

Water Resources in Mediterranean Region. Factors and Constraints for Improving Human Well-being in a Water-stressed Region

Nelson Lourenço¹, Carlos Russo Machado¹

¹ Instituto de Investigação Científica e Tecnológica da Universidade Atlântica, Antiga Fábrica da Pólvora de Barcarena, 2730-036 Barcarena, Portugal

In the Mediterranean basin, wide differences in water supply and demand characteristics exist and no individual case study may be a representative of the entire region. Some countries suffer problems of overexploitation of groundwater while others suffer from water quality degradation. On the other hand, some have enough or plentiful water but lack institutional structures to manage water efficiently, while others have scarce and limited water and seek non-conventional water like desalination or importation of water.

Managing water scarcity

Integrated water resource management is a cross-sectoral policy approach that requires coordination among the different water uses and institutional sectors to respond to the growing demands for water in the context of finite supplies. This process aims at ensuring the coordinated development of water, land and related resources to optimise economic and social welfare without compromising the sustainability of environmental systems. Therefore, it is a complex and multi-dimensional process that must be customised to the specific geographical, environmental, social, cultural, political and economic conditions of each region and catchments (GWP, 2000). It involves understanding the interactions of the various social, political, economic and ecological processes that influence choices and strategies within the ecosystem, and addressing issues through the involvement of various stakeholder groups. This ecosystem approach has been developed, through the concept of integrated watershed management, as a strategy to rebuild agriculture and promote participatory development. (Noronha, 2004). It is a great tool for an adequate decision-making process, providing stakeholders, decision-makers and policy makers with integrated environmental and socio-economic information to deal with the needs of local populations, and to assess different development options and water management strategies (White et al., 2002).

Managing water resources was traditionally approached by the supply sector, building reservoirs and distribution network systems, finding new water sources. It was considered that the major strategies should comply with the needs of humans in terms of drinking water, food, etc. Although this continues to be a major obligation for human societies, it is also clear that water is necessary for more than domestic use or production of food (Lundqvist, 2000). Water is also crucial for the functioning of ecosystems, and for the goods and services these ecosystems produce to society, therefore to the sustainability of societies' development. Nowadays water management must be dealt in terms of change and adaptation: both in society itself and in society's interactions with nature. Lundqvist (2000) approaches the changes in water management as different turns of a screw. In a first moment, scarcity is recognised as a pure natural resource scarcity and the remedy is to "get more water", which is accomplished by large-scale engineering efforts. On a second moment, it is recognised that it may no longer be possible to develop additional large volumes of water. The effort at this stage is re-directed towards efficiency measures, predominantly to get "more use per drop". This often induces significant changes in national policies, through the adoption of demand management strategies aiming at producing more with less water or to produce higher economic values from available water resources.

According with the Millennium Ecosystem Assessment, one-third of the world's population is now subject to water scarcity,

and population facing water scarcity will double over the next 30 years. Furthermore, drylands have only 8% of the world's renewable water supply and 10–20% of this ecosystems are degraded (UNEP, 2005). This lack of freshwater resource turns existing sources of surface water, groundwater, and wetland habitats critically important for the population well-being as well as for the ecosystem health (Withe et al., 2002). These water-stressed regions are usually associated with infertile and hostile lands, but they support nearly 2 billion people (about 40%) of the world's population (UNDP/UNSO, 1997 and White *et al.*, 2002). Nevertheless, these regions are among the world's most fragile ecosystems, being water one of the most limiting factors. Decrease of water availability, in these regions, can have exponential negative effects on the human population well-being. Water scarcity have a strong burden for women, and to a lesser extent to children, which are the main actors in charge of draw, transport, and store of water for household and animal use. However, their involvement in managing water resource is still nowadays very weak (Morna, 2000; Narayan, 1993).

The agricultural production systems require large amounts of water. The "virtual water" contained in the products is a significant concept, especially for water-scarce regions, in which is important to adapt the production systems to products less intensive in water. Analysing the relations between "virtual water" and physical water can be a significant contribution for achieving a balance of economic and population growth, as well as towards ecological sustainability. The importance of virtual water lies with its potential to balance water-rich and water-poor regions, at national and global levels, through the regional and international trade in agricultural products (Yasser, 2004). Naturally, this process implies socio-economic changes that should be thoroughly analysed. Nevertheless, "virtual water" trade must be faced as an instrument to achieve water security and efficient water use (Hoekstra, 2003).

Agricultural systems in drylands are at the root of specific ecological, economic and social concerns that should to be addressed to move towards more sustainable agricultural practices. Water is the principal resource to support the development of agriculture, and it has been a major limiting factor when is scarce or mismanaged. Negative effects of current agricultural practices are a growing problem, and not only in arid and semi-arid regions, and include the following (Khor, 2004): decline in soil productivity and desertification due to overgrazing; salinisation and contamination of ground and surface waters; overuse of surface and ground water for irrigation; little control of farmers over farm prices; loss of small-size farms and farmers, contributing to the disintegration of rural communities and local marketing systems.

In arid and semi-arid regions, some strategies should be stressed: improving water conservation and storage measures; providing incentives for selection of drought-tolerant crop species; using reduced-volume irrigation systems; managing

crops to reduce water loss; and in extreme cases not planting at all (Ching, 2002). Sustainable agriculture can deliver substantial increases in food production at low cost. It can be economically, environmentally and socially viable, and contribute positively to local livelihoods.

Water and Governance

According to the United Nations World Water Development Report we are facing nowadays a Global Water Crisis. The access to safe and easily available water is now considered one of the most critical natural resource issues faced by human societies, and it is clear its relations with other critical issues for the sustainable development: sanitation, health, agriculture, energy and biodiversity (UN/WWAP, 2003). However, this Global Water Crisis is also frequently a crisis of governance (Rogers, 2003), resulting from the failure on determining the roles and responsibilities of public, civil and private interests, as well as of integrating policies and practices in the effective management of water resources and development. Therefore, one of the most significant steps for managing water resources is to involve the scientific community and the community of stakeholders, decision-makers and civil society representatives in the discussion of water management experiences towards the definition of sustainable water management strategies and policy options. Furthermore, one of the key challenges in managing water resources is to develop tools, methods, strategies and policy options, in a context of an ecosystem approach, to satisfy water needs for population and agriculture, ensuring the improvement of livelihoods, diversification of income generation and nature conservation.

The Dublin Principles for good water governance (Solanes, 1999) cover the different dimensions of sustainability (environmental, social and economic) and provide a comprehensive and multidisciplinary frame for approaching the definition of policy options for water resource issues. They have been adopted by numerous international, multi-lateral and bilateral agencies including the World Bank. Following these principles, the European Water Framework Directive (WFD, 2000/60/EC) sets out, for the first time, a detailed and integrated framework for the improved protection and management of all Europe's water resources and aquatic environments from each catchment to the sea (Teodosiu, 2003). This directive represents the most significant materialisation of the international concerns with the water as a strategic and limited resource that need to be protected for actual and future generations. This water framework directive pursues the achievement of sustainable development by promoting the integrated management of water resource, using the river basin as management unit.

It is a very complex and challenging strategy, which should integrate the relations between the natural and the socio-economic environment that contribute to water quantity decrease water quality deterioration. This integrated and comprehensive process includes pollution control and prevention, land-use planning, agricultural policy and erosion control, environmental management and stipulates the involvement of all stakeholders within the basin in the process of water resource management.

The Mediterranean Region: physical and human setting for water management

The Mediterranean region has a key common environmental feature that is related with the existence of a more or less longer dry and hot season. This creates important stress on water resources due to irrigation needs. In fact, in this region, irrigation cannot be seen as a way to increase and improve agricultural productivity. Irrigation in the Mediterranean region is essential to ensure agricultural productivity. Furthermore, there is a clear contrast between northern areas (receiving abundant

water resources from temperate regions) and southern areas that are adjacent to semi-arid regions, with very scarce water resources.

The Mediterranean region is defined as countries bordering the Mediterranean Sea (or within the influences of the Mediterranean climate) between about 27° to 47°N and 10°W to 37°E. It includes 25 countries that, according with Margat and Vallée (2000), can be sub-divided in three major sub-regions (Figure 1):

- **The North:** Portugal, Spain, France, Italy, Malta, Bosnia-Herzegovina, Croatia, Slovenia, Serbia-Montenegro, Albania, and Greece;
- **The East:** Turkey, Cyprus, Syria, Lebanon, Israel, Palestinian Territories, and Jordan;
- **The South:** Egypt, Libya, Tunisia, Algeria, and Morocco.



Figure 1. Sub-regions in the Mediterranean

This region was chosen (since the Bronze Age) by different people to settle, being the place where some of the oldest cultures of the planet begun their development. Nowadays, the Mediterranean can be seen as a border region, separating contiguous regions with contrasted levels of development and opposite demographic trends. The coasts of the north are characterised by intense concentration of urban population and industrial activities, while the south and east is for the most part arid with little urbanisation or industrialisation.

The climatic conditions of the region favoured the development of agricultural systems (and of important irrigation systems) where olives, citrus fruits, grapes, and cork play a major role. However, tourism is today a major source of income for many of the countries in this region, corresponding to 33% of the world's international tourism (Benoit and Comeau, 2005). Both of these activities exert strong pressures over water resources, which in a region located in the border of the desert require a special attention from decision-makers, water managers and water users.

Water in the Mediterranean region is a scarce and unevenly distributed resource. Agriculture accounts for 65% of the total demand in the region, especially in the countries from the South and East, where 80% of the demand is related with agriculture (Benoit and Comeau, 2005). However, the pressures over water resources induced by human activities are contributing for the degradation of water quality, triggering other situations: the rising of costs due to the need of water treatment; health risks; and conflicts of use between users, major sectors, regions or countries.

According with Benoit and Comeau (2005), in the Mediterranean region 108 million of people were living, in 2000, in countries with access to less than 1000m³/person/year. This amount formed the water-poor populations. Of these, 45 million of people were living in absolute scarcity, with access to less than 500m³/person/year. Figure 2 shows how water resources are unevenly distributed in Mediterranean region. According to

the classification of Falkenmark and Widstrand (1992), the North countries (plus Turkey) have a situation of no water stress (access to more than 1700m³/person/year). In clear contrast, the South and East countries are living in situation of water stress, especially Algeria, Tunisia, Libya, Israel, Palestina and Jordan that have access to less than 500m³/person/year.

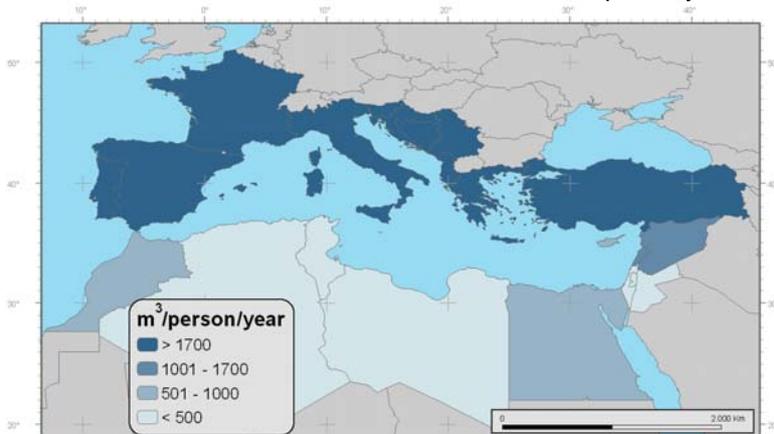


Figure 2. Availability of renewable water resources per capita per year in the Mediterranean region. Source: WRI, 2005

Population issues are the dominant factor in the drivers for changes in water resources management. According to the United Nations (UN) estimations, the total population in the Mediterranean region will rise from around 299 million inhabitants in 1970 to 448 millions in 2000, to about 562 millions in 2025 (UN, 2005). This data show a decrease in the rate of the annual population growth. From 1970-2000 it was registered an annual growth of 1.6%, while for the period 2000-2025 the estimated annual growth is 0.8%. Furthermore, the growth of total population for 2000-2025 is estimated higher (as it was already in the previous period) in the South and East countries (1.4% and 1.6% respectively) that in the North (0.1%) where the population trends to stabilize or decrease. These figures show clearly that there are two different population dynamics in the region. An ageing population with low growth rates in the countries of the North, and a young and rapidly increasing population in Southern and Eastern countries.

Furthermore, these demographic dynamics are intensified by the increasing growth of urban population. Urban culture was always a significant feature of the societies developed in the Mediterranean Region. Nevertheless, it was mainly in the 20th Century that a strong movement of the population towards cities took place. According to the United Nations estimations, in 1970, 48.5% of the total population lived in urban areas. This number increased to around 64%, in 2000, and is estimated to growth to about 73%, in 2025.

The UN estimations show that there will be a decrease in the rate of urban population growth in the Mediterranean region. In the period 1970-2000, the urban population increased at an annual rate of 2.6%, while for the period 2000-2025 the estimated annual growth is of 1.4%. Moreover, the annual growth of urban population continues to be higher in the South and East countries (2.0%) than in the North (0.7%). Nevertheless, this continuous (although slower) growth of urban population shows converging rates of urbanisation but different urban dynamics (Benoit and Comeau, 2005):

The northern countries register fewer inhabitants in city centres, and strong urban sprawl with dispersed population and employment, inducing the growth of built-up areas and loss of agricultural lands, requiring the implementation of new water supply and treatment systems.

The southern and eastern countries register a strong urban growth without any real economic development, very young urban population with high rates of unemployment, expanding

urban areas with increasing unregulated housing, limited technical and financing capacities in the cities to face the needs of adequate water supply and treatment. In 2025, about 390 million of people will be living in urban areas, and a great amount of this total will be concentrated in the coastal areas. The pressures exerted over water resources, both in freshwater and coastal waters, will contribute to increase their scarcity and degradation of the quality. Measures to manage water demand are required to ensure the sustainability of water resources in the region.

Water governance in the Mediterranean Region

Water Management issues are recognised by the scientific community and policy institutions as a key area for international cooperation. Integrated water resource management is a cross-sectoral policy approach that requires coordination among the different water uses and institutional sectors to respond to the growing demands for water in the context of finite supplies. This process aims at ensuring the coordinated development of water, land and related resources to optimise economic and social welfare without compromising the sustainability of environmental systems. Therefore, it is a complex and multi-dimensional process that must be customised to the specific geographical, environmental, social, cultural, political and economic conditions of each region and catchments (GWP, 2000).

In the majority of the Mediterranean countries a rather centralised system is the responsible for the governance of water resources. However, some countries are increasing not only the decentralisation of decision-making processes, but also the participation of local stakeholders in these processes.

In this region, the process of water management is framed by a normative system that evolved in the 20th century. However, in the last 10-15 years these normative frames were strongly restructured in the majority of the countries involved. In EU countries, this process is marked by the development of EU Water Framework Directive, which has a clear compulsory end point: the water status has to be good after its implementation, in 2015. On the other hand, Mediterranean Partner Countries (MPC) are not bound to any international duty to achieve certain objectives in their watersheds.

The modalities of water appropriation and management have evolved during long-time, but water remains a focal issue of the interactions nature/society being submitted to different types of policy options. However, these interactions have also been since long-time regulated through the law (PNUE/PAM/PLAN BLEU, 2004). In the last years, the increasing scarcity of water resources, and the induced tensions and conflicts, were responsible for the recognition of water as belonging to the public domain.

The role of institutions in water management has increased in importance significantly over the last decade, in line with the claim that "for the next several decades the most important question related to water resources development is that of institutional design rather than engineering design" (Ostrom, 1993). This is also true in several of the Mediterranean Countries, where the Governments are investing in the restructure and improvement of water management institutions to achieve better performances in managing this scarce natural resource.

Concluding remarks

Sustainable development is being seen as the basis for a genuine balance between economic growth and environmental values. In fact, there is a considerable corpus of literature based on empirical evidence showing that the degradation or depletion of the environment affects in different ways people

inside societies and among countries, creating, increasing and reinforcing new ways of social and economic discriminations.

To accomplish the necessary growth of well-being, without compromising the capacity of natural resources also producing that well-being for future generations, is a challenge that implies to cut with the existent relationship between economic growth and natural resources use, which has driven to the present situation of environmental degradation. It means also to shift to a paradigm of natural resources management, instead of natural resources exploitation, to bring to a halt the present unsustainable patterns of production and consumption (UNDP, 2001). In fact, it is important, that at the same time man develops technology, which can enlarge the limits of the carrying capacity of ecosystems, to reduce, by means of effective policies, the patterns of consumption and to adapt practices of conservation of natural resources (Bartelmus, 1999).

In a context of economic globalisation it is clear that the linkages of economy and environment, as well as the environmental impacts, are not limited by the boundaries of nation states. Therefore, it is assumed that to correct and solve the environmental problems it is necessary, not only, to correct the economic distortions associated to the inequity of the distribution of benefices resulting from the uses of natural resources, but also to achieve better processes to engage individuals and institutions, at global and local level, in governing themselves. Nowadays the systems that society has developed for governing itself, which are generally based in the nation state, become increasingly complex, and it seems necessary to discuss the basic structures of governance, in order to manage the conflicting and changing economic, social and environmental requirements of modern governance systems. Moreover, individuals, households and communities are seeking greater control over their own destinies, while the boundaries between the public and private spheres are continually shifting (Machado et al, 2002).

Water resources are a societal issue. Considered frequently as a common good, water is essential to life and to numerous human activities, and suffers their negative impacts. In the Mediterranean region, the significance of irrigated agriculture, the intense urbanisation, and the tourism are increasing their demands for water, requiring therefore important efforts to find new strategies to better manage this scarce resource.

In the long-term the growing water demand of Mediterranean countries can only be met from three sources. These are the use of renewable water sources; desalinating sea water; and reallocating irrigation water to more productive uses. For many countries the first alternative is no longer possible, and for many others it will provide water for only a decade or two. Desalination of sea water is a solution, but an expensive one. However, in the long-term it seems likely that it will become even more important as other water sources are fully used, having the great advantage of the limitless amounts of fresh water which can be produced. Finally, the reallocation of irrigation water could be the most likely immediate solution to water demand problems over the next two decades, but depends of political decision (Beaumont, 2000).

Strategies aimed at reconciling human development with the sustainable management of water resources must recognise that water accessibility and scarcity increasingly threaten four fundamental aspects of human security: food production; human health; the health of the environment; and social, economic and political stability.

Water is a crucial natural resource for the sustainable development of world societies. The growing demand of water resources (caused by population and economic growth) and climate change are driving to an increasing water scarcity as

well as to the degradation of their quality, which has an acute relevance especially in water stressed regions. In arid and semi-arid regions, the management of surface and groundwater resources creates significant challenges for the development of local populations. The competition for these resources can be an ongoing source of tension and conflicts.

Referências

- Bartelmus, P. (1999). Economic Growth and Patterns of Sustainability. *Wupertal Papers*, Nº 98.
- Benoit, G. & Comeau, A. (eds.) (2005). *A Sustainable Future for the Mediterranean. The Blue Plan's Environment and Development Outlook*. London: Earthscan.
- Ching, L. M. (2002). *Sustainable Agriculture Pushing Back the Desert*. London: Institute of Science in Society.
- Falkenmark, M. & Widstrand, C. (1992). Population and Water Resources: A Delicate Balance, *Population Bulletin*, vol. 47, no. 3, pp. 1-36.
- Global Water Partnership (2000). *Integrated Water Resources Management. TAC Background Papers*. No. 4.
- Hoekstra, A.Y. (2003). Virtual water trade. Proceedings of the International Expert Meeting on Virtual Water Trade. *Value of Water Research Report Series* No. 12.
- Khor, M. (2004) *Sustainable Agriculture: Critical Ecological, Social & Economic Issues*. London: Institute of Science in Society.
- Lundqvist, J. (ed.) (2000). *New dimensions in water security. Water, society and ecosystem services in the 21st century*. Rome: FAO. 82p.
- Machado, C. R.; Lourenço, N.; Jorge, M. R.; Rodrigues, L. (2002). Sustainability: Importance of social networks in the decision-making processes. *Proceedings of the Conference Policies and Tools for Sustainable Water Management in the EU*.
- Margat, J. & Vallée, D. (2000). *Mediterranean vision on water, population and the environment for the 21st Century*. Sophia-Antipolis: Blue Plan for the Global Water Partnership/Medtac. 62p.
- Morna, C. L. (2000) *Mainstreaming gender in water and sanitation: Literature review for the SA department of water and sanitation*. Johannesburg: Gender Links.
- Narayan, D. (1993) *Participatory Evaluation: Tools for managing Change in Water and Sanitation*, Washington: World Bank.
- Noronha, L. (2004). Ecosystem approaches to human health and well-being: reflections from use in a mining context. *Ecohealth Special Supplement*. Dec. 2004.
- Ostrom, E. (1993). Design principles in long-enduring irrigation institutions, *Water Resources Research*.
- PNUE/PAM/PLAN BLEU (2004). *L'eau des Méditerranéens : situation et perspectives*. No. 158 de la Série des rapports techniques du PAM, Athènes: PNUE/PAM. 366p.
- Rogers, P.; Hall, A. W. (2003). *Effective Water Governance*. TAC Background Papers No. 7, Stockholm: GWP.
- Sachs, W. (2000) Development. The rise and decline of an ideal. *Wupertal Papers*, Nº 108
- Solanes, M.; Gonzalez-Villarreal, F. (1999). *The Dublin Principles for Water as Reflected in a Comparative Assessment of Institutional and Legal Arrangements for Integrated Water Resources Management*. TAC Background Papers No. 3, Stockholm: GWP.
- Teodosiu, C.; Barjoveanu, G.; Teleman, D. (2003). Sustainable Water Resources Management. River Basin Management and the EC Water Framework Directive. *Environmental Engineering and Management Journal*, 2 (4), pp. 377-394
- UN (2005). *World Population Prospects: The 2004 Revision*. Population Database. Available at: <http://esa.un.org/unpp/index.asp?panel=1>.
- UN/WWAP (2003). *UN World Water Development Report: Water for People, Water for Life*. World Water Assessment Programme. Paris, New York and Oxford: UNESCO and Berghahn Books.
- UNDP (2001). *Human Development Report 2001. Millennium Development Goals: A compact among nations to end human poverty*. New York: United Nations Development Program.
- UNDP/UNSO (1997). *Aridity zones and Dryland populations: An Assessment of Population Levels in the World's Drylands*. New York: United Nations Development Programme/ United Nations Student Organization.
- UNEP (2005). *Millennium Ecosystem Assessment Synthesis Report*. New York: United Nations Environment Programme.
- White, R. P.; Tunstall, D.; Henninger, N. (2002). *An Ecosystem Approach to Drylands: Building Support for New Development Policies*. Information Policy Brief No. 1, Washington: World Resources Institute,.
- Yasser, N. (2004). Virtual Water Trade as a Policy Instrument for Achieving Water Security in Palestine. *Proceedings of the Second Israel-Palestinian International Conference on Water for life in the Middle East*, October 10 - 14, 2004, Antalya.