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EVALUATION OF WATER FOR AN INTEGRATED WATER RESOURCES MANAGEMENT IN THE MIDDLE EAST: A SOCIAL AND TERRITORIAL PERSPECTIVE

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SUMMARY – A fundamental step for protection and sustainable use of water resources is the consideration of their values either for sustaining human life and socio-economic functions, or for maintaining ecosystem health. The international debate is concentrated on two different approaches leading to a water sustainable management: the "economic approach" introduced by the UN Dublin Conference (1992) and the "humanitarian approach" stated by the UN Millennium Development Goals (2002). The two approaches have supported divergent views about the prioritisation of the water problems and the respective solutions, while they should instead be complementary for targeting different situations and sectors needs. Specific considerations will be presented on issues of relevance for the Mediterranean and the Middle East regions.

Keywords: poverty alleviation, water and territorial values, water demand management

1. INTRODUCING THE GLOBAL CONCERN ABOUT THE PROBLEM OF WATER SCARCITY

The water issue has been considered as a global concern during the three past decades. One of the first international events focusing on the water problem was the UN Conference in Mar del Plata of 1977, that launched the UN International Drinking Water and Sanitation Decade; while Nairobi, on the same year, hosted the UN Conference on Desertification, following a period of drought which had contributed to shrinking water resources availability, causing desertification and famine in wide African regions. These and other global and regional conferences opened new cooperation programs and funding instruments. In fact, statistics show that from 1960 and 1995 the world consumption of freshwater has doubled (UNDP 1998); however, about 1.4 billion people have no access to safe water and more that 2 billion have no access to water of sufficient quality. Moreover, more awareness is raised about the risks caused by the contaminated waters to human communities and ecosystems.

The weak achievements reached by the international programs despites the large funding disbursed, paved the way to the recent Declaration of the Millennium (2000) that has called for a stronger commitment by the community of donors, to strengthen the effective cooperation for meeting few fundamental targets, two of which are related to water:

- to halve by the year 2015 the proportion of people who are unable to reach or to afford safe drinking water,
- and to stop the unsustainable exploitation of water resources by developing water management strategies at the regional, national and local levels, which promote both equitable access and adequate supplies.

The Declaration is the base of the Millennium Development Goals (MDGs) launched in 2002, that propose to donors more concentrated efforts through effective "partnerships for action" with various stakeholders, and through improved monitoring instruments. The Goal 7 "Ensure environmental sustainability" includes the target 10 related to safe drinking water and sanitation, and propose two indicators for evaluating the impact of the cooperation projects on this issue: a) the proportion of population with sustainable access to an improved water source, urban and rural, and b) the proportion of population with access to improved sanitation, urban and rural.

The major stake offered by the MDG projects is that the water issue is not anymore confined and solved within the water sector itself, but it is strongly linked to the issues of poverty and sustainable

development. The core matter is not how to increase total availability quota, but instead, is how to protect water rights for human life and water needs for ecosystems functionality. Different tools and capacities have to be involved through concerted actions, to identify the functions of greatest values to protect, and the distribution of costs to be paid. Therefore, the instruments of good governance have to guide the decision-making process for an integrated approach concealing supply and demand management, distribution, and quality monitoring.

2. A COMPREHENSIVE APPROACH FOR ASSESSING WATER POVERTY

Understanding the causes of water poverty is a matter of fundamental importance. The insufficient distribution of safe water is traditionally presented as a consequence of the unsustainable demographic growth, particularly in developing countries. The population pressure determines increasing national water stress, defined as a ratio between the total volume of water theoretically available in a country and the total internal population, equivalent to a value below 1000 m3/year/per capita. The macro-regionalisation of water scarcity indicates that eighty countries, involving the 40% of the total world population, are currently suffering for water stress. The logical solutions sorting out from the consideration of water stress would rather being concentrated on increasing water supply, from one side, and on policies for population control, from the other.

However, the issue is more complex that this and it is particularly related to the relation with poverty, social vulnerability, and territorial management. The macro-indicator of water stress does not explain the real elements of the problem, such as the unequal distribution of water access even in situations over the water stress threshold; the situation of the hydraulic infrastructures, that are obsolete and insufficient to cover all settlements; the impacts of upstream activities on downstream areas; the pressure on marginal and polluted water resources; and many others.

Therefore the following sections of this chapter present a brief overview about the different obstacles to water availability for all, to conclude with the idea that it would be more effective to face the problem by different tools offered by a “water poverty” approach and by more comprehensive development programs of integrated water resources management (IWRM).

2.1. Localized water poverty

Great resources are currently mobilised to contrast the trend of increasing water deficit in large areas of the world. The aggregated values that have been presented have a strong communicative power, and are able either to increase a global concern among the public opinion world-wide, or to leverage new funding from donor countries and private companies.

However, two are the major weaknesses of this perspective. The first one relates to the territorial and seasonal variability of the water availability: for instance, in the Mediterranean and Middle East regions, the scarcity maps present different socio-territorial situations, as response to seasonal rains, localised presence of superficial flows, and weak water table recharge. According to the variability, the communities have developed, on one hand, flexible productive patterns to ensure their own food security, particularly with husbandry and rain fed or small irrigated agriculture, and on the other hand, sustainable consumption patterns integrated with traded goods.

The second weakness of the water stress perspective, derives from the elements considered in the ratio water quantity/population number. In other words, the problem is presented only as a physical scarcity, exacerbated by natural stress, and as a consequence of the cultural habits of poor populations that lead to unsustainable pressures over the water resources. Within this perspective, very important elements are missing:

a) the conditions of infrastructures bringing water to settlements and to agricultural/industrial plants, and channelling the drainage system. In fact, not all communities are connected to water networks, particularly in rural areas and slums; wastewaters are often not disposed and are left in natural and urban environments, causing serious damages to human and ecosystems health;
b) the institutional framework related to the responsibilities for providing security and human development, which include provision of basic services for all (e.g. education and health,

access to water and sanitation, housing, income safety nets etc.), thus contributing to alleviation of poverty and of social risks. Human development is a precondition for all development sectors: it is only starting from decent social status, that communities are able to participate in decision-making process, to better undertake sustainable livelihood systems, and to face the water poverty problems.

For the above reasons, more complex indicators can better help to describe the water poverty situation and future trends, based on resource availability, access, community capacity, sector's use, and on the state of the environment, to understand strength and limits for an integrated water management and the future progress that can be carried by a development policy for the water sector (Lawrence *et al.* 2002).

2.2. Consumption patterns

The demographic projections indicate that by 2025 a world population growth of 2.5 billion of people, with a stronger concentration in mega cities. This trend poses a stronger constraint to the challenge proposed by the goal 7 of the Millennium.

A greater weight over the water balance seems to be induced by the demands connected by the changing consumption patterns that a stronger globalisation (induced by information networks and trade) has uniformed. Total consumption of goods is surely increased, but more importantly it has a changed pattern, with an increase in type of goods having a stronger impact on water resources, at different steps of the productive process. Restricted elites have higher consumption of goods and services that are not in line with the restricted resources locally available and with the limited recharge systems of the water bodies.

In the Mediterranean region, a greater pressure over the local resources is caused by non-local consumers. The intensive development of tourist resorts during the past decades has severely increased the water demand. The tourist flows are particularly concentrated on the coastal areas, with a presence of vulnerable water table: in fact, the pressures for water abstraction produce a marine ingression in the groundwater, causing a contamination for water salinity. The long term damages caused by unsustainable pressures from the tourist settlements is paid in terms of a worsening availability of safe drinking water and by a environmental degradation due to changes in chemical features of the water resources sustaining the wet ecosystems. For these situations, particularly in the coastal areas of the Southern Mediterranean region, there are no effective regulations for monitoring and sanctioning the unsustainable pressures, nor mechanisms for compensation of the social and ecological damage, also because the assessment tools are not often available.

Besides the tourism, other water-exigent sectors are expanding in line with the new development trends. The linkage between type of commodities produced and pressure over the water resources has been estimated in terms of volumes of water embedded in the specific production processes ("virtual water", Allan 1998). For instance, for the production of a car it has been estimated an average of 400.000 l of water used during the industrial process; while the UNDP Human Development Report of 1998 show that between 1975 and 1995 the presence of motor vehicles in South-Eastern Asia has developed by 1400%. The virtual water has been calculated particularly for evaluating the agricultural productions and the diet compositions. According to the content of animal proteins rather than a percentage of vegetal staples consumed, a great difference is shown in terms of water pressures. According to Renault and Wallender (2000), the composition of the average diet in the United States determines a consumption of 5,4 m^3/person/day, while a subsistence diet corresponds to only 1 m^3 of water consumed. This explains a lot about the weakness of the demographic concern related to water stress, and shows how the pressure is more influenced by the social and economic wealth. In the arid Middle East it is not uncommon to see beautiful gardens and golf clubs watered with continuous irrigation, beside barren areas where deprived communities reside. The water availability is, again, a matter of human and economic development, of social awareness and education, and of good governance for widening the access opportunities for all.

The economic wealth offers various opportunities of choice about alternative sources of water for meeting the human needs. One example is given by the expensive technologies offering alternative sources of *physical* water, such as the desalination plants utilised e.g. by Israel, Saudi Arabia and the

Emirates; or by adopting a strategy of *virtual* water trade, with importation of goods requiring huge amounts of water and that in a foreign country could be produced at a lower cost. On the contrary, the financial constraints reduce the opportunities for accessing new technologies and developing alternative sources. The consumption of physical water locally available as well as restricted strategies for food security are the only chances to survive under water poverty conditions.

2.3. Disruptive and inefficient management of water resources

The problem is worsened by the inefficient management of water resources, either in terms of operation and maintenance of the distribution networks, or as rational allocation of the resource. The main losses are caused by damages and bad maintenance of the canalisation networks that in many cases are old and obsolete. The problem do not only regards the Developing countries, but is also relevant in Europe, even in cases where the management responsibility has been shifted from central institutions to municipalized agencies, and with an important private presence, that would be supposed to facilitate a more efficient approach. At a world scale, the total loss of collected water has been estimated at 37%; the distribution systems of drinking water are loosing the 50% of water, while in the downstream irrigation canals, losses are estimated by 40% of the distributed volumes (Petrella 2001). Moreover, the problem is worsened for a low efficiency in utilisation of water in agriculture, and for this reason the international community is calling for an effort to meet the objective of allocation efficiency resumed by the slogan *more crop per drop* (SIWI-IWMI 2004).

Another critical factor is constituted by the large presence of big dams that, besides causing wide damages to the traditional socio-territorial systems and negative environmental impacts, their presence if also weakly justified according to water and hydro-power efficiency standards (WCD 2000).

2.4. Increase of pollution sources

The last factor of water crisis is the loss of the original chemical-physical properties of the water resources on which various human uses and ecological functions are based. In cases where their characteristics do not respond to minimal quality criteria of safety related to the different uses, a risk is potentially open either for the communities, or for the ecosystems served by the contaminated water.

The causes for contamination are various, depending either on the massive use of chemical products and heavy metals in the productive and domestic discharges, and on the missing treatment of the wastewaters discharged in the freshwater. In order to reduce the pollution of freshwaters, there are cases of injection of contaminated water underground, with a damage for the groundwater courses. Another source of contamination comes from the saline intrusion in the water table of the coastal areas, caused by a heavy human pressure compared to the slow recharge capacity of the groundwater. The organic pollution is also strongly affecting the environment, particularly in urban peripheral areas in developing countries, where the health alarm is at a highest level, as the MDGs assess, recording a deficit of sanitation services for around 3 billion people in the world.

The qualitative degradation of the freshwaters is also raised by indirect causes, among which the soil erosion, particularly on the river banks, induced by deforestation practices and desertification processes. The erosion material charging the watercourses produces a negative impact either on the water quality or on the river capacity, causing phenomena of dangerous flooding. The human mismanagement of water resources produces heavier impacts because of the effects of climate change.

2.5. Scarcity as a matter of governance

From the above-described causes for the current water crisis, a lesson that could be learnt is that the issue cannot only be reduced to a problem of *physical scarcity*. The problem of equal access for all in many countries around the world is not only significant in conditions of water stress, but also in situation of theoretical abundance. Thus the problem is also caused by an *instrumental scarcity*, meaning that instrumental resources are missing, such as financial resources, adequate

infrastructures, institutional response to community demands, monitoring and control of contamination processes, etc. The lack of sufficient water resources for the development of all human beings does reflect the asymmetric social relations among groups using those resources for their productive and reproductive needs (Raffestin 1981).

The water poverty is then a matter of good *governance* of the resource, as it was already stated by the second World Water Forum (The Hague 2000). The policies oriented towards the MDGs cannot avoid the exercise of democratic management of the natural and instrumental resources. Starting from the consideration of the multi-functionality of the water resources for the human and territorial needs, the strategies have to mainstream different principles:

- the goal of equal access for all has to be kept as a priority, with guarantee for the right to a minimum vital consumption of safe water, that has been calculated as a quantity of 50 l/person/day (Gleick 1996);
- the utilisation of water has to be considered as a fundamental tool for poverty alleviation and human development, based on systems of sustainable livelihood and enhancing local cultures;
- the quality protection of water has to keep the highest value for the resource, to enable the support to a multiplicity of utilisations, meaning that any form of utilisation would not be allowed to damage other sectors uses;
- the water quality monitoring has to be effective, in order to protect the health of affected human communities, as well as the ecological functions and the maintenance of biological diversity;
- a ban has to be ensured towards disruptive and polluting uses of water resources, and effective instruments for controlling the consumption at efficiency levels have to be realised.

This list is meaningful since it represents a limit to the locally-negotiable decisions regarding water management. In other words, the participatory decision-making observed within a good governance system has to respect will and needs of the local populations, but also to ensure the observation of interests that are more pertaining values of other socio-territorial systems or at different scales: for instance, affecting communities downstream of the same catchments, or affecting global commons of the entire world (e.g., water balances co-responsible for climate change).

2.6. From the analysis of water poverty towards a prioritisation of water values

The past section has introduced the general causes of water poverty, as a knowledge-basis for a theoretical situation to be reversed on a positive trend. Each constraint could logically be reformulated as a priority goal for the future; however, from the overview offered, it is clear that no technical solution could be self-sustaining, but the challenges have rather to be faced by integrated programs, as it has been proposed by the Integrated Water Resources Management (IWRM) approach. As discussed, at different scale, and via instruments of good governance and public participation, a prioritisation of potential uses and modalities of usage, as well as decision about non-use for conservation purposes, could be decided. From the prioritised functions, according to the characteristics of the resource and to the expected impacts over the resources, a systems of evaluation of the water uses could be elaborated.

3. ECONOMIC EVALUATION VERSUS PROTECTION OF ACCESS FOR ALL

The evaluation of natural resources is a useful instrument for defining priorities for use and safeguards, thus for favouring quality conservation while limiting unsustainable uses. The definition and tools elaborated in the field of evaluation and management of environmental goods are utilised, by analogy, for the issues concerning water resources.

The principle of economic evaluation of water has been introduced by the UN Conference of Dublin in 1992, in preparation to the Rio Summit on Sustainable Development of the same year. According to the Dublin declaration, water, as scarce resource, has to be managed on a rational and efficient manner, in order to limit the qualitative and quantitative degradation; and according to three sorts of fundamentals for a sustainable management: the *ecological fundamentals,* proposing a holistic vision of the water resource and an intersectorial approach; the *institutional fundamentals*, indicating the need for a broader involvement of the affected communities and, in particular, women groups, non-governmental organisations, and the private sector; and finally, the *instrumental*

fundamentals, proposing a particular attention for the opportunity-costs related to the alternative water uses as well as the adoption of economic tools for compensating the damages caused to the ecosystems (e.g. *user pays*, *polluter pays*, etc.).

The economic evaluation resources is proposed as a fundamental tool for enhancing the resources, in particular by proposing methods of monetary evaluation of goods and services that the environment – including freshwater – proposes to human communities. Another tools offered by the economic approach are related to the management of water services, operating in order to respect efficiency and cost-recovery as in the case of other commodities offered in the market. However, the experiences acquired in the field of water management are posing some questions of equity. For instance, could privatization be compatible with the management of water perceived a social good that has to reach all deprived communities, as for the MDG?

In fact, the Dublin and Millennium Declaration have targeted different aspects of the water poverty problem, and have influenced the water management policies on a divergent – rather than complementary - way. The latter could be seen as responding to a *humanitarian* approach, while the first is more responding to an *economic* approach. A presentation of the main points of difference is given by Table 1.

Table 1. Divergent views for management and governance of water resources (Minoia 2004)

Elements of management and governance of water resources	Responses according to the humanitarian approach	Responses according to the economic approach
1. Possession of the resource	Water is a common good of the humankind	Negotiable possession rights
2. Management of the service	It is a public service to be guaranteed for all	Private management of the service with efficiency criteria
3. Access and networks	Equity of access for all	On the basis of efficiency of allocation and distribution
4. Utilisation of the resource	Free, since it is necessary for human life thus of incommensurable value	Based on market values and criteria
5.Charge of the costs	From public budgets	The service has to be paid by the users
6. Charging tools	State revenues, e.g. income taxation or from other activities	Tariffs are calibrated on the service costs

As a first difference between the two approaches, we can note that the *humanitarian* give more emphasis to the goals to be protected, whilst the *economic* approach is more focussed on the definition of operative management tools for management of the water commodity.

In particular, the *humanitarian* principle is based on the consideration of water rights as essential prerequisites for the exercise of any other human rights that have already been recognised by the international law, e.g. the right to life, to food, to self-determination, to adequate living standards, to shelter, education, and health (Scanlon 2004).

The term "*economic* approach" makes it evident the nature of the utilised tools for a monetary evaluation of the environmental goods, according to market dynamics. Given the complex elements that should be included in the evaluation exercise, the application of market values appear as a reductive solution (Nunes 2001), while alternative methods for definition of social values (Rapport *et al.* 1998) and for the intrinsic values of ecosystems (Richardson 1994) have not received the same application force nor have had a sufficient validation by the scientific community. Therefore, besides the wide expression of interests, in principle, for integrating the economic analysis methods with those of the social sciences, and for the needs of founding the economic indicators on biological parameters, in fact it is only within the economic approach that the calculation of environmental costs are provided, for their internalisation within the productive processes.

The *economic* approach is sustained, among other institutions, by the World Bank that invites the developing countries, like those of the Southern Bank of the Mediterranean, for a larger presence of the private sector within the water institutions. However, the private investment is still immature in the Mediterranean and Middle East regions (MEDA), since the water sector is commonly not economically attractive: from data of the World Bank, the cost-recovery deriving by tariffs can only cover the 35% of the operational costs, thus without considering the necessary structural interventions for maintenance and for depuration, nor for extending the network towards peripheral and rural areas. For this reason, in fact, the integration of private companies has initially started through public subsidies: in various cases, these have been provided by aid programs from external donors; but this fact demonstrates that the privatisation has not alleviate the financial charge over the public sector.

The debate is also related to the issue of tariff, since pricing water is not accepted in various MEDA countries for various institutional, religious, cultural, social and economic reasons (Ahmed 2000). This does not signify, however, that users are not paying at all: in fact, they bare the costs in various informal ways. For instance, in Egypt water for irrigation is officially free and the main infrastructures are taken care by the public sector; but the siltation problems that occur at the level of tertiary canals going to the cultivated fields is the cause for the physical lack of water reaching the small farmers. In fact, the duty of maintenance of the final sections of the irrigation schemes are under their responsibilities; however, a recurrent informal solution is to drill private wells and then to pay for their setting and operation. Moreover, this practice is not controlled and produces a degradation of the water cycle, with evident but unmonitored impacts on the water table. Another case regarding unofficial pricing of water is for drinking water in Yemen: although water markets are legally prohibited, the poor urban people spend on the black market of water vendors the main part of their personal income.

However, even in European cases there are studies showing that increasing the tariffs the water companies do not ameliorate inefficiencies and losses. In France and the UK between 1990 and 1994 the prices of domestic water have increased, in average, of about 50%; however, the networks have not been ameliorated, and the loss has been estimated as 30% (Petrella 2001).

Technical solutions for calculating tariffs as a full cost pricing are usually not always viable since water distribution to users is a downstream section of a long and costly process, including treatment, operation and maintenance, rehabilitation and construction of infrastructures, monitoring, administration etc. As a consequence, a full tariff would be unbearable particularly for poor communities and for areas not enough populated for abating the costs. Solutions for enhancing at least the marginal environmental costs within the tariffs (Ahmed 2000) would also penalize the generality of users, while the costs should be rather bared by those users actually responsible for the damage: either via fiscal tools penalising activities with a bad impact, or via sanctions for the pollution caused to the environment. However, a weakness to this solution is given by the difficulties of application of the polluter-pays principle in the agricultural sector (which is the sector where the 80% of the water resources are utilised in the Mediterranean region), where the non-punctual polluting sources are predominant, thus their identification are not easy.

According to the *humanitarian* approach, the communities basing their livelihoods on contaminated or insufficient water resources shall not pay for their restoration because they are victims of the lack of access to safe water, and not responsible for that. Therefore, legislative mechanisms should be offered for ensuring the rehabilitation of the service and for compensating the suffered damage. As a general principle, the determination of the tariff scales should not evaluated on the basis of the costs, particularly in condition of low capacity to pay; but on the basis of the types of uses and the impacts produced. The evaluation of the usages have to favour the vital human functions, the sustainable livelihoods, the respect of traditional cultures based on the territory, the ecological services, and the landscape functions.

A final consideration is about the partiality of both approaches. An integrated approach for a differential cost recovery system seems to be more appropriated, based on criteria of equity of access, free use for vital services and fiscal levy of other uses; as well as for management of the service, that has to maintain a centrality of public decisions over strategies and investments to prioritise; a public control over allocation, quality of water used and monitoring of impacts; and finally a public decision making about tariffs based on values to be preserved.

4. INTEGRATED APPROACH BETWEEN HUMAN AND ECOSYSTEM NEEDS

Another point of weakness of each one of the presented approaches comes from their particular consideration of water resources for social and economic uses. However, if water is considered for its multi-functionality also referred to the ecological systems, and as constitutive element for the territory, the need can be raised for a more complex *geographical* assessment of the resource, also integrating the cultural and landscape values.

Thus, the *Integrated Water Resource Management* (IWRM) has to include the following aspects:

a. the resource related to the different human and ecological needs;
b. the eco-system approach at catchments level;
c. the landscape and culture of water;
d. the governance as interaction among social components benefiting from the resource.

These aspects constitute the four levels that are necessary for a sustainable management, based on a water governance in accordance to the territorial and environmental values of the basin area.

4.1. Definition of water demand

Introduced in opposition to a traditional supply-side management, the water demand management has been conceived as a flexible tool that is offered in accordance to the communities needs. On the basis of the local systems, an assessment is provided about the efficiency of the water consumed, and consequently about the management solutions that can be proposed in order to realise savings of water, which can avoid heavy and costly interventions on the environment for acquiring more volumes of water (e.g. for new dams, wetland drainage, canalisations etc).

The regulatory mechanisms provided by the demand side management have the effect to reduce the global water demand, protecting at the same time the fundamental water needs for human activities and for the ecosystem functioning. A (non-exhaustive) list of socio-economic functions and ecological functions that compose the demand of water resources, is presented in Figure 1.

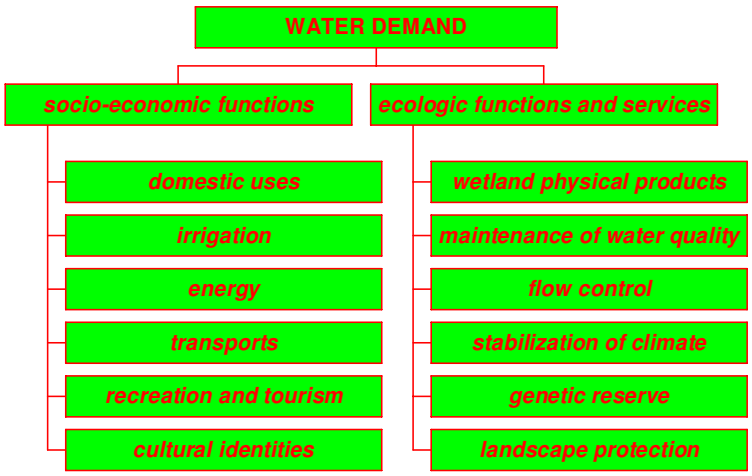

Figure 1. Composition of water demand based on functions and services for human communities and ecosystems

4.2. The ecosystem principle

Water, before being a social resource and a productive input, it is a natural resource, that sustain interact with the ecosystems, and has to be managed at a basin scale. This means that the assessment of the water demanded by the communities has to be integrated by the assessment of the ecosystems needs, as specified in the above paragraph and figure 1.

According to the ecosystem principle, the ecological services and functions provided by the water resources have to be analysed: e.g. the water flow and storage determine wetland values, biological productivity, bio-geochemist cycles, decomposition activities and natural habitats, thus transforming the landscape elements (Richardson 1994). To these *functions* correspond *values* which determination differs from that definable on the market. Some alternative instruments have been elaborated, like the *contingent valuation*, which is based on the social perception of the value of the environmental good, thus on the willingness to pay for the conservation of an environmental good or service (Rapport 1998). However, the social awareness of environmental values is often more influenced by public communication and psychological reasons than by a knowledge of expert analysis and assessment. There is also a discrepancy between a social value justified by a use, and a preservation need. In fact, some of the functions of the water resources are directly related to their use, while in some other cases their non-use is necessary, as e.g. for objectives of environmental conservation, for a long-term preservation of quality, etc., as summarised by Figure 2. In this case, the value is recognised for precautionary reasons of for a potential to be left to future generations (*bequest value)*.

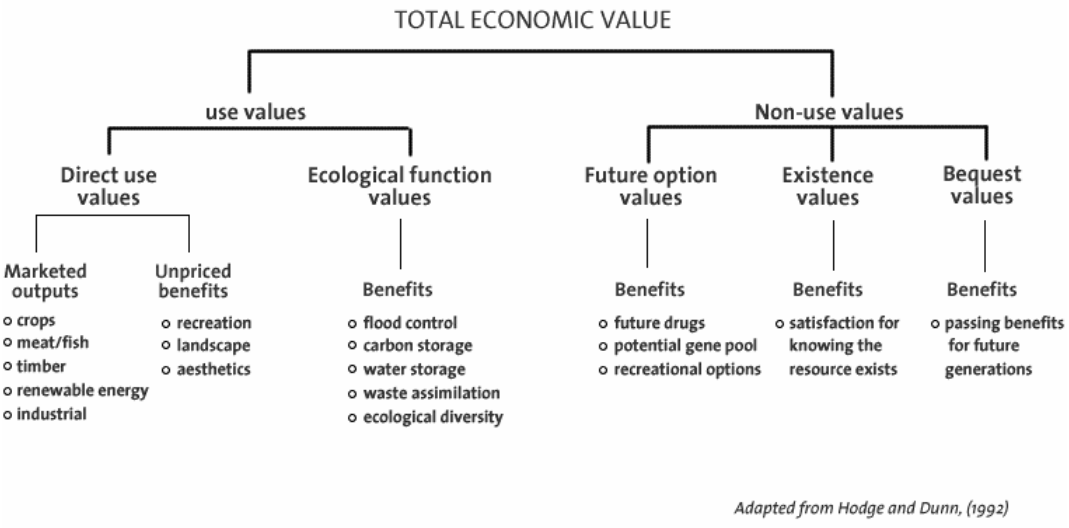

Figure 2. Use and non-use values

4.3. The value of landscapes and water cultures

Such functions are even more difficult to translate on a quantitative system of values, if not reduced to their marketable aspects for interests of physical culture and tourism fruition. In the Mediterranean space there is a diffused presence of common hydraulic artefacts even though named differently, for abstraction and distribution of waters: e.g. the water wheel known as *saqia* or *noria*; the groundwater canals known as *qanats*, *foggara*, *khittara*, *galerias* etc.. They have a fundamental function for the constitution of the visible landscape and for sustaining a complex system of social and economic relations based on the water schemes (Minoia 1996). Tools and water structures are key elements for the resource management, for production and social organisation, upon which the resilience of the territorial system is based, and which enable a response capability to face the situation of crisis. The frequent interventions occurred during last century have been based on technical aspects of the supply side management, without evaluating the linkages between a community, the environment, and the built landscape, nor this has been recognised as a source of failure or external intervention on the territories.

4.4. The water governance

The recognition of differential values for the same water resource is a fundamental step for a sustainable water governance, and has to be based on the basis of the priorities assigned among the functions of use and conservative ones, as well as for functions of territorial stability. To each sort of

use various stakeholders have to be involved, thus organised or non-organised groups, civil society, environmental NGOs, economic groups, water providers etc. The economic evaluation by a monetary value is possible and useful only for few situations, but in all cases it is not a result of a pure technical decision: the expert evaluation has to be integrated to a negotiation process among diverging – if not conflicting – interests. Consequently, the water management policies have to be based on good governance methods, as expression of a social negotiation, where the economic value has to be integrated, without overcoming, the complex territorial value of the resource. Finally, any decision regarding water management has to be adapted to the primary need of preserving the resource, according to the precautionary principle and to the international conventions, recognising the linkage between the local use of water resources and the global interests.

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