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Conceptual frame on water culture and its use to raise public awareness on sustainable water management in the Mediterranean basin

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I - The geographical, physical and socio-economic context

1. Geographical and physical context

The Mediterranean climate is typified by an enormous irregularity in the distribution of rainfall in space and time. Although the entire Mediterranean catchment area receives a total average volume of precipitation estimated at 1100km^3 (1000 million cubic meters) per year, nearly two-thirds of this volume is concentrated in one- fifth of the Basin's surface area. While three countries, France, Italy and Turkey, receive half of the total precipitation, the southern countries receive only 13 per cent.

Part of this precipitation is used directly by vegetation; the other part produces surface or underground flow, which constitutes an 'internal inflow' of precipitation to freshwater resources. Adding this interior inflow to the Basin's external inflow gives the total of 'natural, renewable freshwater resources' (underground and surface) of the Mediterranean catchment area, which amounts, on a yearly average, to about 600 km^3 per year. These resources are the maximum potential of water resources 'given by nature' on average every year. This potential can be exploited more or less intensively without affecting the rights of future generations since it is renewed every year by rain, at least insofar as this is not altered by climate change (Benoit and Comeau, 2005).

In the Mediterranean area, several countries have to cope with aridity weather because there are arid areas inside their territory, or because they are connected with deserts for geographic or cultural reasons. Moreover Mediterranean island and peninsula are almost lacking underground or ground water.

However, flourishing civilizations have developed in this area. Therefore, most of traditional techniques relative to the water organization for water harvesting, conservation and diversion have been discovered or imported from neighbor areas, and in all cases widespread all along the Mediterranean Basin as well as the systems of slope protection and the creation of soil that have different characteristics according to the environment. In southern Italy and in Spain there are also systems like for example underground drainage tunnels that are common in oasis towns, in North Africa and in the Eastern World that have been handed down by Islamic civilization or by more ancient civilizations.

Ecosystems dependent on water contribute to the maintenance of local and regional biodiversity and generate a high biological productivity with a key role in the trophic networks, especially in

arid systems. Moreover, rivers and ephemeral channels constitute ecological corridors, enhance landscape values and contribute to the control and removal of diffuse pollution. There also very important cultural values of water and water landscapes, linked to the personal and collective identity and to the historical, archaeological and cultural heritage of societies, which should be preserved.

These values consolidated in the creation of cultural landscape and urban ecosystem.

In the past the survival of the archaic societies of the whole Mediterranean areas depended on the accurate and economical management of natural resources. The close link between traditional farming techniques and settlements made the traditional historic centers a fundamental element for environmental safeguard. In the Mediterranean area, which is characterized by intensive historical settlements, each part of the environment is not only the result of natural process, but rather represents a cultural landscape where historical centers are the crystallization of knowledge appropriate to the correct environmental management and maintenance.

2. The social and economic context

Over 500 million people are presently living in 25 countries of the Mediterranean Region. Total population does not show much difference among the different sub regions, but there are significant differences among countries. The rate of annual population increase is lowest (0.2%) in Italy and highest (4.2%) in Jordan. It is lowest in south-western Europe (0.4%) and highest in the eastern Mediterranean sub region (3.4%) (FAO, 1995 a and b) while there is a direct relationship between poverty and population growth, other factors (culture, tradition, mentality) also influence behavior related to birth rate.

The main features of the northern sub region are: urbanized and industrialized societies with high-medium income levels; low population growth, predominance of private and communal forests; abandoning of large agricultural lands as a result of increased agricultural production and decreased rural population (offering large potential for afforestation on one hand, and causing increased fire risk on the other); pressures and disturbances from expanding urban concentration and increased tourism in forest areas.

Common features of the southern/eastern sub region are: low-medium income levels; high growth rates and population density in rural and forest areas; dominance of state ownership of forest resources; existence of rapid deforestation and natural resources degradation and their consequences (serious rates of soil erosion and desertification) due to destructive interventions of large rural populations (i.e. encroachment for croplands, over-grazing, over-cutting of timber and fuel wood); populations heavily dependent on forests and natural resources for their livelihood; silvopastoral activities vital for rural inhabitants; increasing urban expansion and tourism pressures especially in coastal zones (Boydak, 1997).

In the Mediterranean region nearly 70% of the available water resources are allocated to agriculture. In the arid and semi-arid countries of the region agricultural water use accounts for as much as 80% of the water consumed, decreasing to 50% of the total available resources in the Northern countries (Hamdy and Lacirignola, 1997).

Diminishing water resources in the Eastern and Southern Mediterranean are expected to be one of the main factors limiting agricultural development, particularly in the 2000 – 2025 period. The water needed for irrigation is even scarcer than the land itself and land suitable for irrigation is becoming harder to find. At present, the irrigated areas account for more than 16 million hectares.

Despite the high priority and massive resources invested, the performance of large public irrigation systems has fallen short of expectations in both the developing and developed countries of the Mediterranean. Crop yield and efficiency in water use are typically less than originally projected

and less than reasonably achieved. In addition, the mismanaged irrigation project schemes lead to the “sterilization” of some of the best and most productive soils. Salinity now seriously affects productivity in the majority of the Southern Mediterranean countries as well as in the coastal zones. Salt affected soils in the region amount to nearly 15% of the irrigated lands.

Given the increased costs of new irrigation developments, together with the scarcity of land and water resources, future emphasis will be more on making efficient use of water for irrigation and less on indiscriminate expansion of the irrigated area.

Over the next twenty-five years, substantial amounts of fresh water supplies will be diverted from agriculture to industry and households in the region. Irrigated agriculture will face two challenges: water scarcity and dwindling financial resources. Despite these challenges, irrigated agriculture is expected to provide 70 to 75 percent of the additional food grain requirements to the developing countries of the region. This will not be possible without developing effective methodologies and systems for assessing and improving the performance of irrigated agriculture. Such systems have to evaluate the contribution and impact of an irrigation scheme in terms of production, self-reliance, employment, poverty alleviation, financial viability, farmers’ profitability and environmental sustainability.

Water plays multiple environmental, social and economic roles with complex relationships, some of which are not immediately evident. In addition to this functional complexity, its heterogeneous availability in space and time, both in terms of quality and quantity, complicates the matter. However, it is essential to understand and manage such complexity to maintain and protect the multiple roles of water (Burmil *et al.*, 1999; Lemly *et al.*, 2000). Water flows have multiple environmental functions, which are essential for maintaining the health and productivity of both the ecological and socio-economic subsystems, including such less evident functions as the role of rivers in the maintenance of beaches and coastal fisheries. Therefore, it is required an innovative and integrated approach, under which each possible management option and its implications for the overall system needs to be considered.

In most of the Mediterranean sites, the socio-economic systems have traditionally been attached to a careful management of water. The natural scarcity of water has limited the intensive exploitation of the land while, at the same time, has favored the existence of arid ecosystems with an especially interesting biodiversity. Arid zones have developed traditional systems of water management highly sophisticated, with a demonstrated sustainability and well adapted to the natural conditions what, in turn, has promoted a rich water culture.

The momentum for investigating the ethics of the uses of water resources in the south stems from the water scarcity accelerating problem. In addition, there are conflicting demands for water among different users within and between nations, which threatens social and international security, and stability.

The World Summit on Sustainable Development held in Johannesburg in September 2002, has emphasized the importance of considering the use of freshwater to be an ethical issue. This consideration comes from the perception that current natural resources of the world are increasingly viable to a deadly threat created by the human impact. Cultures are heterogeneous and usually involve a complex dimensions and factors with widely differing orientations. Cultures are not fixed entities and they vary with time and affected by values, beliefs, economic and political situations.

Sustainable development is an essential component of any analysis of water management. The social, economic, environmental and cultural dimensions are pillars of the sustainable development. The concept of sustainability is very rich indeed, if this threefold context is adopted. Sustainability is a discursive outcome of the contending articulated concerns of society, those involved in the economy and those anxious about the status of the environment; therefore, its

definition is thus a dynamic one. The ethical and cultural aspects are involved in the social dimension of sustainable development.

Investigating the cultural aspects of natural resources management, water management would be strongly related to the framework of 'four ways of life' identified by Douglas (1982). Also, Thompson has shown this framework to be particularly relevant to the water sector. He indicated that there are *three social solidarities* that shape the politics of water use and management:

- The institutions in the public sector -*hierarchism*- which are the dominant providers of water services and regulatory regimes ;
- The private sector firms and local *entrepreneurs* that provide some water services and a high proportion of construction capacity ;
- The *civil movement* bodies that advocate water related *environmental and human rights ethics* and play a social audit role.

It is important to note that the third solidarity can only deploy *voice* (ethicists). The other two solidarities can deploy a wider range of instruments. The third solidarity, which is mainly, composed of *civil movement activists* who provide a voice for the impoverished consumers and the environment help in promoting the ethical and cultural dimension for the sake of sustainable development.

Also, Hoekstra (1988) explained that many of the current controversies among water researchers and policy makers can be explained by the existence of different cultural perspectives. He also pointed out that many water issues are not only technical problems but are also value driven.

The cultural and socio-economic aspects of water management are not as clear as the scientific and technologic ones. Abu-Zeid, president of the World Water Council noted that "the cultural and socio-economic values of water are still a very elusive subject".

II - The historical approach to water management in the Mediterranean: Lessons from the past

1. Water harvesting and management techniques in the Mediterranean arid zones

Ancient Mediterranean societies were based on an efficient capacity of managing water in relation with the environment and the recurring climate change. Water culture is the foundation for any social system both where there are great rivers that generate hydraulic societies (Wittfogel 1975) and where there are not waterway and therefore small scale societies develop (Laureano 2005).

In ancient times, Egyptian society depended upon the Nile River for its existence. Society flourished for approximately 3000 years because of the Egyptian people's ability to harness the power of the river for agricultural purposes, social events, community projects and religious purposes. The central importance of the river in the Ancient Egyptian's daily life is evident in history and is reflected in their art, religion, writings, politics, and social life. The river shaped nearly every facet of their existence. The ancient Egyptians were a religious people. Two of the earliest religious cults were sun and nature. As an agricultural society, they depended upon the cyclical nature of the Nile floods to replenish the lands with fertile topsoil and they depended upon the sun to help produce a bountiful harvest. Witnessing the natural processes of the earth likely influenced their beliefs in the afterlife.

In those places without great rivers, the people were obliged to develop several water harvesting and saving techniques, such as those used by the *Nabatean agriculture*, called in this way by the people of the Negev desert (Petra; Jordan) who have developed a culture based on the

condensation of the water in caves and pit, the stone arrangement for rainfall harvesting, the collection of flood in cisterns and the underground dams inside the arid river beds of the wadis.

These techniques are not only widespread in the Negev desert but also in the whole Mediterranean area. In Petra they present their urban ecosystem synthesis but they can be also found in Algeria, Morocco, Tunisia, Libya, Greece and in southern Italy, French, Spain and in particular in the isles where they have been preserved from prehistorical age thanks to local traditions or they have been imported by current exchanges.

People living in the Sahara desert have developed a careful water management culture. Here, drainage galleries (locally called foggara, qanat, khettara) collect the water and a specific juridical system and elaborated agreement on water management has been created expressly to administrate this important resource.

This water culture spread over the Mediterranean thanks to different civilizations that characterized the area. In particular, the Egyptian, the Minoan - Mycenaean-, the Phoenicia-Punic, the Greek -Roman-Byzantine, the Islamic culture and the medieval monastic movement spread new knowledge and managing water techniques.

Small-scale societies based on hydraulic agreements and water harvesting and distributing techniques characterize the Andalusian agriculture in Spain, grounded on local traditions and influenced by the Islamic civilization.

In the isle of Ibiza there is a irrigation practice, called *feixes*, designed according to an ingenious hydraulic organization that allow to deal with the excessive amount of water of the marshy areas during the raining season and to give water to plants during the dry season without irrigate the soil.

The fields are divided into long and narrow rectangular plots by means of a network of canals having the twofold function of draining the water in excess, thus collecting and saving it and of irrigating the fields during drought seasons. In fact, if these works were not carried out it would be a swampy area in some seasons and arid or flooded by seawater in other seasons. In this way, it is possible to carry out a self-regulating process, which allows practicing intensive cultivations of both marshlands and arid lands. Open canals are about one-meter deep and flow at a lower level than the plots of land thus keeping them dry. The land excavated for building the canals is used to raise the level of the cultivated land. During hot seasons when the land undergoes high evaporation, the plots absorb the necessary quantity of moisture directly from the subsoil and from the walls of the canals by osmosis and capillarity. The process is then fostered by further underground canalizations excavated in the plots. These underground canals are built with porous stones and pine-tree branches covered with a layer of Posidonia algae collected along the coast. This method ensures the good running water piping and at the same time it allows to obtain a certain level of permeability in order to give the land the quantity of water necessary to keep it humid. Therefore, the irrigation is carried out from the subsoil directly to the plant roots. This technique enables to save water that would be lost because of evaporation by using open irrigation methods.

2. The water induced landscape

The most widespread system that can be defined as one of the typical features of the Mediterranean area is the terracing which can be found from the Middle East to Greece and from Italy to Portugal. Terracing associated with olive and wine growing actually contributes to shaping the landscape. The slopes and hills in the northern Mediterranean have stood up to erosion over time and their present shape is the result of that long-lasting titanic action. Along with the dry stonewalls, the stone barrows (specchie) and the tholos constructions (trulli), terracing is typical of the Apulian region in the south of Italy. Here, the terraced slopes of Amalfi and in the north of Italy, the Cinque

Terre in Liguria, create fascinating and traditional urban ecosystems. In Sardinia in the Baleari islands and in Catalonia there are systems of fields surrounded by dry stonewalls called *tanka*, which is a term deriving from an ancient Mediterranean toponym.

The majority of the ancient Mediterranean sites follow the layout of the terracing and the water systems network. These sites adopt the techniques of rainfall harvesting, protected vegetable gardens, the use of organic waste for the creation of humus, the methods of passive architecture and of climate control for food storage and for energy saving as well as the practices of recycling productive and food residues. The aesthetic qualities, the beauty of natural materials, the comfort of architecture and spaces, and the organic relationship with the landscape that these ancient towns boast are especially due to the intrinsic qualities of traditional techniques and to the search for symbiosis and harmony intrinsic to local knowledge. The same consideration is true for entire historical centers and rural landscapes which are doomed to perish and be abandoned when they are unable to incorporate the innovations they need in order to function.

3. Ancient water techniques for security and sustainable future

Traditional knowledge originates from people and is transmitted to people by recognizable and experienced actors. It is systemic (intersectorial and holistic), experimental (empirical and practical), handed down from generation to generation and culturally enhanced. Such a kind of knowledge supports diversity and enhances and reproduces local resources (Science and Technology Committee, UNCCD). Traditional knowledge is to be considered as part of an extensive system which hands down and accumulates shared knowledge whose proficiency and evolution is appreciable over long and very long periods. The functioning principle of the traditional systems is based on a strong cohesion between society, culture and the economy. Their efficacy depends on the interaction between several factors, which should be carefully considered: aesthetic and ethical values complete the interaction between environmental, productive, technological and social aspects. Traditional techniques, therefore, cannot be reduced to a list of mere isolated technical solutions able to solve a specific problem. To catch the full meaning and importance of traditional techniques they must be always highly contextualized, not only into the local environmental situation, but to a precise historical moment and the complex social construction which originated them.

The understanding of the logic of traditional techniques' use and of their success in terms of environmental sustainability and efficacy over long periods is fundamental not only to safeguard a vast cultural heritage but as a new paradigm on which the modern re-proposition of traditional techniques must be founded. As a matter of fact, using traditional knowledge today means to re-interpret the logic as innovative advanced knowledge and to elaborate models of technological development based on the added values of tradition: the versatility and the interpenetration of technical, ethical and aesthetic values; the production not per se but for the good of the community and based on the principle according to which each activity has to start up another one without waste; energy use based on cycles in constant renewal; the protection of ecosystems and of cultural and biological diversity as the fundamental principle of the economic and productive processes. These values allowed societies, in the past, to manage ecosystems in balance, to carry out technical, artistic and architectonic works universally accepted. Traditional knowledge is a dynamic system able to incorporate innovation subjected to the test of the long term and the local and environmental sustainability.

Local knowledge is an economic factor in different production sectors. Situations in which tradition persists, and its role in society and economy is consolidated and stabilized, can be proved specifically in the more technologically advanced countries and sectors. In Valais, the water harvesting systems from the sources of springs and from glaciers which, through little surface canals called *bisse*, allow mountain slopes to be irrigated by gravity on a higher level than the stream's natural course. A similar technique is today re-proposed in Tibet with innovative

methods to *protect glaciers, which* are in danger because of global warming. In the Loire Valley, the traditional technique of the *cave-dwellings* and of the excavation of subterranean caves is maintained in order to preserve each single meter of surface area, precious for high-quality wine production and, in order to organize wine cellars with a perfect microclimate for the production of that product. In Tuscany, wine production provides the economic resources necessary to preserve from destructive transformations one of the most wonderful agrarian landscapes, consolidated and affirmed over the centuries. Thus, it is wrong to consider traditional knowledge as marginal compared to the great economic and technological processes under way. Even from a quantitative point of view, their use still supports most of humankind, which is distributed throughout the less industrialized countries. Paradoxically, in these places where traditional techniques are still used in a massive way, the modernist thought as a phenomenon of backhandedness, whereas, in advanced countries, they create an image of desirability and provide added value, considers these. What we recognize as tradition is not a static and immutable condition but a dynamic system, which evolved by making innovative aspects so much an integral part of it that sometimes becomes difficult to interpret. The more this is done with respect for tradition and authenticity, the more it requires advanced innovative and appropriate capacities and creates added value as well as economic effects. In Liguria where in the Cinque Terre region there is one of the largest systems of *terraced slopes* in the Mediterranean, this traditional practice that protects the soils, catches and channels the waters, has been perpetuated through innovative agricultural mechanization. Agricultural work on terraces is hard due to tiring transport systems, which are operational only on foot. Traditionally there were techniques of transport by means of sledges drawn up the hill by ropes. Already at the beginning of the century these were substituted with mechanical funicular systems on rails. The same technique is re-proposed today with appropriate *monorail* systems that enable the ascent of the slope without disturbing the landscape or the ecosystem.

4. Lessons from the past

We must speak about an on-going construction of tradition. To guarantee its future does not mean to reduce or inhibit capacities of innovation, though this idea has been undergone over time to critiques and biases and weakened by the lack of communication and exchange of successful experiences as well. With emigration and the dramatic transfer from traditional habitats into new urban agglomerations, the rapid abandonment of the agricultural sector by large segments of the population and with the superficial suggestion of the absolute superiority of modern technology, the process of conservation and dissemination of knowledge is interrupted and lost. On the contrary, the good welfare conditions of people favor social cohesion, confidence within cultural identity and enable the safeguarding of traditional systems through the guarantee of a high remuneration of the work necessary to maintain them. It explains the apparent paradox of those rich countries, which were able to maintain high levels of traditional techniques, and succeeded in paying for the necessary efforts with a great increase in product value. Thus, we can state that tradition is a feature of 'successful modernity', capable of getting benefits and values from it. To re-propose tradition by resuming its historical relationship with people's innovative and creative power is decisive to safeguard landscape and realize security and sustainable futures.

III - An analytical approach to water culture

In spite of the particular perception that people may have about water use, from a theoretical standpoint water can be conceived of as a *public good* given that it fulfils two criteria: a) water is supplied to all consumers and no one can be excluded from using it; and b) what one person consumes under normal conditions of supply reduces the possibilities of another using it. Whether considered at the level of social perception or from an objective perspective, issues related to water consumption are the focus of public debate and controversy, particularly during times of scarcity such as periods of drought. Furthermore, the partial or total privatization of water resources has

begun to occupy recently the public agendas of many governments, so that water resources are increasingly being viewed from a market-oriented perspective too.

Thus, from either a theoretical approach or through an analysis of the social and political reality, water is an issue of public debate about which people express their opinions, hold certain beliefs and attitudes and behave in a particular way, leading to a variety of *cultures* regarding the use and consumption of water resources. For this reason it is necessary to examine the issue of water theoretically in terms of "political culture"; an approach that explores citizens' orientations as the result of a set of attitudes, beliefs, values, knowledge and behavior. As regards issues related to *water culture*, this theoretical approach allows us to classify citizens' orientations into the four following categories or analytical dimensions:

- *Affective dimension.* This dimension includes the feelings people express about the consumption and distribution of water (for example, the perception of whether there is a problem of water scarcity or not, beliefs about the causes for water shortages, views about inefficient water use, etc.).
- *Cognitive dimension*. This dimension has to do with the level of knowledge people have about issues related to the water cycle and the players (individuals, groups and institutions) that use and consume water resources.
- *Conative dimension.* This refers to the degree to which people approve or disapprove of measures to regulate water management and distribution (water rates, assessing priorities in times of scarcity, management schemes, financial resources for investments in infrastructures, policies to increase water supply or reduce demand, etc…).
- *Active dimension (or behavioral dimension).* This refers to how both individuals and groups of citizens behave with regard to water consumption.

Studies that have been conducted on this topic attempt to determine the relationships that exist between these four dimensions in order to draw useful conclusions for designing public policies aimed at raising awareness on managing water, its preservation, consumption and distribution. Yet the water debate cannot be carried out in an abstract context as citizens' opinions and beliefs regarding water and the problems arising from it have to do with very specific issues. Although these issues may vary from one geographical area to another, they generally revolve around the following questions:

- Water rights and management schemes (public, private, joint)
- Level of water provision (consumption) and the criteria for distributing water among different groups of users.
- The cost of water (criteria to calculate how much users must pay for water).

The analysis of *water culture* therefore has as its aim to determine how the water debate is formulated among the population and what the most relevant explanatory factor is in that debate. In short, our aim is to determine if the debate is articulated around sentiments (feelings), beliefs and values (affective dimension); around preferences regarding policies to regulate water consumption (conative dimension), around citizens' behavior regarding water use (active dimension), or if it is a combination of all three dimensions; while at the same time attempting to account for the influence of knowledge on all three (cognitive dimension) (**Tab. 1**).

Table 1. The water debate: dimensions and issues.

Dimension	Issue
Affective dimension	• Degree to which users perceive of water as being a public or private good and approve of water management schemes. • Perception of the severity of the water problem. • Belief about the causes for the water problem. • Opinions on inefficient water use.
Cognitive dimension	o Knowledge about local water management schemes. o Knowledge about organizations that have jurisdiction in water-related matters. o Knowledge about groups of players involved in the water sector (irrigation communities, hydrographic confederations, etc.). o Knowledge about the water cycle.
Conative dimension	▪ Degree to which users approve of the criteria for allocating water in times of scarcity. ▪ Degree to which users approve of possible measures to reduce water demand. ▪ Degree to which users approve of possible measures to increase water supply: building reservoirs, water treatment plants, transfers, etc. ▪ Degree to which users approve of new water pricing schemes. ▪ Opinions about investments in infrastructures. ▪ Opinions about the transfer of water between regions.
Active dimension (behavior)	➢ How individuals behave differently with regard to water use. ➢ Membership in or tendency to belong to the associational movement.

The intensity of the water debate as well as the positions held by citizens regarding it depends on a variety of factors. These include *socio-structural* factors (type of user, type of activity, type of business, family income, and type of household), s*ocio-demographic* factors (age, sex), *cultural* factors (educational level, value systems) and *contextual* factors (low, medium or severe water scarcity). Clearly, the positions held by the various players involved in the water debate will differ depending on these variables, which will be examined independently in our analysis. As regards factors of the socio-structural type, the position taken by people will depend on what water consumption and water use means to them. Here two broad groups of citizens can be differentiated according to type of consumption:

- *Productive consumers.* These are users for whom water is an essential factor of production (farmers, industries) and for whom consumption responds to an instrumental rationale based on the possible productive income to be gained from the resource.
- *Domestic consumers.* For this group of citizens, the amount of water needed is determined by specific cultural patterns in such a way that water consumption is based on an expressive rather than an instrumental rationale.

Yet not all productive consumers or all domestic consumers are the same. Indeed, different subtypes of consumers can be distinguished within each of these groups according to their type of activity, income level, occupation, household installations, age, sex and educational level. For example, the position held by productive consumers in the water debate will vary according to the role that water plays in production. While water is a fundamental factor of production for farmers with irrigated farms, a distinction must be made within this group between farmers who have access to water through a collective concession (for instance those belonging to an irrigation community) and those who do so through a private concession (for example, by means of wells).

Their preferences regarding priorities of use or levels of provision, as well as individual behavior (saving) and collective behavior (actions to coordinate consumption) will differ in each case. As regards domestic consumers, individuals' social position will have a significant influence on their values, attitudes and behavior with respect to the water issue. Indeed, public opinion studies differentiate between two large groups according to their social status. One of these groups occupies what could be called the *social centre*. This group encompasses people that occupy the highest rungs of the social ladder, that is, those who have greater resources in economic (i.e. income) or cultural and symbolic (i.e. educational level, training) terms. The other group occupies the *social periphery* and comprises people with lower economic resources (i.e. less income, lower education levels). In general, people who belong to the *social centre* have a higher tendency to voice their opinions and participate in the public debate on certain issues. These are people who have also developed post-materialistic values (centered on improving their quality of life and protecting the environment) and are more involved in associations and engage in collective behavior. Thus we can expect different attitudes towards the water debate among people belonging to the *centre* and those belonging to the *periphery* of the social structure.

Finally, it is important to highlight how people's values, beliefs, attitudes and behaviors regarding the issue of water use and consumption may be conditioned by the *context* in which they live. When dealing with an issue such as water -which is largely influenced by factors related to the natural and climatic conditions of a given territory, how public authorities manage water or by the different uses to which water is put- it is to be expected that people will react according to their own particular situation. For this reason it is necessary to include situational variables such as the type and size of habitat or the fact that people live or have lived under conditions of normal or restricted (drought) supply when analyzing water culture. In short, the analysis of people's orientations regarding the water debate must be conducted from both a *socio-demographic approach* (taking into account the influence of such variables as sex, age or type of family); a *socio-structural approach* (accounting for individual's social and economic status including income level, occupation, activity or household installations); a *culturalist approach* (which attends to norms and value systems) and a *situational approach* (which takes into account the habitat and situations of normal supply or scarcity) (**Tab. 2**).

Table 2. Independent variables.

Approach	Productive consumers	Domestic consumers
Socio-demographic approach	Sex, age, educational level. Type of family.	Sex, age, educational level. Type of family.
Socio-structural approach	Type of activity. Size and type of exploitation. Social position (occupation, income, etc.).	Occupation. Income level. Type of household.
Culturalist approach	Basic normative orientations: Materialism vs. Post-materialism.	
Situational approach	Type and size of habitat. Normal access to water resources. Water restrictions or scarcity.	

IV - The water impasse in the Mediterranean countries. Toward a new Water Culture

1. Water harvesting in arid zones and risk management

Arid zones needs to employ all the human skills to guarantee the provision of water. The different techniques of water harvesting show that, according to constraints zones, their design method

differs considerably across region's country: (i) Benches for retaining local water and sediments to agricultures purposes (*tabias*), (ii) *Impluvium* with mastered and conducted runoff (*Meskat*, typical water harvesting structure of Tunisian Sahel) (iii) crops terraces to limit runoff, (iv) structures built on *Oued* bed's to slow water flow and recharge shallow water table (*jessours,* mainly in Southeast country, Matmata), (v) hillside water storage, (vi) derivation canals and floodwater spreading (*Mgoud*),(vii), underground water catchment's by the means of draining galleries (*foggaras,* technique developed in the Southern country oasis) and water distribution via canals (*Seguias*). Inspired by their ancestor, engineers improved major of these techniques, which represent today an evident component implemented within the water mobilization strategy.

However, despite the tremendous efforts consented to the accessible water mobilization, Tunisia, for instance, took conscience that its water management policy must be presently turned to the demand master and within the framework of holistic approach aiming to guarantee the sustainability of the national hydraulic potential. Official forecast (Plan bleu, 2000) claimed that global water demand will regularly grow until reaching 2700 million m^3 at the horizon of 2030 while the agriculture demand, less than 1900 million m^3 in 2003 (80% of the global demand), will reach 2100 million m^3 and will face more competition with other sector water demands (urban and industrial). At this purpose, competent Tunisian authorities established a complementary work focused on the improvement of hydraulic infrastructure efficiency across the country. The present decade (2002-2011) will also aims to take advantages of treated wastewater, development of non-conventional water resources such as high saline water and sea water treatment. The two key words of the future national water policy are Efficiency and Water Economy over all level of hydraulics structures. On the other hand, it seems to be evident that Tunisia like other Mediterranean countries has to cope permanently with risks of droughts and perspectives of water shortage that threaten constantly the water resources equilibrium and especially irrigated agriculture. Indeed, national forecasts predicts the frequency of dry year occurrence varying from 10 to 15 % in Northern country, whereas, it attempts 25 to 30% in the center and the south. The probability to have two successive dry years still rather rare for the North (3%), while it reaches 10% in southern country. A three-year drought sequence has a frequency of 1% in the North and 3% in the center and the south (MAERH, 1999). The frequency of droughts has led Mediterranean countries, from north to south, to acquire a relevant experience in water management under shortage conditions. Several practices and techniques were adopted to reduce drought negative impacts. It deals with irrigation modernization, cultures techniques improvement, and management of the water demands. A strategy of drought management must be instituted in all countries; the applied guidelines represent a decisive alert tool to all concerned structures and allowing them to act in opportune time. That's why, today there is a concrete awareness about water scarcity, and all stakeholders involved in water management collaborate closely for a sustainable rational use. Water culture in Tunisia and other countries is concretized through all historical and contemporary techniques and hydraulic structures, observable across the whole country. This relevant expertness reinforces the Mediterranean countries capacity to face with serenity, globalization future challenges that require more than more intensive pressure on water resources.

2. Mediterranean systems, water management and sustainability

Hydrovorous economic activities, in particular intensive irrigation systems and a high urban and tourist development in coastal areas are being increasingly established in Mediterranean countries as Spain. With a Water Exploitation Index (Amount of water abstraction respect to renewable resources) of 33%, Spain is the third European country with a highest pressure on water resources, beside only two islands: Malta and Cyprus (EEA, 2003). Paradoxically, this pressure in Spain is highest in its most arid areas, such as the Segura basin, where in mid 90s irrigation consumed 228% of total renewable water resources, which means the highest pressure on water in the whole Mediterranean European countries (Institute for Prospective Technological

Studies 1997). In the Segura basin, water consumption in irrigation greatly exceeds total renewable resources because additional water sources are used, particularly groundwater overexploitation (consumption of water reserves) and water transfer from other river basin.

In arid areas water resources are scarce, but may important reserves of groundwater accumulated during long time exist. The intensive consumption of such no-renewable reserves allow for a certain period of time the support of water-intensive economic activities, such as irrigation and tourism. This leads to the misperceived assumption of that there are no critical limits to a permanent growth. However, the experience has shown that renewable water resources cannot always been substituted by means of a new technological intensification, due to the appearance of unexpected limits and environmental, social and economic side effects. This has been the case for long-distance water transfers (between different basins) which has revealed unsustainable social, environmental and economic costs, and for groundwater pumping at increasing depths, which faces important limits in terms of energetic costs and water quality due to saline intrusion.

The unsustainable growth of irrigated lands and more recently the quick spread of big urban-tourist developments in many Mediterranean countries as Spain and, recently, others from the southern side, along with the magnitude of the associated environmental effects, reveal an urgent need to adopt a systemic approach. The occupation of habitats of high ecological value, the loss of biodiversity, the aquifer over-exploitation, the loss of springs and wetlands and the increasing pollution of soils and waters, points to the existence of clear limits for the sustainability of these types of socio-economic activities. The limiting factors arise not only from the scarcity of water resources but also from the magnitude of environmental costs associated with these activities and the attached unsustainable water management.

3. A new approach for the concepts of water resources and water uses

The concept and quantification of available water resources, and hence the amount of water resources that can be assigned to and used by the socio-economic activities, does not constitute an independent variable. Instead, it is closely linked to considerations regarding the type of environmental, social and cultural water functions that should be maintained, to which current societies in Europe and the neighborhood countries of the Mediterranean are showing an increasing sensibility. The recent reform of the Water Act in Spain has begun to acknowledge this, by establishing that water resources available for socio-economic uses have to be computed after water needs for environmental functions, such as environmental flows in rivers, have been quantified and discounted. This means a very important change of the concept of available water resources applied in Spain and the rest of Europe during the last 150 years, under the so-called old hydraulic policy and constitutes an important challenge for the actual water management.

Regarding water uses, the traditional differentiation among the categories urban, agricultural and industrial sectors is no longer useful in Spain, Europe and many Mediterranean countries, since such categories now includes very different situations which should be treated separately. In the case of urban water consumption, there is a wide gradient from basic survival to big-scale urban-tourist activities. In terms of water management, it is necessary, at least, to differentiate between 1) the drinking water and basic domestic water needs, which should be considered as a human right; 2) water for non-basic individual and collective urban purposes which represent a citizen right (water for cleaning uses, maintenance of public gardens...) and 3) water for the urban-tourist sector (hotels and residential resorts). Between the basic access to good quality drinking water, still lacking in many areas around the world, and the exclusive residential resorts with private swimming pools and gardens, there is little in common, but all these type of urban uses enjoys in Spain the same maximum priority for water. This is quite unfair from the point of view of social needs and from the point of view of economic rationality, since many tourist activities receive a privileged treatment regarding water access when compared to agricultural or industrial activities, by means of their urban status.

The case of agricultural uses is even more complex. Irrigated lands include very different systems in terms of socio-economic characteristic and environmental costs and benefits. In a simplified way, in Spain there are two models of irrigated lands representing both extremes of a gradient. The first one is the traditional, familiar irrigated land, based on the sustainable use of resources, such as renewable water and soils with high natural fertility. These traditional irrigated lands have created agro landscapes, usually along the river valleys, with outstanding landscape and biodiversity values. Moreover, these traditional irrigated lands have a rich cultural heritage accumulated along a thousand years of history. Paradoxically, these agro landscapes, the most suitable for irrigation, are disappearing due to their transformation into urban areas.

The second case is that of intensive irrigated lands, with an almost industrial production system, belonging to big agro-business for the international market, usually located outside the river valleys in areas with no renewable water nor fertile soils, which require a high consumption of energy, non-renewable resources and chemical inputs. These two types of agricultural systems (traditional irrigated lands intensive agro-business irrigation systems) are very different in terms of social and environmental costs and benefits, but despite of this they are treated similarly in terms of water rights in a contexts of scarce water resources.

Clearly, it is necessary a completely new approach to establish priorities and rights to water uses taking into account their environmental, social and economic context and independently of their generic consideration as urban, agricultural or industrial status. A recent European Declaration for a New Water Culture, suggest water uses prioritized according to the functions of water. Three levels of priority should be considered:

- *Water for life*. The top priority is basic water supply for survival of people, which must be recognized as a universal human right. The maintenance of the essential environmental functions of water and aquatic ecosystems must also be guaranteed, as a basic need for a sustainable and healthy biosphere.
- *Water for general interest purposes*. The second level of priority applies to the need of preserving public health, social cohesion and equity. Here it is included the urban water supply for more general purposes and the maintenance of traditional sustainable irrigated systems with a high social interest.
- *Water for economic growth.* The water-based economic activities oriented by private interest constitute a third level of priority (being agro-business, industrial or tourist water uses). These water-based economic activities should access to water only after the previous priorities (water for life and water for general interest purposes) are met. Moreover, water for private interest must be managed under the control of public authorities and applying principles of economic rationality in order to optimize economic efficiency.

These new priority levels according to water functions are part of a new paradigm, the New Water Culture, which has been proposed in recent years as a response to the crisis of the old hydraulic policy, the emergence of new actors in the water debate and the existence of serious conflicts regarding water planning and management.

V - Raising public awareness on water management by reinforcing the water culture in the Mediterranean Area: Communication strategies

1. Gaps between past and present

A brief comparison of the public perception of the issues related to the relation of human beings in the Mediterranean area in ancient and recent times shows significant social and cultural changes

(**Tab. 3**). It must be noted that these descriptions correspond to an average perception, particular situations remains in those place in north and south Mediterranean where the social and economic situation has not evolved according with the present technological facilities.

Table 3. Relation of human beings in ancient and recent Mediterranean area.

Cultural reference	Ancient times	Present times
Type of social environment	Agriculture based, rural	Industrial based, urban
Basic Values	Water is life, and life needs: Water, food, security	Water is life, and life needs: Security, access to goods (consumption)
Beliefs regarding water	Gods gift	Water cycle
Access to water	Water belong to those who use it, mainly in agriculture	Water is a public good. Water is needed for agriculture, industry and local consumption
Risk Management of water	Cisterns, saving, aqueducts	Great infrastructures, dams
Participation	All Citizens	Complex stakeholders, too distant to citizens, closers to farmers
Territory and water management	Local	Supply on demand. Market commodity.
Quality of water	Basic value, little impact of humans	No clear perception. No respect from the public. Damages in surface and underground waters
Technological approach	Small scale	Deep wells , big dams, large conductions
Education for water	Fundamental perception of its importance. Family values.	Scarce commitment. Access guarantee from external sources
Impact on water resources	Very low, adapted to local water cycle	Very high, alterations of water cycles and water courses equilibrium. Contamination of underground waters
Water reserves	Domestic, cisterns, little dam and aqueducts	Big dam, water trade

2. Communicating new water policy

Despite declarations and commitments of several European Countries and European Organization, a new water culture has difficulty to develop.

The European Commission established an independent international team of renewed experts from different part of the word to review the international cooperation projects dressing integrated resources management (IWRM) over the last ten years with European founding (European commission 2006). The results of this review included a report where a significant chapter is devoted o traditional knowledge and it's relevant for advancing integrated water management. (European Commission 2006)

The European commission panel said that scientific knowledge regarding what we have to do is clear to the expert. Nevertheless almost nothing has been done from a practical point of view. The matter is therefore linked to political and communication issue and not to the scientific one. It's important, therefore, the Science become able to communicate o people.

In order to communicate, people's attention must be captured. Communicating new water policy means showing its results to the public and making it become part of culture. Politicians are generally interested in issues and actions that have effect in the short and medium term and that

are verifiable during their mandate. However, the enormous problems afflicting the planet today, from poverty to migrations and resource destruction together with the climatic-environmental crisis, involve a brief span of time if we compare it to the social and geological history, but they appear to be very long and distant from the type of commitment most politicians undertake. Therefore, although a long-term research is necessary for any serious approach, it is also important for research to show its application potential and scientific projects should contemplate an immediate checking system. Thanks to concrete examples the scientific message reaches the public and, therefore, becomes interesting for politicians.

Program adhesion and support is gained if the researcher himself is directly involved in the research. This is the reason for which it is necessary to have a scientific approach that is not detached and neutral, guided by economic or academic motivation. On the contrary, it should be motivated by a strong cultural, social and even passionate commitment. A new paradigm in water culture is communicated through sincerity, by taking the responsibilities personally and thanks to direct evidence in pilot actions. The successful experiences, presented in a new and winning way, show their potential and start participatory processes at all levels. Policy becomes the promoter of programs where the new vision is a determining factor of change and brings appropriate solutions as well as hope and happiness.

3. Addressing policy makers

The most suitable methods to address policy makers are:

- Create the best level as possible in the communication and participation to the projects.
- Involve the Local Government Administrators and policy makers right from the beginning of the projects, e.g. by organizing conferences hosted by the Public Administration and inviting politicians and citizens on the same occasions of the project meetings.
- Achieve visibility in the mass media by communicating the projects' validity in a disseminated and original way, highlighting that the scientific results have practical consequences both on the specific choices and on the general view of the world.
- Create the most active local participation in order to involve the administration and the public opinion in the projects' finalities.
- Involve the national and international organisms that work in inherent sectors to the projects by inviting their representatives to the scientific conferences of the projects and by forwarding their scientific results to international conventions.
- Involve the economic sectors that may be interested in the projects' scientific results and encourage them to finance the implementation phases.
- Involve greater society sectors through associations and pressure groups and by divulgating the projects' scientific results in collateral events.

4. Communicating a new water culture through the implementation of projects

The success of the projects depends on the following factors:

- The scientific research project must be founded on a clear idea that must be communicable in an original way and have a direct implication in decision and concrete action making.
- The project must not be limited to research but should also organize on the ground operations to show the public opinion what the practical effects on everyday life are.
- Encourage the participation of partners who are already working with research projects and on the ground activities and implement their involvement in European projects.
- Give the project other outcomes and a continuity that go beyond the research in itself by creating a solid relationship with the partners, networks and pilot actions. To achieve

this the three years term usually assigned to single projects are not sufficient. It would be convenient to extend the partnership to several related projects.

- The project's finality should not constitute for the partners, or at least for the scientific project coordinator, an occasional or marginal commitment, but should be the centre of his activities and be part of his individual mission. For this reason it is important that the partners were previously involved in the project's finality and that they will carry on being concerned in it later on.
- It is important to pursue not only the results of the specific project but also to prompt every possible related outcome.
- Partners should develop a real collaboration and a sharing of intentions as well as the general view that must be directed, developed and communicated by the scientific coordinator, who will be entitled to.
- The project must not be directed and monitored in a bureaucratic way through the inspection of the WP's procedures, but it must be flexible and allow a certain degree of autonomy in order to achieve objective results and to be able to undertake new and unexpected directions.
- The project must not be carried out in an isolated research context but within an issue that has been previously developed by other scientists and organisms at a national and international level. In this sense the greatest receptivity to the participation of international organisms and research groups is necessary together with the implementation of sharing and dissemination protocols with no copy right on results.

5. Values to be recovered and public awareness building

Some key and important values need to be recovered and valuated in order to ensure increased public awareness, such as:

- Perception of scarcity: The old generations were more sensible to the water scarcity in the region because the access to water was very painful. In fact, they were forced to travel for huge distances and spend a lot of time to have access to limited water quantities. Nowadays, with the full access to water at all time and places, a wrong feeling and opposite perception have been built: the water is a cheap commodity and abundant resource. To recover the scarcity value, a lot of work is needed at all scales: awareness, cultural values, economic measures and legislation.
- Modifications of water cycle by the human impact: The mobilization of water resources (dams, groundwater aquifers, etc) has to take into account:
  - Changes from surface reservoirs in the Mediterranean area, with high losses due to evaporation, to underground reserves. Recovery of good quality and sustainable exploitation of aquifers.
  - Good management and maintenance of dams. Periodic cleaning to move sediments downstream.
  - Better control of flash-floods using ancient technologies to divert water to neighbor terraces and underground reservoirs.
- Sharing of scarce resources by different actors: Certainly, the economic and population growth need more and more water. In addition to improving resource management, there is huge scope for improving water demand management (WDM). This includes all actions and organizational systems intended to expand technological, social, economic, institutional and environmental efficiencies in the various uses of water. It means making water consumption doubly efficient, by increasing both the efficiency of the ways by which water needs are met, and those by which water is allocated to various uses. Nevertheless, the agriculture sector

will remain the largest consumer though it share is expected to be reduced especially in the south (from 82% in 2000 to 74% in 2025). More attention is to be given to improving water productivity of crops based on the virtual water concept.

- Recovery of water, no waste water: Though a lot of efforts (technology, economy) are still needed for the treatment of waste water, huge habits and misunderstandings are to overcome in parallel especially in the agriculture sector where the products produced on such water type are not well accepted by the consumers.
- Make use of the cultural and ethical values: Policy-makers are beginning to appreciate the value of including religious and cultural values in public awareness and education strategies. Regardless of people's culture or religion, spirituality and ethics are very important for influencing behaviour.
- Public awareness programs need to be holistic and multidisciplinary. They should not focus solely on particular places (schools, religious monuments, universities, administration, public places, etc), but extend to the education system as a whole. Further, and what is rarely the case, programs should be co-planned by concerned ministries (Education, Water, agriculture, culture, industry, etc.) so as to be multi-disciplinary – with components of applied science, economics, health, and culture.

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