéen illustre parfaitement les défis mondiaux vers le développement durable, notamment dans le secteur de l'eau. Les économies des ces pays sont en forte dépendance de l'eau et du sol, ce qui cause des énormes disparités entre les pays du nord et ceux du sud et l'est de la méditerranée (PESM), qui se traduisent par une très grande vulnérabilité pour les PESM. En 2010, le printemps arabe a mis en évidence la revendication des citoyens du PESM d'une nouveau modèle de développement plus participatif, intégré, durable et équitable.

Ce document de synthèse analyse les enjeux, risques et opportunités de l'eau et l'économie verte autour de la Méditerranée afin de comprendre la dynamique des flux des investissements et ses impacts dans les pays de la Méditerranée.

MOTS-CLÉS

Économie verte, Eau, Méditerranée, Efficience de l'eau, gestion de l'offre, gestion de la demande, écosystèmes.

CONTENTS

CONTEXT AND BASIC NOTIONS

The current global growth system has been shown to be not only unsustainable but inefficient (World Bank, 2012a). The environmental dimension of development - considered one of the durable development pillars along with economic and social ones (figure 1) – has been completely ignored up to date, with natural resources being exploited both irrationally and exhaustively (World Bank, 2012a). As a consequence the world's population is faced with a pessimistic scenario with recurrent crises, where the lack of resources might lead to a serious outcomes (lack of livelihoods, water scarcity, social conflicts…) Solving the environmental crisis is thus a prerequisite to ensure sustainable development (Herrero, 2014).

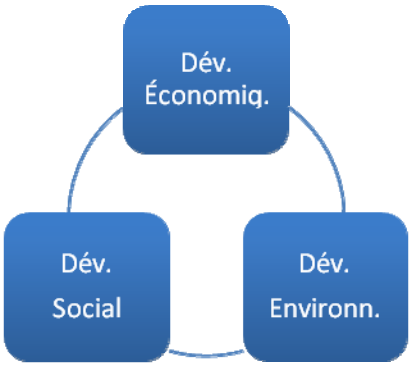

Figure 1 – Sustainable development pillars (Rio+20)

Water plays an essential role in human development. However, water availability is not guaranteed for the future, due to natural and anthropological factors (UNEP, 2011). This situation is more serious in those countries with a higher vulnerability level, as the South and East Mediterranean Countries (SEMC), which is caused by a combination of unfavorable natural conditions, climate change and socioeconomic constraints (Fernandez and Thivet, 2012).

Throughout this paper what is meant by the transition towards a green economy in water sector will be analyzed. This will mean examining any transitions that should be carried out in the short-term and in an efficient way in order to prevent countries remaining locked in unsustainable economic models and to prevent irreversible environmental damage (World Bank, 2012a).

GREEN ECONOMY

The notion of green economy appeared in 1789, when natural resources stock and environment quality were added as variables in economic production (Malthus, 1798). However, it was not until the 1970's that this notion was developed through economic theories that considered "natural capital" as an input in the production and economic growth function (World Bank, 2012a).

The green economy is currently a new economic paradigm. Economic activity must involve an improvement of well-being and social equity, while significantly reducing ecological scarcity risks (UNEP, 2012). Briefly put, the green economy is defined as an economy with the following characteristics: low CO_2 emissions rate, sustainable resources management –efficient and optimal-, and which is socially inclusive (Brender, 2012).

According to the United Nations Environmental Program (UNEP), the transition towards a green economy can be achieved by investing 2% of annual total Gross Domestic Product (GDP) from now up to 2030 in two fields covering ten areas: the field of "natural capital", including the basis of primary production industries: agriculture, fishing, forestry and water; and the field of "physical capital": transport, energy, industry, waste, tourism and construction (UNEP, 2011).

GREEN GROWTH

Green growth is a strategy to promote economic growth and social development, while ensuring natural assets continue to provide the resources and the environmental services needed for our well-being (OECD, 2011b). The economical changes needed for green growth are introduced by implementing green economy measures (UNEP, 2012; WWF, 2012).

Green growth is presented as "the necessary solution", efficient and affordable, to make the current growth system sustainable. It is defined as necessary, to stop environmental degradation, as efficient, in resources using, and as affordable through self-funding (in some cases), market and R&D stimulation (World Bank, 2012a).

DIFFERENCES BETWEEN APPROACHES

The terms 'green economy' and 'green growth' are often used as synonyms whereas there are some important differences according to the development model of reference, an issue currently under discussion (Redaud, 2013; Herrero, 2014; WWF, 2013).

The green growth development model is based mostly on an economic growth approach; the other 2 pillars considered in Rio+20, the social and the environmental ones, even if they are considered as important, they are not of primary importance. Nevertheless, the green economy development model is included in the framework of the three pillars, checking constantly the accomplishment or the improvement of all the three of them (Rieu, 2013).

As previously mentioned, the green economy is the paradigm of sustainable development and is the subject of multiple current discussions. For example, water and the green economy will be one of the main subjects in 7th World Water Forum, which will take place in Korea in 2015 (WWF, 2013).

WATER AND THE GREEN ECONOMY AROUND THE MEDITERRANEAN

Throughout history human progress has been strongly dependent on water availability and social skills which afford the use of water as a productive resource (PNUD, 2006). Nowadays, the distribution of water withdrawals is mainly for agriculture (70%), industry and energy (20%) and human consumption (10%) (UN, 2014).

Unfortunately, freshwater is scarce and is inequitably distributed. In the Mediterranean basin, France, Italy and Turkey receive half of the total rainfall, while in the whole of the southern countries rainfall represents only 10% of the total (Fernandez and Thivet, 2012). Low rainfall and growing water needs, caused by a significant non-controlled demographic growth, has created a scenario where more than 180 million people are defined as water-poor (UN, 2014).

In figure 2[1], we can observe the water stress index due to water[2] withdrawals in the Mediterranean basin. The regions suffering the greatest stress levels are in the south. These disparities, which characterize the economical status of the countries, are responsible for important fractures in the basin. In figures 3, 4 and 5 we can identify the origin of water stress according to its use: agriculture, industry/energy or human consumption.

[1] UN-Water, 2013. UN-Water Statistics. Available on the Internet: http://www.unwater.org/statistics.html, [Accessed on 19/10/2013]

[2] Surface water and groundwater withdrawals

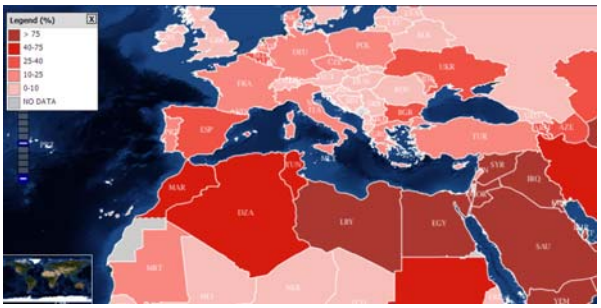

Figure 2 – Percent of freshwater resources withdrawn (%)

Figure 3 - Agricultural water withdrawal as a percent of total withdrawal (%)

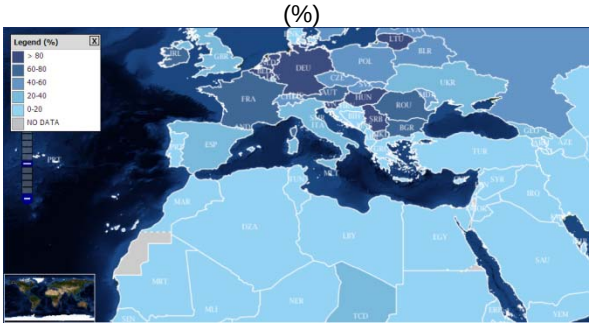

Figure 4 - Industrial water withdrawal as a percent of total withdrawal (%)

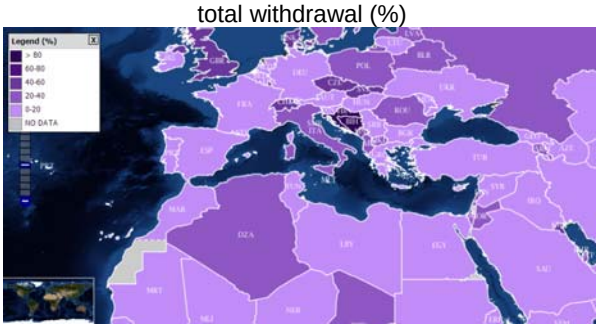

Figure 5 – Human consumption water withdrawal as a percent of total withdrawal (%)

Thus, in SEMC and Spain, we can note that freshwater withdrawn stress is a consequence of its utility in agriculture, whereas in France (and the rest of northern countries) freshwater stress is originated by industrial and human consumption use. However, it is important to notice that this cartography analyses water withdrawals and not water consumption, in which the agricultural sector remains the first cause of water stress around the basin (Rieu, 2013).

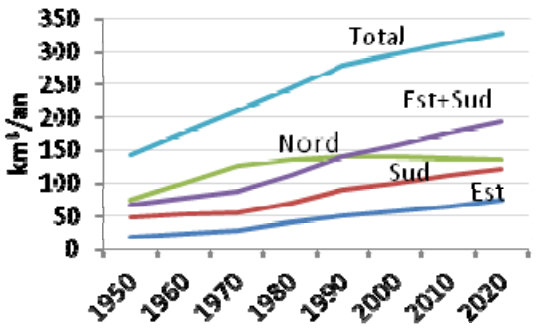

Figure 6 – Global water demand (Basin Mediterranean)

Water demand prospection shows a continuously growing pattern caused by a certain number of factors such as demographic growth, living-standards improvements, water resources overexploitation, ecosystems degradation and climate change effects (figure 6). The total water demand in the Mediterranean basin is predicted to exceed 330km^3 p.a. in 2025 (Icard, 2008; Rieu, 2013).

Confronted with this scenario, the primary challenge for the water sector is to reconcile water demand and availability in a sustainable way.

Figure 7 shows the forecast of the evolution of water demand and its availability in a business-as-usual scenario (UNEP, 2011). The dotted demand curve shows the evolution of demand within the current system (no technological improvements), while the continuous demand curve takes into account the future evolution of technology that should take place in the future. These improvements will contribute to reducing water demand by up to 20% by the year 2030 (UNEP, 2011). Global water resources remain stable but once again due to technological improvements, such as the discovery or exploitation of new aquifers, the water available will increase up to 20% in

15 years. Nevertheless, the technological improvements are not sufficient to approach the two curves, remaining the water demand curve highly superior to the availability one[3].

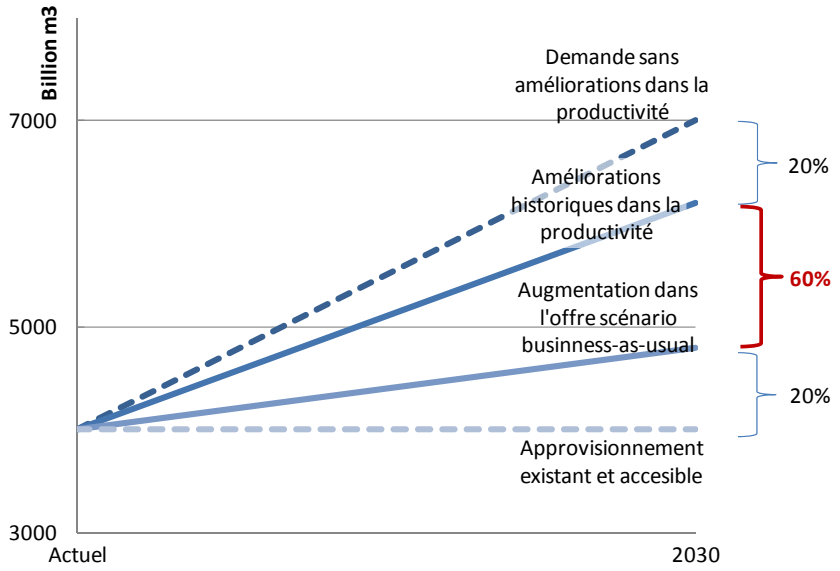

Figure 7 - Forecast of water demand and offer evolution

Within this framework, Mediterranean countries should plan their strategies to fight this water crisis. The Green Economy stands for solutions fulfilling the three pillars of Rio+20: planning policies should focus on sustainable solutions and not only on new resources mobilization (Rieu, 2013). As a general approach, we should consider that there are no right or wrong solutions, but adapted to a scale and/or to a period of time (Dugot, 2006).

WATER AND THE GREEN ECONOMY: CHALLENGES

DRINKING WATER AND SANITATION

The commitment to accessibility to drinking water and sanitation services is universal. Indeed, it was declared a such a right by the United Nations in 2010 (ONU, 2010). In addition, the Millennium Development Goals established specific objectives for basic services accessibility before 2015 (ONU, 2000). In effect, the lack of accessibility to water and sanitation entails expensive consequences for social (in terms of health, education, etc.), environmental and economical development.

In 2004 in the Mediterranean Basin, over 20 million of people didn't have access to drinking water and over 47 million didn't have access to proper sanitation. This issue is geo-localized, particularly in the SEMC and especially in rural areas (Plan Bleu, 2013).

[3] 2030 Water Resources Group, 2009. *Charting our water future; economic frameworks to inform decision-making.* 1 éd. McKinsey & Company, 198 p.

FOOD SECURITY

The SEMC present good conditions to conduct agricultural activity: good soil availability and a strong rate of hours of sunshine. In order to ensure food security, government policies tend to promote the increasing of land crops (frequently irrigated) and the intensifying of agricultural productivity with heavy investments (Roignant, 2007). Nevertheless, a more efficient water management may bring an increment of livelihoods whose surplus could be sold in internal markets..

Confronting food security in a water scarce situation must be undertaken under a global and complex approach which is the result of a combination of the available strategies. One of the options is to stimulate the production of less water demanding crops, taking scarcity reasons into account (Rojat, 2013). Another option is to promote irrigation crops destined for external markets, which are generating substantial incomes that would be used to authorize imports to complement the food security of citizens (Rieu, 2013).

INCOME GENERATION

Agriculture remains the primary source of income for several families in SEMC and it is one of the most important economical sectors in the region, generating wealth through external markets. International food exchanges entail virtual water[4] exchanges which represent water transfers between countries. As shown in figure 8[5], SEMC are virtual water importers, which seems logically correlated with the low water resource availability. Commercial and food security strategies also have an influence in the virtual water flux between countries (Fernandez and Gaëlle, 2008).

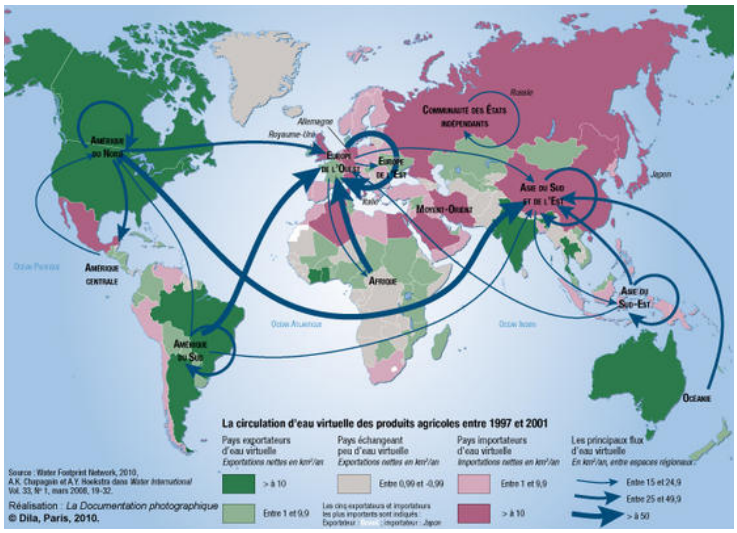

Figure 8 – Virtual water exchanges through agricultural products (1997 – 2001)

Tourism is a key sector for wealth creation for almost all the SEMC (Fernandez and Thivet, 2012). Indeed, every drop of water used in tourism generates an income higher than the same drop used Apart from the impacts of water efficiency in agriculture and tourism, the adoption of green water measures entails sustainable job generation in all sectors (Tode, 2013). As a condition, these

[4] Virtual water trade (also known as trade in embedded or embodied water) refers to the hidden flow of water if food or other commodities are traded from one place to another.

[5] Blanchon, D, 2010. *L'eau, une ressource menacée ?*. La documentation photographique, dossier nº 8078. Paris. La documentation française. 2010. 64 p.

measures should be inserted in a large and strong framework which includes an adapted professional education, the accomplishment of basic needs, measures of market stimulation, etc (World Bank, 2012a).

PREVENTION OF SOCIAL CONFLITS

The Mediterranean basin, especially the SEMC, also happened to be the cradle of some social conflicts in recent years. These conflicts are often caused by a lack of jobs or income opportunities, particularly in rural areas and mainly affecting the young population (Ménoret, 2011). Some authors placed economic poverty as the origin of the growth of extremist religious networks. Similarly the Arab Spring of 2010 began as a direct consequence of the lack of work opportunities and the rise in food prices (Wikipedia, 2014).

Adopting a green economy in the water sector is a good opportunity to inclusively develop vulnerable regions through job creation (which can avoid the rural exodus) and guaranteeing a decent standard of living (basic needs accomplished).

RESILIENCE BUILDING AGAINST CLIMATE CHANGE

Climate change (CC) impacts for the Mediterranean Basin will mean an increment of temperatures and a decrease in rainfall, which will be shorter, stronger and more spaced in time (Icard, 2008). L'IRSTEA has also predicted a decreasing trend in the low flow level for the water bodies in the Mediterranean (Sauquet, 2014). All these impacts will turn into alternating periods of floods and droughts and will have harsh consequences for the most vulnerable localities. The increment of the efficiency in water management and its adaptation to CC contribute to building resilience and decreasing peoples' vulnerability (FAO, 2008).

WATER AND THE GREEN ECONOMY: WEAKNESSES AND RISKS

THE GREEN ECONOMY IS A POLITICAL CHOICE

According to Lina Tode, a manager responsible for the Governance and Knowledge Development Regional Project for the Plan Bleu, the green economy is often poorly defined and misunderstood by SEMC governments (Tode, 2013). Moreover, according to Hervé Levite, from the Center for Mediterranean Integration, this poor knowledge is compounded by a lack of awareness in decision makers and citizens. Indeed, we don't know the cost of the irreversibility of our actions (Janvier, 2014), which could provide convincing arguments to the question as to why we should act quickly and efficiently on ecosystems recovery (Levite, 2013).

Decision makers often argue that, in a green economy, job creation in certain sectors are offset by job losses in more traditional sectors (Tode, 2013). In addition, job specialization will demand new skills that must be considered in advance (as well as its specific training) (Massolia, 2012). Framing the green economy in a global and robust framework is essential in order to guarantee the success of adopted measures and the accomplishment of sustainable development (World Bank, 2012a).

Frequently, poor water countries suffering a severe water scarcity develop a better knowledge of water management than rich water countries, which prefer heavy investments in order to satisfy

current needs without developing a proper long term strategy. For example, Libya, which GDP per person is the highest in Africa, depends up to 98% on groundwater reserves, mostly non-renewable and coming from sub-Saharan fossil catchments, traversing more than 3.000 km to the coastal region (Salem, 2005). Paradoxically, once the water is in the city, it is inefficiently used, having a human consumption of 280 liters per day, well above the European average (around 150 liters per person per day). Algeria, with high GDP coming from petrol, has adopted desalination as an alternative strategy in spite of its high energy consumption, constructing 13 large plants in the country (ADE, 2007) whereas other less energy consumer options would have been equally reliable.

The adoption of green economy measures is a political choice and it is generally influenced by the conflicts of interests due mostly to water allocation and by short term policies. In fact, water management is usually a responsibility of the Ministry of Agriculture (in Tunisia and Egypt) or the Ministry for Industry (in Morocco and Lebanon) but rarely of the Environmental or Finance Ministry(as in Spain, France or Algeria) (Roignant, 2007).

DEVELOPMENT "GROWTH" INDICATORS

For decades, the growth of a country has been measured exclusively in terms of economic growth. Indeed, Gross Domestic Product (GDP) has been used as the main indicator of the annual growth of a country. Nevertheless, economic growth indicators are not complete and they contain strong limitations when it comes to measuring well-being, social progress or environmental performance (Le monde diplomatique, 2012).

The green economy advocates a more effective indicator system, which should be a key factor in decision-making and policy implementation. According to this idea, the United Nations has developed the System of Environmental-Economic Accounting (SEEA- Water) which describes the interaction between the economy and the environment (UN, 2013). The promotion of this kind of indicator on an international scale may be a useful tool for making green economy decisions.

INERTIA IN CONSUMER BEHAVIOUR AND THE ROLE OF SOCIAL NETWORKS

The inertia in consumption and production behavior as well as the private interests of certain stakeholders represents important constraints to the green economy. A proactive aptitude to change and the promotion of social based processes may accelerate this transition (World Bank, 2012a). As an example, in Spain, the social movements "Plataforma en defensa del Ebro[6]" and "Nueva cultura del agua[7]" stopped water transfers planned by the Spanish Government in 2000 (PDE, 2014; FNCA, 2014).

WATER AND THE GREEN ECONOMY: OPPORTUNITIES

The transition towards a green economy relies on a wide range of measures concerning water availability and water required (represented by the water demand curve). Ecosystems, considered as a water consumption and production system, has now been added to traditional sectors – agricultural, industrial and domestic- (Fernandez and Thivet, 2012).

[6] Platform for the Defense of the River Ebro
[7] New Water culture

The current water crisis leads to prioritize demand management policies as against those relating to availability, unlike the traditional resources management (Fernandez and Thivet, 2012). Nevertheless, water availability management may also be considered as a green economy tool, if it is sustainably carried out.

AVAILABILITY MANAGEMENT OPPORTUNITIES

The principal objective of water availability management is to increase the fresh water available. To that effect, a large number of different systems are frequently used in the Mediterranean basin.

Building hydraulic infrastructures

Hydraulic infrastructures are conceived to reduce the water bodies' seasonality and to fight the unequal distribution of water between regions.

The traditional hydraulic infrastructure *par excellence* is the dam, which needs an important initial investment and whose recovery cost[8] is markedly high. It presents negative impacts from a technical point of view (the infrastructures fills in quickly due to solid transport), environmental (having an impact in the water quality, the water bodies flow, the fauna and the flora) and social (community fractures and people displacements). However, during the last century 500 large dams were built in the Mediterranean basin for a total storage of 230 km^3 (Blot, 2006). We could mention particularly, the Assouan dam in Egypt (169 billion m^3) or the Gasset Plan in Spain (1926), which intended to provide a dam for almost every single river (Blot, 2006). Currently the negative environmental impacts have been minimized with the ecological continuity imposition, by the Water Framework Directive (WFD) for the European Union countries. Nevertheless in the SEMC ecological continuity has not been implemented, among other things due to the seasonality of water bodies (Levite, 2014).

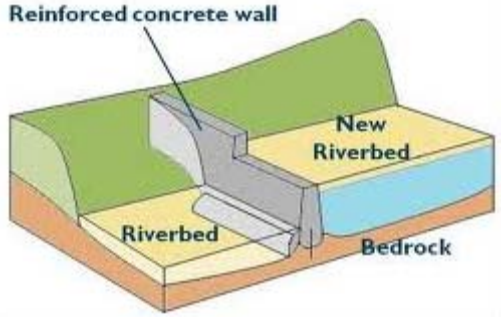

Figure 9 – Diagram of a water sand

Sand dams are a good alternative to traditional hydraulic infrastructures (figure 9). The storage principle of these particular dams is based on sand water retention capacity, between 25% and 40% of its volume. These structures prevent water evaporation during the dry season, avoid the pollution of the water storage and increase its quality through water filtration. Besides, they have a positive impact on the surrounding vegetation (Excellent, 2014). This technology, used successfully in sub-Saharan Africa, remains lightly developed in Mediterranean countries.

It is important to note that sometimes aquifer management represents a good alternative to avoid dam construction. This option becomes particularly interesting for transboundary aquifers, where a good management can mean the operating system becomes sustainable and profitable. For example, Algeria, Tunisia and Libya, have set up the SASS project in order to prevent further degradation phenomena in the aquifer. This has led to the creation of new reserves for groundwater exploitation, equally distributed, and to a more effective monitoring system (Academie de l'Eau and al., 2010).

Water transfers have been considered a recurrent solution, but they are currently being more and more criticized for their ecosystem impacts and especially for its social limitations caused by the

[8] The recovery cost is the period in which the infrastructure is paid off.

water allocation (PDE, 2014; Roignant, 2007). However, water transfer can sometimes represent the best solution to water shortages, as in Tunisia, where a wide water interconnected network withstood the lack of water to ensure access to drinking water and irrigation facilities (Rieu, 2013).

Promoting the water allocation

When water availability is limited, a system of water allocation is needed to guarantee the sustainable utilization, the economical efficiency and the equal distribution of water. The first priority for water allocation worldwide is drinking water (domestic use), followed by agricultural and then industrial uses. Frequently, ecosystem water needs are not even considered, especially in SEMC. For the years to come and according to the environmental pillar of sustainable development, this demand should also be placed in the water allocation priorities (Bonnet and al., 2005).

Dominique Rojat, program coordinator of AFD in the CMI explains that water allocation viewed from an economic point of view and supposing a perfect market, would vary according to the economic profit of the water use (Rojat, 2013). In SEMC (with the exception of Libya), tourism is one of those sectors where water has a high marginal cost. So an increment in water allocation for the tourism sector would be economically justified. However, allocation must cope with a wide range of requirements which are not just economical. The AFD supports reflections within this subject in some countries of the Mediterranean basin, such as Morocco, in order to analyze the factors and the externalities which would have an impact on it. Water allocation responds to a complicated mechanism that should ensure an optimal efficiency without endangering water availability for citizens (Rojat, 2013).

Exploiting groundwater

Groundwater withdrawal is a mechanism in development in several countries in the Mediterranean basin. Hydrological stress has entailed the exploitation of deep fossil aquifers in Libya and Tunisia (OSS, 2013) and of other aquifers that are less profitable either by their size, depth or water quality, in Algeria (SASS), Morocco (Tadla), France (Eocen layer) or Spain (Guadiana) (Rieu, 2013). Groundwater exploitation, which can represent a short term local solution, can contribute, in addition to the proliferation of illegal private wells, to a significant reduction of water availability. In addition, the fall of the groundwater level in coastal areas can lead to salinity problems of fresh groundwater(OECD, 2011a).

A complementary measure to groundwater withdrawal is the artificial recharge of aquifers through water injection into the water table. This can be achieved by the use of lagoons or pumping (more expensive) and it is especially suitable for semi-arid regions with intensive seasonal rainfalls. This measure has already been tested in the Minesteghju aquifer in Corsica and in Morocco (Haouz water table, additional volume of 5Mm^3/year) (BAD, 2008).

Desalinizing Water

Desalinization is becoming more and more effective due to the recent technological improvements. Some countries, like Malta or Israel have made a strong commitment in this regard. But the price of desalinated water subsidies, around 0.60 €/m^3 for large plants, means that it remains uncompetitive (Roignant, 2007). The negative impacts or desalinization are coastal urbanization, natural reserves degradation, rejects (water with high content of chlorine, salt and high temperature) and the increment in energy consumption (Roussel, 2008). But the technological evolution dynamic is destined to reduce costs, making desalinization more effective and competitive in the future(Roignant, 2007).

Water distillation by solar ovens, which operates based on the greenhouse effect, is a low-energy alternative for desalinization. Pilot projects, used mainly for domestic and decentralized production, have been implemented in Morocco, Tunisia and Spain (Viaintermedia, 2007; pS-Eau, 2012; Aguado, 2013).

Reusing wastewater

In order to conserve the water resource and to increase water availability, some countries such as Cyprus, Egypt, Israel, Spain or Tunisia reuse wastewater for agriculture, domestic or industrial purposes (Fernandez and Thivet, 2012). In the agricultural sector, this method is an interesting way to recycle not only water but also nutrients and fertilizers, mainly nitrogen and phosphorus. Wastewater reuse for agriculture purposes presents the following advantages: (i) wastewater is a regular source of water, (ii) nutrients and fertilizers can increase crop yields, (iii) significant savings in pumping water and (iv) facilitation of peri-urban crops which decrease transport costs (Winpenny and al., 2013). For example in Spain, in Llobregat delta, the regional authorities are analyzing the possibility to reuse wastewater for agricultural purposes in order to reduce the hydrological water stress in the basin (Compte and Cazurra, 2004). The techniques implemented to treat the wastewater are selected according to the final water quality required and normally go up to secondary or tertiary treatments. Cost-benefit analyses prove that wastewater reuse can be economically attractive if agriculture value added is considered, such as savings in fertilizers, energy pumping or crops productivity. However, the infrastructures costs i remain extremely high, especially due to wastewater and treated water storage (Rieu, 2013). To sum up, these systems are not economically viable if we take into account infrastructure costs but they are if we integrate them into a wider regional framework (Winpenny and al., 2013).

DEMAND MANAGEMENT: TECHNICAL OPPORTUNITIES

The green economy encourages the use efficiently of resources as well as the water demand management does. Mediterranean countries can save 30 billion of m^3 of water each year between now and 2050 by adopting policies based on demand management (Plan Bleu, 2013). Technical measures can be categorized according to the particular sector concerned.

A. Agriculture Sector

Improving efficiency in hydraulic systems

Significant water savings are doable by the implementation or dynamic regulation systems in large structures, regulating water supply depending on demand (Fernandez and Thivet, 2012). In addition, water losses due to canalization and irrigation techniques that are estimated at over 50% in many countries in the Mediterranean, can be limited by frequent network inspections (MAP, 2007).

Improving irrigation efficiency

Irrigation is one of the main causes of wasting water. Modern irrigation systems, such as localized systems, have been implemented in countries as Cyprus, France or Italy in order to increase water value and reduce water consumption. However, localized systems if they are not well managed can increase the vulnerability of crops. For this reason, crop management should be adapted to the irrigation system used and so the technicality used (Fernandez and Thivet, 2012).
In some cases, traditional systems widely known in rural areas such as spate irrigation are an easy way for flood control, rainfall reuse for agricultural and aquifer refilling (SSWM, 2013).

Reducing vulnerability of agronomic models and cropping systems

Some essential factors for achieving a crop in a water shortage period are crop choice, crop variety and the adaptation between period and water needs. For example, corn or potato production demands a large amount of water. However, this water is not well valorized by the fact that internal consumption of these products, in a national scale, limit income generations through sales. In this way, there are others types of crops, which demand less water contributing to saving the water in excess so increasing the water value per cubic meter. The implementation of strategies for water valorization is complex, because governments are obliged to ensure food security of population with crops such as potatoes or corn, even if the water value in these cases is lower.

Using supplemental irrigation

The recourse to blue water supplemental irrigation facilitates the crop production in water scarcity periods, increasing the value of the water used.. In France, supplemental irrigation is used in a majority way (Rieu, 2013). In Syria, the use of supplemental irrigation has increased the wheat yield by 40% (Fernandez and Thivet, 2012). Of course, adequate infrastructure and water availability in shortage periods are minimum prerequisites.

Using management and planning tools

Accuracy and efficient rainfall forecast methods represent a very useful tool for crop planning and optimization. In SEMC, where communication and information systems are not widely implemented, especially in rural areas, these methods can lead to significant success for crop development (Fernandez and Thivet, 2012).

B. Domestic Sector and Tourism

Increasing efficiency in drinking water networks

Water losses due to leaks in domestic networks can be as high 40% to 50% (Belghiti, 2011). The implementation of a supervision system consisting of network diagnostic and leak detection and repair can not only save water but also contribute to job creation (Tode, 2013).
To compensate the lack of resources or capacities of national governments, some countries have established Public Private Partnerships (PPP), via agreements (World Bank, 2012b). Concessioner companies are engaged to increase network efficiency and to price water under the control of the state. PPPs are a service outsourcing which may contribute to achieving tangible improvements concerning economic benefits. For example, in Algeria, PPPs have reduced network leakages from 40% to 25% and have ensured the continuity in the service higher than 80% (Fernandez and Thivet, 2012). The main disadvantages of PPPs are related to service quality (regularization) and the outsourcing of national services to foreign international businesses. In order to prevent the exodus of public capital, partnerships between local and foreign enterprises are encouraged and so are “public and private” concessions instead of “public or private” ones (Dugot, 2006).

Improving water efficiency

The introduction of water saving systems can easily reduce domestic water consumption – by up to 40%, without any loss of comfort to the user.
One of the most important measures for implementing the green economy is the provision of individual meters, which leads to an adjustment in consumer behavior (Fernandez and Thivet, 2012). In this way, individual meters installed in Tunisia, has decreased water consumption by 32% (Dugot, 2006). Apart from water saving, meters facilitate the implementation of other measures like pricing, improving network efficiency, etc. (Tode, 2013).

Another measure to improve water efficiency is wastewater reuse. In the touristic sector this measure can contribute to decreasing water demand for irrigation of gardens or golf courses, as in Tunisia. In the case of reusing greywater[9], a recycle in situ system could be done. In Cyprus, as it is shown in figure 10, a grant program has been established in order to recycle greywater in an individual home scale, making treated water suitable for irrigation or toilet flushing. The reutilization of wastewater has led to a decrease in water consumption of 40% (Fernandez and Thivet, 2012; EC Europa, 2012).

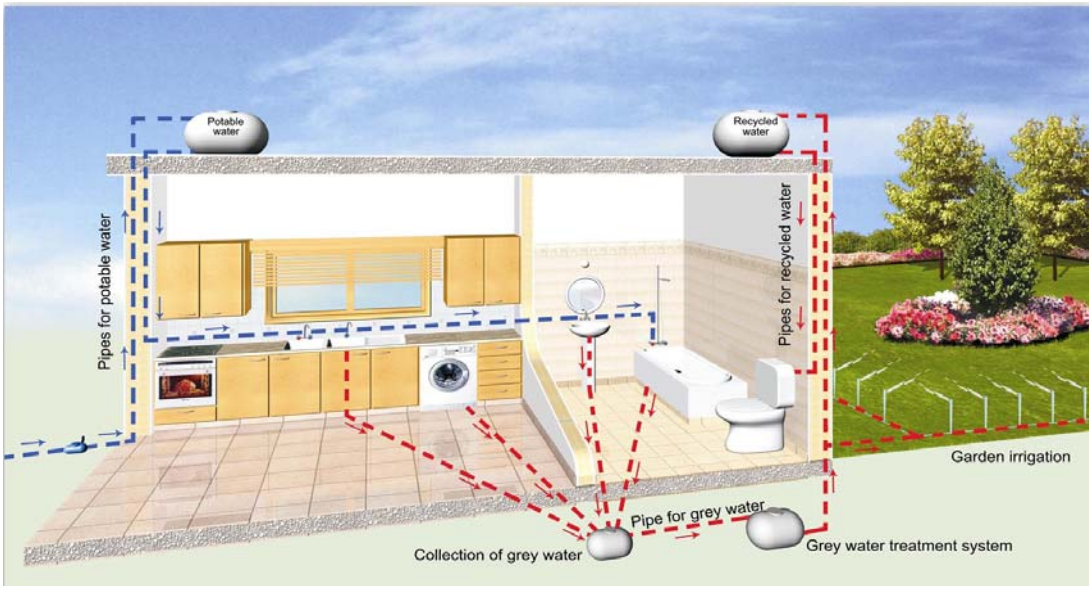

Figure 10 – Grey water reutilization system in Cyprus

Rainwater can be also treated and reused for domestic purposes. According to ONU-Habitat, rainwater collection is a reliable long term solution against water scarcity (UN-Habitat, 2005). The capacity of collection depends on the urban typology. For example, rainwater collection is estimated to be able to decrease domestic water consumption by up to 8% in France and 7.5% in Spain. This rate could be higher for those countries where the single family home typology is predominant (Baillieux et al., 2004; Ferrer, 2014). The main disadvantages of rainwater collecting are the limitation of water runoff and infiltration, which could have negative environmental impacts.

DEMAND MANAGEMENT: ECONOMIC OPPORTUNITÉS

Access to quality water costs money. Traditionally this cost has been borne by local authorities but this system has proved to be unsustainable. The green economy promotes the maxim “water pays for water”, which means that cost recovery should be covered by consumption revenues. Frequently when an increment in water prices is observed, strong cultural, political and/or ethical resistance occurs and decision makers are obliged to adapt measures as a consequence, which render complete cost recovery difficult (Dugot, 2006).

[9] Greywater is defined as wastewater generated from wash hand basins, showers and baths, which can be recycled on-site for uses such as WC flushing, landscape irrigation and constructed wetlands

Pricing

According to the OECD, pricing is the most efficient way to manage water demand (OECD, 2009). Nevertheless, twenty years ago pricing policies were nonexistent in SEMC. Nowadays, even if this trend has been reversed, water price is still far from total cost recovery, especially in the agricultural sector where water is highly subsidized (Dugot, 2006).
The "Green Morocco Plan", adopted in 2008 to stimulate agriculture in Morocco, uses irrigation water pricing as a tool to increase the recovering tax and to adopt good irrigation practices. This would ensure irrigation system sustainability and increase water valorization through the production of less water demanding crops (Belghiti, 2011). The new water rates are introducing a price increment proportional to the cost of pumping water (Belghiti, 2011; Rieu, 2013).
In 1990, the Tunisian government adopted a reform for the irrigation water pricing in order to achieve the goals of water pricing transparency, incrementing flexibility (according to regions and crop types) and achieving the related national goals (like ensuring food security). From 1990 to 2000, prices increased steadily - 8% per year in real terms. This measure set off a rise in the tax recovery from 57% to 90% during this period. In 1999, the tariff system evolved to a binomial system[10], in application for the Northern large fields, with the aim of achieving a higher cost recovering rate and of promoting irrigation systems for lands (Louati, 2011).
In 2001 Spain started gradually increasing water prices for domestic and industrial uses, at the rate of 12% from the period between 2001 and 2009. The price of water was higher in those regions suffering from higher water stress. With these measures, the cost recovering tax of services is 80%, still under the objective of 100%. This gap in the cost recovering tax implies that (i) urban water services do not recover the cost of water, (ii) public grants are not included in the price of services (iii) there is a gap in infrastructure amortization and (iv) environmental costs are not covered (Díaz, 2011). Enrique Cabrera, from the Technological Institute of Water of the University of Valencia, a cost recovery of 100% is essential to ensure water system sustainability. In addition, an increment in water pricing should contribute to job generation due to infrastructure renewal (Cabrera, 2013).

Subsidizing

Financial grants are complementary to the pricing system in the Northern countries of the Mediterranean Basin. These grants are usually funded by the EU, framed in its Common Agricultural Policy (CAP), through the country or local collectivities. These aids are conceived to encourage the yield of some types of crops and to promote local rural development (Plan Bleu, 2013).

Implementing withdrawal fees

This measure, designed to make users pay for the volume of water withdrawn, has been adopted by almost all countries around the Mediterranean. However, it is not being well implemented in some countries like France, Italy or Spain (Rieu, 2013). In addition, current withdrawal fees present a poor motive to water saving due to the low fees imposed (Fernandez and Thivet, 2012). Reversing this situation is a difficult challenge considering that an increment in the withdrawal fee would lead to an increment of illegal withdraws, which are hard to control by the authorities. For these reasons, a minimum level of awareness of real water price is an essential prerequisite.
As a consequence of the implementation of "Green Morocco Plan", during the 2008/09 crop year, the fees coming from irrigation water withdrawals showed an increment from 4 to 15% depending on the irrigated crop (Belghiti, 2011).

[10] The binomial pricing model is composed by a component regulated according to the surface, which reflects the fix cost of infrastructures and a volumetric component calculated according to the consumption.

In Spain, the implementation of withdrawal fees has been included in a wide structural measures framework which comprises (i) the gradual implementation of a compulsory measure system for the total water consumption and (ii) the implementation of a binomial pricing system. The energy grants elimination was also contemplated for the irrigation sector[11]. This framework has increased the cost recovery tax up to 60% (OECD, 2011a).

Energy grants may also influence the water withdrawal rate. The restructuring in Morocco of grant systems applied for promoting renewable energies and penalizing fossil fuel utilization, has contributed to the reduction of the amount of water withdrawn (World Bank, 2008).

ECOSYSTEM MANAGEMENT OPPORTUNITIES

Ecosystems have an essential role in the water cycle, influencing not only the quality of water resources but also its quantity. Historically, ecosystems have been almost ignored in national policies and strategies. It was not until the 1950s, when water resources management evolved towards an approach integrating water, soil and associates resources in order to guarantee a coordinated development (Fernandez and Thivet, 2012). In Europe, the WDF adopted the IWRM in its axes of intervention (ONEMA and OIEau, 2014).

Developing new branch models

Mediterranean ecosystem presents a high biodiversity and can be classified into wetland, forest, marine, urban and agro-ecosystems. So far, just the urban and agro-ecosystems have been deeply analyzed because they are those which are linked to domestic, agricultural and industrial sectors, the most water demanding sectors (Puydarrieux, 2013). Nevertheless, the other ecosystems present an important link to water, acting as a tampon zone to water regulation and being very effective quality indicators (OZHM, 2014). Developing these ecosystems through new branches may contribute to improving the water resource situation when job generating (UNEP, 2011).

- The forest branch may contribute to water preservation in a localized region, to build resilience of settlements against natural phenomena such as floods and to enhance biodiversity (UNEP, 2011; Plan Bleu, 2013). Furthermore, numerous sub-products of the sector could be transformed and commercialized, like pellets, which are used for energy generation via combustion (UNEP, 2011).
- Wetlands conservation is a very good opportunity not only associated to environmental aspects but also for economical reasons: most of the wetlands, such as oasis or marshes, have an important potential for tourism, so contribute to income generation. Besides, ecosystem conservation implies additional benefits such as job generation, resilience building, species diversification, qualitative and quantitative groundwater improvements, etc (OZHM, 2014).

  The two images of figure 11[12] show two different states of Ouargla oasis, a saline depression located on the North-Western aquifer in Sahara and which lies under Algerian, Tunisian and Libyan territory. The picture on the left, taken in 1976, shows the vegetal covering composed by palms and dates surrounding Ouargla, which collected the irrigation water for several generations. The intensive nature of irrigation systems used has caused the degradation of soil quality, the lowering of the water table and the salinization of both groundwater and surface water. The picture on the right, taken in 2006, shows the result of this degradation around the oasis, as well as the proliferation of irrigation lands, that may cause an irreversible damage for this particular ecosystem.

[11] The energy grants promote normally an excessive water withdrawal, especially for groundwater.

[12] Source : Google Earth

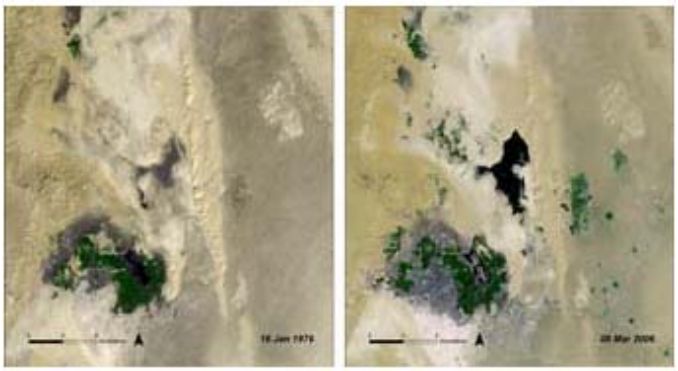

Figure 11 – Ouargla Oasis, in 1976 (left) and in 2006 (right)

- Innovatory solutions such as hydroponic farming are attractive alternatives against the water crisis in the SEMC. This technology, which minimizes the quantity of water used and the fertilizer requirements, is characterized by a good efficiency but high technicality (RTVE, 2012).
- The aquaculture industry, which combines plants and fish production in a symbiotic environment, allows the reutilization in situ of biological rejects and thus reduces the toxicity in water. These kind of techniques are especially implemented in areas where land availability is limited, but they can be adapted to a Mediterranean context (FAO, 2013).

In short, SEMC have favorable characteristics for developing these innovatory industries, in order to limit hydrological stress and at the same time, to place the South and East Mediterranean Countries in a competitive position towards international markets.

Evaluating the Ecosystem Services

The realization of Ecosystem Services Evaluation (ESE) is a recommended tool in a green economy and aims (i) to increase the awareness of biodiversity value by stakeholders, (ii) to integrate these values in the national planning strategies and policies and (iii) to conserve and to preserve the essential ecosystem services (Puydarrieux, 2013). The French approach to ESE is innovative. Currently, France is developing methodological and operational tools which are replicable and can be used at different scales. One disadvantage is the lack of available data - a continuous problem. Indeed, a review of the water natural heritage assessments is the minimal base required to first, evaluate the ecosystem state and second, to design short and medium term strategies (Couchoud, 2013). The elaboration of a Water White Book is one of the work lines of the MWE and the Plan Bleu, which will facilitate the assessment of the adopted measures and its impact on shared resources.

CONCLUSION

The water resources situation in the Mediterranean countries is alarming. Indeed in 2025, in a business-as-usual scenario, ten out of twenty-one countries will be suffering water stress, with less than 1000m^3 per habitant per year, which will affect their sustainable development and in the worst case scenario will cause a water shortage which will be life-limiting in effect.

The green economy is an interesting alternative to the classical economic system, in which the environment is included as a major factor in productivity. Achieving a “green state” means adopting a sustainable and inclusive management model, without the option of also enhancing economic growth.

But a major constraint for the success of the green economy is the lack of awareness by stakeholders of the importance of challenges and the potentials of the green economy. On the one hand those authorities sharing a vision of a green economy don’t take into account the gravity of the current situation and the urgency of implementing a strategy that will be measured in the medium and long terms. On the other hand, citizens who are supposed to be the levers of this transformation are reluctant to change their behavior. It is clear that greater environmental awareness is required before a situation of irreversibility is encountered.

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