INECO

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INECO ("Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Basin") is a Coordination Action Project supported by the European Commission through the 6th Framework Programme (Contract No: INCO-CT-2006-517673).

SIXTH FRAMEWORK PROGRAMME

PREFACE

Water stress is gradually becoming a critical issue in most countries of the Mediterranean Basin. Foreseen increases in water demand as a result of the development of important economic sectors, particularly tourism and agriculture, coupled with water quality degradation have contributed towards the development of policies for water supply management and enhancement of the knowledge-base on water resources. In addition to the increasing water demand and adverse quality effects, a major challenge arises from the need to properly maintain and rehabilitate hydraulic infrastructure, the development of which has been the dominant policy for supplying water to local communities. With water management problems becoming more and more acute, it is gradually being recognized, at the international, national and local level, that in the majority of cases the solution does not lie in the further increase of water supply, as there are significant technical, environmental and financial constraints.

In the above context, the INECO Project was officially launched in July 2006 with the objective to discuss problems in the decision making process and the deficiencies of current water governance structures around the Mediterranean Basin. The research of INECO followed a case-study driven approach, focusing on alternative or improved institutional and economic instruments which can promote equity, economic efficiency and environmental sustainability. The Project emphasized on the shared dimension of water management problems, and built on participative processes, in order to disseminate applied research and lessons from the implementation of policy instruments. Seven (7) case studies were developed, each focusing on a locally important water management issue, which was further analysed through participatory processes. Lessons learnt from these Case Studies, as well as from policies already adopted for the mitigation of similar issues are considered relevant both at the local and European level, as they provide a framework for orienting research and policy to specifically address the needs of local societies.

This volume is the Proceedings of the Conference on “Institutional and Economic Instruments towards Integrated Water Resources Management in the Mediterranean Region”. The Conference, which was the final event of INECO, was jointly organised with the Water Development Department of the Ministry of Agriculture, Natural Resources and the Environment of Cyprus, on June 11th in Nicosia, Cyprus.

The objective of the event was to disseminate water policy-related recommendations, derived from an in-depth analysis of cross-cutting water management issues and institutional conditions. Additionally, presentations of the event outlined experiences of decision-makers and stakeholders in integrated water management and planning in the Mediterranean region. In this regard, this volume includes a collection of papers from the Case Studies developed within the framework of the INECO project and from the Water Development Department, highlighting recent developments and challenges in policy framing, public participation and development of incentive-based policies for addressing factors contributing to the exacerbation of water stress issues.

CONTENTS

THE INECO EXPERIENCE: MAIN OUTCOMES AND LESSONS LEARNED FROM PARTICIPATORY CASE STUDY PROCESSES

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ABSTRACT

Multi-stakeholder participatory processes are increasingly viewed as the only means of developing policies and strategies for alleviating real (or perceived) water-related conflicts at local, national and international level. They are considered as problem-solving, institutional innovations to democratise water management, manage conflict and enhance effectiveness of water management operations. Methods and tools employed to foster stakeholder engagement vary greatly, depending on issues at hand, opportunities for dialogue and information sharing, as well as the overall socio-economic and political context.

This paper outlines the approach followed in the EC-funded INECO Project (Institutional and Economic Instruments for Sustainable Water Management in the Mediterranean Region, Contract No: INCO-CT2006-517673) for fostering dialogue among diverse stakeholder groups and facilitating joint agreement on policy recommendations for mitigating water stress issues in seven Case Studies in the Mediterranean region. The scope of these Case Studies was defined through situation analysis, aimed at depicting significant water management issues faced by the local societies. Subsequently, through different methods (e.g. stakeholder workshops, surveys and questionnaires, individual consultation meetings with key actors), stakeholders jointly collaborated to identify ways through which these issues could be addressed in a desired water resources management situation. In this regard, the recommendations derived for problem mitigation incorporated the very different perspectives of stakeholders and facilitated the comprehensive analysis of the wider economic, societal, institutional and sustainability implications of proposed water management options.

1 INTRODUCTION

Sustainable water management is intrinsically linked to inclusive stakeholder participation. Stakeholder involvement can help embed public values and concerns on environmental protection in policy design, also maximising the acceptability of mechanisms for sharing impacts, risks and costs among the affected user groups (Soma and Vatn, 2009). Furthermore, the implementation of demand-side approaches to water stress issues necessitates involvement of water users, not only during the design, but also during the implementation stage of the relevant plans.

The emphasis placed on stakeholder involvement in EU and international policies is also manifested in most of the recent water-related research initiatives. Specifically

targeted research is increasingly exploring ways of developing and sustaining collaborative learning processes, fostering the involvement of local decision-makers, user groups and citizens. Such endeavours usually encompass a broad range of tools and methods, tailored to local political contexts and social conditions. Approaches are designed so that interest groups have the opportunity to articulate their preferences, hopes, expectations and problems, and share their views and experience on the issue(s) at hand (Rowe and Frewer, 2000; Jeffrey and Russel, 2007). These "social experiments" in water policy framing usually form part of an overall effort to build the capacity of the local societies to address their problems in an integrated and holistic way, based on the premise that stakeholders are more likely to own and apply new ideas that they have helped to develop themselves (Moriarty et al. 2004). In this context, the often required institutional innovation to enhance sustainability and accountability in water management is better accepted and applied when defined through joint planning, rather than when stemming from research outcomes or decision of public authorities alone.

The approach followed within the framework of the EC-funded INECO project was primarily aimed at fostering constructive engagement of stakeholders at the local level. By choosing to focus on water management issues shaped by local specificities, the project worked towards the mobilization of local actors to adopt soft-path solutions. This paper presents the methodological approach followed for the development of local Case Studies, aimed at the identification of instruments and the formulation of policy proposals for addressing water management issues at local level.

2 METHODOLOGICAL APPROACH FOR CASE STUDY DEVELOPMENT

2.1 General Framework and Premises

The INECO Project was launched with the aim to introduce an interdisciplinary approach to water management, building upon the integration of three major aspects: environment, economics and society. The project's main strategic goal was capacity building for promoting constructive engagement among stakeholders towards Integrated Water Resources Management (IWRM). INECO, through its activities and analyses also emphasized on the principles adopted by the EC Water Framework Directive 2000/60, for integrated management at the river basin level, recovery of water service costs, implementation of water pricing policies towards the attainment of environmental objectives and public participation. Starting with the premise that sustainable water management is intrinsically linked to stakeholder involvement and participation, the project focused on discussing shared problems in the decision-making processes and the deficiencies of the current water governance structures in Cyprus, Tunisia, Egypt, Lebanon, Syria, Algeria and Morocco.

Of the water management challenges defined in The Hague Ministerial Declaration on Water Security in the 21st Century, three were identified as broadly related to the project's scope and objectives and to the water management issues faced in most Mediterranean Countries:

- The **"Sharing water"** challenge, with reference to the processes and mechanisms (institutional, regulatory, legislative, economic) for water

allocation at the river basin level, at the service provision level and at the transnational level.

- The **"Valuing water"** challenge, with reference to the assessment of costs and values associated with water use, the implementation of the cost-recovery principle for supporting sustainable water service delivery, and the implementation of the user-pays and polluter-pays principles, while at the same time ensuring equitable access to water resources.
- The **"Governing water"** challenge, referring to the institutional and regulatory framework that creates the enabling environment towards the implementation of IWRM.

Each challenge suggests different and complementary issues that need to be addressed within a water management system, so as to achieve long-term sustainability without compromising the well-being of all user groups. These challenges and their relevance to the Mediterranean context formed the backbone of the project's Case Studies; they further motivated efforts towards the constructive engagement of stakeholders in the different areas for discussing implications of alternative or complementary institutional and economic responses for water stress mitigation (Fig. 1).

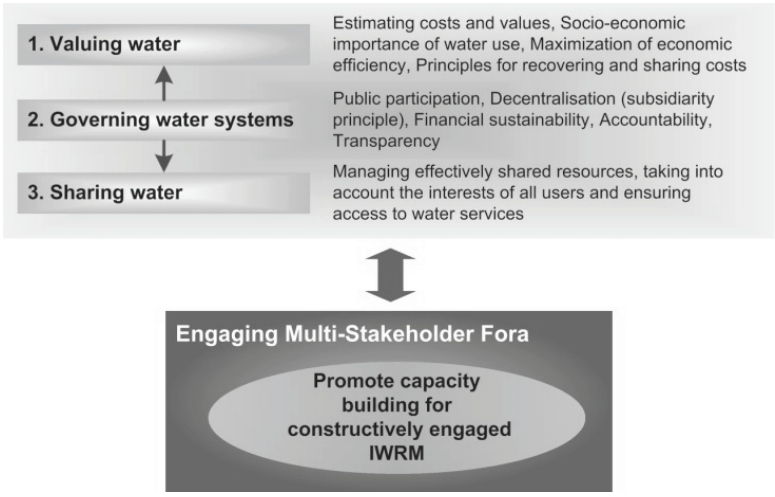

Figure 1: The INECO Framework and Goals

In an ideal IWRM situation, water resources are managed at the appropriate level, in a globally sustainable way, and balancing the diverse technical, financial, social, economic, institutional and environmental aspects. At the same time, the water-related interests of all stakeholders are considered in decision making on water use. In the above context, stakeholder involvement and participation governed the entire INECO cycle of Case Study development, in order to:

- Ensure that project research and outputs are in line with the needs of local societies;
- Raise awareness among user groups on the impacts of their use on other users, including the environment, and encourage civic responsibility in water management;
- Foster constructive engagement among parties concerned for reaching consensus on solutions to local water management issues of common interest.

The following section outlines the processes followed for stakeholder involvement and participation, focusing primarily on procedures and tools employed, so as to attain the widest possible visibility and impact at local level.

2.2 The Case Study Development Process

The approach followed for the development local participatory processes in the INECO Case Studies was based on the method of Objective Oriented Project Planning - OOPP (GTZ, 1997).The OOPP method, which is based on the Logical Framework Approach, has been proposed as a tool for supporting urban participatory planning processes (UN-Habitat, 2001). It is broadly divided in three stages:

- The first stage, **Problem Analysis**, involves identifying stakeholders, their key problems, constraints and opportunities; determining cause and effect relationships between threats and root causes.
- The second stage, the **Analysis of objectives**, concerns the development of policy objectives from the identified problems, and the identification means to end relationships.
- Finally, **Option analysis** includes the identification of different options that can contribute to the achievement of objectives. Options are then evaluated by stakeholders in order to determine the most suitable strategy for achieving the mitigation of the problem at hand.

In INECO, the OOPP method was implemented through a series of Regional Activities that followed the schema presented in Fig. 2, in order to arrive to a synthesis of findings into regionally adaptable guidelines.

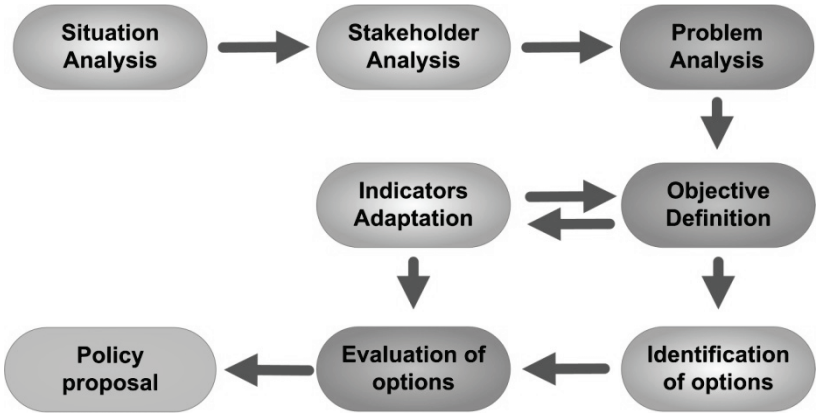

Figure 2: The INECO Framework for Case Study Development

The first step involved the **"Situation analysis",** for identifying a water management issue of concern to the local society and decision-makers. Employed tools involved data collection and review, and in some cases, targeted interviews with decision-makers. Two important outputs were derived from this stage: (a) the identification of the range of natural, technical, financial and institutional constraints facing the water sector in each country/region; and (b) the analysis of the current governance setting, mapping responsibilities of the actors involved in water management operations, and the relevant rules and regulations defining the overall (water) policy context.

The analysis of the current situation led to the selection of an issue considered important in each region of interest, but also of relevance to other countries of the Mediterranean Basin, hereafter described as "focal problem". Subsequently, the **"Stakeholder Analysis"** step involved the identification of stakeholders, and the mapping of their constraints and opportunities in relation to the issue at hand. This

step entailed the implementation of individual stakeholder consultation meetings, to identify who can affect or is affected by the discussed issue and is likely to be impacted by alternative solutions.

The **"Problem Analysis"** step involved the identification of causal interrelationships between threats and root causes of the focal problem. The key purpose was to ensure that "root causes" are correctly determined, so that they can be subsequently addressed, and that the analysis does not merely focus on the symptoms of the discussed issue. Due to the importance of this step, the analysis of the focal water management problem was undertaken in three stages. Firstly, a preliminary identification of causes and effects of the focal problem was undertaken through data collection and personal knowledge and experience. Causes and effects were mapped into a draft "Cause-and-Effect" diagram, the "Problem Tree" of each Case Study, so as to facilitate discussion with stakeholders. In the tree diagram, the main (or focal) problem was represented as the tree trunk. The causes of the problem were designed as the tree roots whereas effects were the tree branches. Following from this preliminary analysis, indicators relevant to the identified problem causes and effects were developed, so as to objectively highlight the significance of each component. Although the development and adaptation of indicators was in some cases hindered by limited data availability, it also offered the opportunity for developing a clear framework for monitoring the effectiveness of current and future policies for the mitigation of the selected problems. Findings were then extensively discussed in dedicated regional workshops, which aimed at consolidating result outcomes and reaching consensus on the different degree of impact of the identified causes (minor or major, one-time or permanent). Workshop events also fostered dialogue between parties concerned, allowing the free exchange of views on current policy deficiencies and areas where action needs to be prioritized.

The next step included the **Definition of Policy Objectives**, implemented again in two stages:

- In the first stage, the validated Case Study "Problem tree" was used as the basis for the development of an "Objective tree". The process involved: (a) reformulating problems into positive, desirable conditions, and (b) changing relationships from cause-effect into means-ends.
- In the second stage, the objective tree was presented to local stakeholders in dedicated workshops or meetings. Stakeholders collaborated in modifying the tree, ensuring that objectives are feasible, in line with current policy priorities and contributing towards their implementation.

Throughout the process of analyzing problems, effects, causes and developing objectives, views on potential merits or difficulties, and risks associated with different possible interventions were also brought to the table. Proposed interventions served as the basis for the **identification of alternative, mainly institutional and/or economic options** that could contribute to the achievement of the suggested objectives. Suggested responses were scrutinized against deficiencies associated with the implementation of instruments already in place, and supplementary ones were added, according to stakeholder suggestions, previous research outcomes, international experience and literature review.

The **evaluation** of the suggested responses was undertaken in two steps. Firstly, stakeholders were asked to evaluate broad categories of options, not focusing on specific measures (e.g. public participation instead of Advisory Councils or focus

groups). This first step was mainly aimed at assessing the feasibility and the applicability of suggested options on the basis of the following criteria: (a) individual stakeholder preference, taking into account effectiveness and applicability, (b) relevance to address current water management problems, (c) relevance to the focal water management problem of the Case Study, (d) need to prioritize in terms of actual implementation, and (e) relevance to future water management challenges that can be envisaged by stakeholders at national level.

Approaches selected by the different groups were then more extensively discussed so as to refine the context of proposals made, and identify policy pathways and prerequisites to their implementation. They were further evaluated, using the criteria framework described in Table 1, which was defined taking into account the "headline" overriding criteria for IWRM (Environmental Sustainability, Economic Efficiency, and Social Equity).

Table 1: Framework the evaluation of institutional and economic instruments

Category	Criteria
A. Effectiveness	**A1**. Contribution to the achievement of the key objective **A2**. Mobilization of local community **A3**. Promotion of technological/institutional innovation
B. Social considerations	**B1**. Affordability for sensitive user groups (poor, women etc.) **B2**. Promotion of inclusion of all user groups **B3**. Cultural/ethical acceptance **B4**. Alleviation of conflict among user groups
C. Economic efficiency	**C1**. Financial cost of implementation **C2**. Negative economic impact on important sectors (agriculture, industry, tourism) **C3**. Impact on regional economic development strategies
D. Ease of implementation	**D1**. Need for institutional and legislative reforms **D2**. Required effort for integrating with existing policies for other sectors (e.g. agriculture, industry) **D3**. Administrative barriers to implementation **D4**. Existing capacity constraints (human, technical, managerial)

This framework was translated into a dedicated questionnaire, aimed at mapping the perceptions of the different groups in matters of:

- Effectiveness, to evaluate contribution to the achievement of the objectives set, but also to the enhancement of collaboration, public participation and community empowerment.
- Social considerations, to map impacts on equitable access, social sustainability and affordability, especially for low-income groups and users.
- Economic considerations, outlining the overall economic impact that an option or proposal can have in the regional economy and local development strategies.
- Ease of implementation, describing efforts required for implementation, taking into account the current political environment, legislation, existing administrative structures and capacity constraints.

It should be noted that the approach described above was not implemented as a strictly linear process; similarly to all related efforts, stakeholders did not move mechanistically from one step to the next, always in a forward direction. Planning is an iterative and creative process; the selection of an option often involves significant

leaps in thinking, which cannot be neatly slotted into a specific “step” of the overall process.

Despite the limited time of INECO, significant efforts were devoted to the maximization of local opportunities for multi-faceted solutions, by fostering the discussion among all interested parties before an option (in this case an institutional or economic instrument) was proposed. To achieve this goal, efforts were made to mobilize stakeholders upfront, and give floor to their participation in the analysis of local problems, the definition of objectives and the discussion and evaluation of suggested options. Throughout the articulation of the process, emphasis was also given to openness and inclusiveness; stakeholders were regularly informed of all outcomes and replies of other parties, whereas collected data and information was made accessible to the public through the distribution and web uploading of material.

3 LESSONS LEARNT FROM THE IMPLEMENTATION OF THE INECO CASE STUDIES

As depicted from Table 2, which summarises the scope of the seven Case Studies developed within the course of the project, the work undertaken was associated with diverse water management issues, common in many countries of the Mediterranean Basin. The analysis of the issues at hand, in collaboration with local decision-makers and user groups portrayed the significance of stakeholder engagement in the promotion of more sustainable solutions, but also the need for integrating different policies affecting water management operations.

Table 2: Scope of the INECO Case Studies

Case Study Area	Scope	Associated issues
Pegeia, Cyprus	Groundwater depletion	Wastewater reuse & competition between uses Development patterns
Tunisia		
Oum Er Rbia Basin, Morocco	River Basin Management/ Water Allocation	Intra and inter-sectoral water allocation at the basin level
Damour River Basin, Lebanon		
Bahr-Basandeila, Egypt	Urban water management Industrial pollution prevention and control	Hyper-urbanisation Sustainability of water services
Barada River Basin , Syria		
Seybouse River Basin, Algeria		

Throughout the overall process, individual Case Study work highlighted the relevance of developing (new) policy instruments through joint planning and in close collaboration with beneficiaries: in addition to other factors, deficiencies of past water management policies were also due to the fact that there was limited exploitation of local knowledge on constraints, potential impacts and local specificities. Furthermore, and as the mitigation of water management issues seldom lies on water management policies alone, focus should be placed on ways to bring together policy-makers, planners and decision-makers from all sectors affecting or affected by water management operations, in an effort to develop integrative and concerted action, maximising the use of available resources (natural, financial and social) to enhance

economic growth without compromising environmental sustainability. In this regard, Table 3 summarizes policy questions that emerged from the INECO Case Studies, highlighting the commonalities of constraints and problems faced by decision-makers.

Table 3: Policy questions from the INECO Case Studies

Case Study Context	Theme	Policy-related questions

River Basin Management	Supply enhancement vs. Demand management	• Infrastructure financing & cost recovery
		• Efficiency improvements
		  • In water use (subsidies for technology improvements)
		  • In water allocation – phasing-out of low value uses

	Development of participatory processes	• Means for conflict resolution • Means for allocation of water between competitive uses/users • Public information organizations on local WM issues
River Basin Management and Groundwater Management	Public subsidies vs. economic efficiency for low-value uses	
	Enforcement of groundwater abstraction metering vs. user group opposition	
	Community management (bottom-up) vs. centralized management (top-down)	Feasibility, capacity, financing
Urban water management/Pollution prevention and control	Competitiveness vs. environmental protection	Incentives towards cleaner production in the industrial sector Incentives/disincentives to excessive agrochemical use
	Strengthening the participation in voluntary programmes	Incentives, user awareness, consumer awareness
	Sustainability of urban water services	Funding, cost recovery, affordability and access Community management in rural areas

Furthermore, what was demonstrated through individual Case Study work, was the need to enhance the capacity of institutions, authorities, groups and individuals to make informed choices and transform these choices into desired actions and outcomes. Towards this end, the social experiment of INECO attempted to enhance local capacity towards constructively engaged IWRM; through participatory processes and dialogue, the project brought different actors at the table to share their views and discuss alternative solutions and their implications. The success and impact of this experiment is to be judged by local stakeholders; however, the mutual learning process developed has led to a better understanding of the societal and institutional changes required for sustainable water management, of how these are

currently perceived in each region analysed, and of how future research could be better oriented to address local policy needs.

REFERENCES

GTZ (1997), ZOPP - Objectives-oriented Project Planning: A planning guide for new and ongoing projects and programmes, Unit 04, Strategic Corporate Development.

Jeffrey P. and Russel S., (2007), Participative planning for water reuse projects: A handbook of principles, tools and guidance, Aquarec Project: Integrated concepts for reuse of upgraded wastewater, Available from: http://www.aquarec.org.

Moriarty P., Batchelor C., Laban P. (2005). The EMPOWERS Participatory Planning Cycle for Integrated Water Resource Management, EMPOWERS Working Paper 3, Available from: www.empowers.info

Rowe G. and Frewer L. J., (2000), Public Participation Methods: A Framework for Evaluation, *Science Technology Human Values*, 3, 25, SAGE Publications.

Soma K., Vatn A. (2009), Local democracy implications for coastal zone management – A case study in Southern Norway, *Land Use Policy*, **26**, 755-762.

UN-Habitat (2001), Tools to Support Participatory Urban Decision Making, The United Nations Centre for Human Settlements, Urban Governance Toolkit Series.

THE ESTABLISHMENT OF A DIRECTORATE FOR INTEGRATED WATER MANAGEMENT IN CYPRUS

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EXTENDED ABSTRACT

The current legislative and regulatory framework for water management in Cyprus is characterised by fragmentation of responsibilities among different ministerial departments, local authorities, agencies and other actors. This fragmentation results in difficulties in coordination among the different authorities involved, particularly with regard to efficient monitoring, regulation, and water resource planning and management. A characteristic example is the management of groundwater resources, where the monitoring and control of groundwater abstractions remains ineffective, due to the multiplicity of authorities involved in the authorisation of borehole drillings, the lack of capacity for groundwater abstraction monitoring, especially from private boreholes, and the non-definition of sanctions in case that permit conditions are violated. The above demonstrate the need for introducing legislative and institutional reforms, to cope with current and emerging water management challenges in water management, allocation and use.

Overall, the effort for the re-organisation of the water sector in the country was initiated from the early years of the Republic of Cyprus. The first study, undertaken by Thorp in 1961, highlighted the weaknesses of the current institutional framework and the lack of authorities vested in the Water Development Department to implement action on water management issues. Subsequently, Krausz – Caponera (1963) characterised the current legislation as an “odd mix of laws and regulations” and criticised the current allocation of responsibilities, the system of water use rights and constitutional provisions for water management. They also recommended the establishment of a Water Management Authority, as governmental department or semi-autonomous public institution. Similar proposals from independent assessments were submitted to the Government in 1970; however, the Turkish Invasion of 1974 slowed down all efforts for institutional reform.

The issue surfaced again, during the period 1980-1989, when large-scale hydraulic works were implemented through World Bank funding. The relevant loan provisions also included a requirement for establishing an independent entity for water management in the country, integrating the responsibilities of different governmental departments. A detailed appraisal, undertaken by Rofe, Kennard & Lapworth in 1989 also recommended this reform, which would allow the integrated management of water works and more efficient allocation of water resources in the southern part of Cyprus.

Following from the above recommendations and requirements, the Council of Ministers undertook a first step, by designating in 1997 the Water Development

Department (WDD) of the Ministry of Agriculture, Natural Resources and the Environment (MANR&E) as the sole entity responsible for the implementation of water management plans. A new water management law was voted by the House of Representatives in October 2000. This law provided for the establishment of an independent Water Management Authority, but was cancelled by the Supreme Court, as it violated the relevant constitutional provision, according to which integrated water management is the responsibility of the Government and cannot be allocated to any other body. A new law towards the same direction was approved by the Council of Ministers and submitted to the House of Representatives in 2001; as the relevant vote was still pending in 2003, MANR&E requested its withdrawal, since the accession of Cyprus in the EU would require further amendments and adjustments.

Finally, in 2008 a new law was prepared and approved by the Council of Ministers on February 6th 2008. In support of this initiative, the following measures were undertaken:

- The formulation of a Committee at Ministerial level for revising existing and proposed measures in view of the implementation of the Law. The members of the Committee will include the Minister of Agriculture, Natural Resources and the Environment, the Minister of Finance, and the Minister of Interior.
- The undertaking of studies by the Ministry of Finance towards the re-organisation of the Water Development Department and the evaluation of the human resources required for the implementation of the Law.

Among other issues, the Law (whose approval by the House of Representatives is pending) includes provisions relating to:

- The transformation of the Water Development Department to a Directorate for Integrated Water Management and the official allocation of relevant responsibilities to the new Directorate (currently these are informally exercised by the Water Development Department);
- The transfer of all water management responsibilities currently allocated to the Physical Planning Department and the Regional Officers to the new Directorate;
- Stakeholder involvement in the formulation of the national water management policy through their representation in the relevant Council of the Directorate;
- The integrated control of the surface and groundwater abstractions, through the issue of one abstraction permit;
- Reformulation of the system for the allocation of water use rights and of water pricing policies, so as to ensure recovery of related costs, efficient water usage and water conservation;
- Penalties and sanctions for the violation of water-related laws and regulations;
- Allocation of responsibilities for the issue of regulations for water management.

Overall, the Law is considered an important and essential step towards sustainable water management in the country, and is the outcome of a long effort of reform to adjust the institutional framework to new needs, priorities and challenges.

THE INECO CYPRUS CASE STUDY ON GROUNDWATER EXPLOITATION IN PEGEIA,PAPHOS: OUTCOMES AND PERSPECTIVES

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ABSTRACT

The INECO project in Cyprus attempted to foster constructive dialogue for enhancing groundwater management at local level, emphasizing on socioeconomic and policy considerations for the application of institutional and economic instruments. As a result of consultation with the Water Development Department of Cyprus, the limestone aquifer of Pegeia, which is located in the south-western part of the island, near the town of Paphos, was selected as the case study area. The overall project methodology evolved around a cyclic development process, which aimed at promoting the shift towards a desired IWRM situation. This approach resulted in a mix of options, determined as the result of a negotiation process, where policy makers, water resources and water utility managers and stakeholders were involved. Stakeholder involvement and participation activities were horizontal, spanning the entire duration of the project; they included 6 public participation meetings and workshops with local stakeholders, presentation to the public, and distribution of fliers and non-technical reports to the public. A key requirement that emerged from INECO was the need for improving information sharing patterns. Recommendations regarding technical options included the maximisation of water recycling and reuse in agriculture and in the domestic sector, whilst the construction of small-scale desalination units for hotels, and the engagement into stricter standards for water saving, could enhance water conservation and alleviate pressures exerted in the public water supply system by large-scale consumers. The provision of information on the state of the aquifer and on current policies regarding water management in Cyprus managed to foster the active involvement of citizens, highlighting the importance of instruments for encouraging water conservation and developing a new culture on “responsible” water use. Along this line, it is generally perceived that public involvement at the local level needs to be further enhanced through open and inclusive public hearings, awareness campaigns, participation in round table discussions and other means to support exchange of views and ideas.

1 INTRODUCTION

The main goal of the INECO project was to promote capacity building for constructively engaged Integrated Water Resources Management (IWRM), emphasizing on the application of institutional and economic instruments that are associated with three management challenges: (a) Sharing water, referring to the mechanisms (institutional, regulatory, legislative, economic) in place for water

allocation at the river basin level (between uses), at the service provision level (between users) and at the transnational level (if relevant), (b) Valuing water, referring to the assessment of costs and values in water use, the maximisation of economic efficiency, the implementation of the cost-recovery principle for supporting sustainable water service delivery, and the implementation of the user-pays and beneficiary-pays principles, and (c) Governing water wisely, referring to the development of an enabling environment towards IWRM.

The overall project methodology evolved around a cyclic development process, which aimed at promoting the shift towards a desired IWRM situation [1]. This approach resulted in a mix of options, determined as the result of a negotiation process, where policy makers, water resources and water utility managers and stakeholders were involved. The final outcome was determined by technical, financial and political attainability, under prevailing socioeconomic conditions.

As a result of consultation with the Water Development Department of Cyprus [2], the limestone aquifer of Pegeia, which is located in the south-western part of the island, near the town of Paphos, was selected as the case study area. The Pegeia aquifer is located in the Pegeia village area, west of the town of Pafos. It is a phreatic coastal aquifer, developed in a karstified reef limestone, and in some parts it exhibits semi-confined conditions. The aquifer area is approximately 20 km², with an average width of 5 km and length of 4 km. For a number of years, and since the time that the amount of water supplied from the Pafos Irrigation Project was reduced, the aquifer is under intensive overpumping. Despite the rise of water table levels, degradation in groundwater quality due to excessive pumping, but also due to the lack of sewerage and wastewater treatment infrastructure, has already been observed in some locations [3].

The aquifer is considered a locally important water resource, as it supplies water to the rapidly developing village of Pegeia and the nearby tourist establishments. This rapid development, contributing to an increasing demand for freshwater, increases the vulnerability of the water body and raises the question of how to achieve sustainable water management without compromising economic growth. Nowadays the aquifer is mostly used for potable water supply and to a much lesser extent for irrigation. More than 5000 houses and tourist units are supplied through four boreholes, which are located within the main irrigated area. One of these started operating in 2004 whereas three new boreholes were connected to the system in July 2007. Furthermore, since June 2004 additional water for domestic purposes has been supplied from Asprokremmos treatment plant. In addition to close monitoring of the aquifer's state, several other protective measures have already been applied, including the provision of alternative water supply for irrigation purposes through the Paphos Irrigation Project.

In the above context, the Case Study developed for the Pegeia area followed the overall methodological framework implemented in INECO; in addition to fostering dialogue, adopted processes also offered an opportunity to build more informed processes for water management, and to develop recommendations for the public consultation processes currently under way in Cyprus, as part of the WFD implementation process.

2 THE STAKEHOLDER ENGAGEMENT PROCESS: MAIN OUTCOMES

The different steps of the applied methodological approach concerned:

- **Stakeholder and Problem Analysis**, involving the identification of stakeholders, the mapping of their key problems, constraints and opportunities, and the definition of the key water management issue in the region of interest;
- **Objective Analysis**, concerning the development of policy objectives from the identified problems, and the identification of means-to-end relationships to support the process of IWRM planning;
- **Option Analysis**, including the identification of different options that can contribute to the achievement of the agreed objectives. Options were subsequently evaluated by stakeholders to formulate the most suitable strategy for problem mitigation.
- **Formulation of a policy proposal,** taking into account results from all previous stages, and the evaluation of alternative policy approaches on different issues relevant to the Case Study context.

The overall process was articulated through individual (preparatory or consultation) meetings with key stakeholders (decision and policy makers, representatives of key water users), workshops and public meetings open to stakeholders and all citizens concerned, discussion fora, and dedicated surveys. Details as to the main tools followed and the main outcomes of each stage are presented in the next paragraphs.

2.1 Stage 1: Analysis of the focal problem of "Increasing vulnerability of the Pegeia aquifer, Cyprus"

According to the perception of local stakeholders (Water Development Department (WDD) [4] and its Regional Department in the District of Paphos, Municipality of Pegeia, farmers of the region, citizens of the area, hotel owners, and developers) the focal water management problem faced in the Pegeia aquifer can be best described as **sea intrusion and groundwater depletion**. Stakeholders, based to their knowledge of the overall situation regarding groundwater depletion in Cyprus, tried to develop a common analysis background, describing the causes and impacts of groundwater overexploitation in the Pegeia area and throughout the island as well.

A workshop, open to all parties, was held on the 26th and 27th October 2007 in Pegeia. The workshop was primarily aimed at discussing the problem with local stakeholders, through the development of a "Problem Tree" describing the causes and effects of the problem in a qualitative way. This two-day event also offered the opportunity for a first exchange of views on policy objectives and potential options, which are further discussed in the following paragraph. Through a dedicated and simple (non-technical) questionnaire, stakeholders were also able to express their views on the significance of the problem, its effects and primary causes.

According to this framework, groundwater depletion is attributed to ***low recharge*** and ***groundwater exploitation patterns*** [4], the latter considered the main cause of the problem. **Low Recharge** of the coastal aquifers can be mainly attributed to *limited and variable rainfall* as well as *high evapotranspiration* (corresponding to as much as 82% of the total annual precipitation) as a result of the pertaining *climate conditions* [5]. Due to these climate conditions the Government of Cyprus embarked in 1960 into an ambitious programme of exploiting surface run-off by constructing many dams for

storing water for drinking and irrigation needs. This, however, resulted to the *reduction of the natural replenishment of downstream (riverbed) aquifers*. Further pressures resulted from the *non-effective exploitation of many water development schemes*, which also included the development of new irrigated areas, which helped in achieving economic sustainability for these new projects, but also created new demands that did not exist before. At present, *competing demands* and tension between different dynamic economic sectors (agriculture, urban growth including tourism) and the environment are also challenging the existing water management practices in the island. Finally, *water reuse in agriculture is still far from accepted*, especially when alternative (fresh) water supply is available.

Overexploitation of groundwater resources [6] can be mainly attributed to the *uncoordinated groundwater management framework*, which often leads to ineffective and conflicting decisions, *social pressures from user groups* during the processes of boreholes permit issuing and application of penalties for overabstraction. *Equity* among farmers that depend on surface water from the public water supply system and those that depend solely on groundwater from private boreholes does not exist, especially when water tariffs for surface water supply are increased. As *environmental concerns were not key priorities* during the 1960s and 1980s, when most waterworks were developed, impacts to downstream users and the environment were not accurately valuated, whereas public participation and efforts for integrating interests of all those concerned were minimal. Finally *the limited institutional capacity* within the governmental departments, and especially in the Water Development Department, has rendered management decisions, operations and implementation of the water policy and *regulation and control* much more difficult than before.

Replies to the relevant questionnaire revealed the perceptions of stakeholders as to the significance of causes and effects to the problem. According to the perception of most respondents, the key cause of groundwater depletion is “wasteful water use”; respondents also point out that water availability is lower than local needs. Additional issues concerned the following:

- Building permits exceed the capacity to provide water in Pegia and will affect the depletion of the aquifer;
- The effect of the currently applied agricultural practices in the region (in terms of quantity required and nitrate concentrations) needs further analysis;
- The seasonal variation of water demand and its impact on the exploitation of the aquifer is an issue that requires further analysis;
- There is lack of awareness and education of local residents on water conservation;
- There is lack of information on water issues in the area;
- The quality of the water in the aquifer is not only affected by the current agricultural practices, but also from the lack of a sewerage system;
- There is need to take measures in order to reduce water losses in the distribution system (according to estimates, losses presently account for approximately 40% of water extracted).

Furthermore, a common issue that emerged during this “Problem analysis” workshop concerned the need for the disclosure of information regarding the state of the aquifer: although information is shared among authorities, most citizens were

unaware that information on the vulnerability of groundwater bodies (as required from Art. 5 of the Water Framework Directive) [3] had been disclosed, and that the Government of Cyprus provides important incentives for water conservation.

2.2 Stage 2: Definition of policy objectives and identification of instruments for problem mitigation

The identification of key objectives, which should be pursued for problem mitigation, was partly based on the results of the previous stage ("Problem Analysis"). As additional stakeholders joined the process, a preliminary "objective tree" was drawn and further elaborated to define a set of key policy objectives, to achieve the main goal of "Reversing current sea intrusion and aquifer depletion trends". Overall, at the end of this process four key policy objectives were identified, as well as potential options towards their achievement. These are presented in the following paragraphs, which also comment on barriers that have (or could) inhibit the implementation of suggested responses.

Objective A: *Development of additional water supply sources*

The current effort for the protection of the Pegeia aquifer and the reduction of abstractions to sustainable levels involved the "phasing-out" of the use of groundwater for crop irrigation in the area. Farmers were forced to use water from the Paphos Irrigation Project instead of water from the aquifer [7]. However, additional efforts for introducing new, alternative water supply, in the area are currently being pursued. The Municipality of Pegeia, in collaboration with the WDD has initiated the process for the construction of sewerage networks and wastewater treatment infrastructure. In addition to pollution prevention, treated wastewater could be further used for crop irrigation, especially during drought. Furthermore, the WDD has launched a tender for the construction of a desalination plant to meet the drinking water needs of the Paphos district; the introduction of desalination will improve the reliability of freshwater supply in the town of Paphos and the areas in its vicinity, and alleviate the pressures exerted on surface and groundwater bodies. Many hotels and tourist units are also exploring the option of developing their own desalination facilities, given the severe impact of the accentuated drought of the past few years. Associated issues related to cost recovery do not seem to raise concern, as it is recognized that further real estate development would require infrastructure development. Water charges are affordable in the area, and even if full recovery is effected, the share of household income spent on water services will remain below the threshold of 1.5%. Other suggestions of local stakeholders focus on small-scale decentralized solutions to meet the increasing demand, rainwater harvesting and the construction of small interception dams. Water recycling and reuse at the neighbourhood level to meet municipal and garden irrigation demand gain momentum among citizens. Additional suggestions concern the reduction of losses in the drinking water distribution network, which are currently estimated in the range of 30 %.

Objective B: *Improvement of efficiency in water use*

Water conservation and improvement of efficiency in water use are core components of the National Water Policy of Cyprus [8]. Measures include awareness campaigning, financial and fiscal incentives and legislative mandates concerning the entire range of water use sectors, with particular focus on crop irrigation and

domestic water usage. In the above context, the WDD has embarked on a Strategic Plan, providing financial incentives for the promotion of technological adjustments aimed at water conservation [9]. These include subsidies for borehole drilling to safeguard surface water supply, introduction of improved irrigation systems, or installation of grey water reuse systems in lavatories and for garden irrigation. However, although financial incentives towards water conservation are available, these are not known to the citizens of Pegeia. Measures proposed by stakeholders comprise: (a) the increase of water tariffs (especially the volumetric part), to achieve adequate recovery of water service costs. Suggestions on how additional costs will be allocated to consumers include increased tariffs for the hotel sector as well as for large scale water users; (b) introduction of seasonal water rates, to account for the costs of infrastructure aimed at meeting peak (tourism-induced) water demands; (c) introduction of mandates for regular water audits for large consumers (e.g. hotels) or cases where there is "excessive" water use; and (d) additional incentives for conservation in the home and in tourist installations, such as further rebates or tax exemptions for the installation of water saving equipment. It should be noted that although crop irrigation does not presently contribute to groundwater overexploitation, proposals were made towards the change of cropping patterns, in an effort to also conserve surface water and rationalize water use.

Objective C: *Regulation and control over groundwater abstractions*

The pieces of legislation aimed at the protection of groundwater resources from overexploitation is summarized in the Wells Law (Cap 351), which requires the issuing of the relevant permit by the corresponding District Officer for borehole drilling [6], [10]. However, as the authority vests within a body that does not have the technical capacity to assess the potential for further groundwater exploitation in relation to sustainable extraction limits, the Law has resulted in the existence of a large number of boreholes and wells that are not properly assessed in terms of environmental impact. With regard to compliance to the extraction limits defined in permits, authorities and citizens often point out that supervision and control are "relaxed" for private boreholes, whereas penalties and fines imposed in case of overabstraction are relatively low. In the above perspective, options towards the regulation of groundwater abstractions mainly focus on borehole monitoring and extraction control, and the enforcement of stricter penalties and fines for over abstraction, although questions were arisen as to the feasibility of such measures taking into consideration the large number of private boreholes operating throughout the country. For the particular case of Pegeia, and as groundwater is solely used for drinking water supply (domestic and tourism sectors), suggestions also include measures aimed at reducing groundwater usage for domestic purposes. Other forms of fiscal and financial instruments (e.g. low interest loans) were also suggested.

Objective D: *Enhancement of awareness among water users and citizens*

Making water users more aware of the importance of water conservation is a key objective for decision-makers and citizens at large. Awareness campaigns on water saving are an everyday reality in Cyprus, as there is strong need to rationalize and curtail water use to meet available supply during drought. Furthermore, the WDD, within the framework of the WFD implementation process, has initiated public participation processes on the draft River Basin Management Plan [11]. Means employed involve presentations, public meetings, dedicated questionnaires and

information sharing. However, all these initiatives towards public participation do not seem to reach water users at the local level. Suggested options towards enhancing awareness and participation include: (a) awareness campaigning, focusing not only on general measures towards water conservation, but also on incentives available at the local level; (b) more information sharing through specifically targeted local meetings and public hearings at the local level. Information disclosure would be more effective if non-technical terms are used, so that information, actions taken and proposals are easily understood by citizens without scientific background on water management issues; (c) efforts to establish deliberation processes, through citizen panels, could be of significant benefit to local decision-makers, as they would give citizens the opportunity to freely express their views on issues of local importance and become more informed on the scope of current decisions and offered incentives.Furthermore, all authorities and actors involved pointed the need for institutional reform, to achieve centralized and integrated management of groundwater and overcome barriers related to the current fragmentation of responsibility in the authorization of borehole drillings.

2.3 Option prioritisation

The next step was to evaluate suggested instruments. A first step involved the prioritisation of suggestions using on a set of predefined criteria common to all the INECO Case Studies. The survey involved the ranking ten (10) broad categories of instruments taking into account the local and the national water management context, current conditions and priorities, and future challenges.

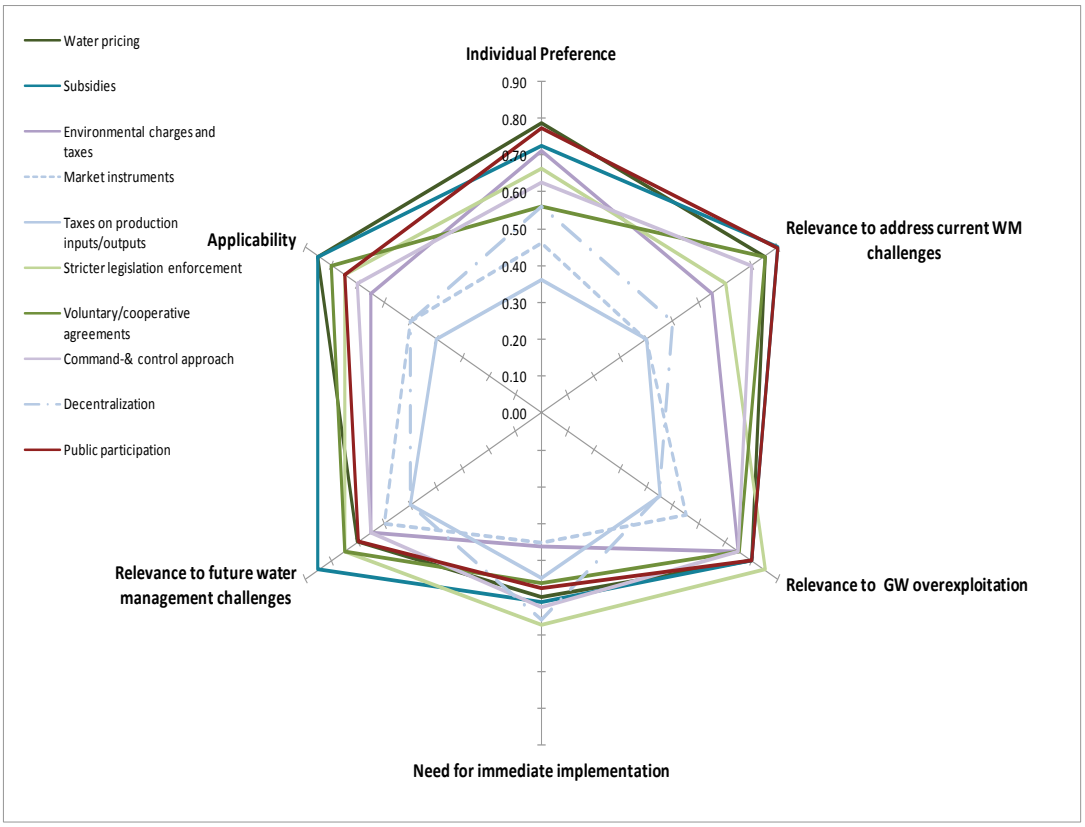

Figure 1: Proritization of instruments for addressing current and future water management challenges

In total, 50 questionnaires were distributed; 20 responses were received, representing all key stakeholders and user groups, whereas support was provided in

the dedicated discussion sessions. As depicted from the spider chart of Fig. 1 that summarizes results, instruments and approaches, which seemed to be most relevant and applicable, comprise water pricing, financial incentives and voluntary programmes towards water conservation, strict enforcement of liability rules and regulations, and enhanced public participation.

2.4 Consolidation of suggestions and formulation of a policy proposal

The process of identifying pathways towards the effective implementation of suggested instruments was articulated through individual interviews with Municipal Authorities, Water Authorities, water & environmental experts, and citizens and professionals from the target region. The interviews were articulated around four (4) main thematic areas: (a) cost recovery issues and cost sharing principles, (b) means for regulating abstractions, (c) ways of enhancing incentives towards water conservation, and (d) ways of enabling public participation and enhancing stakeholder involvement in decision-making. Results are discussed in the following.

The effective **regulation** of individual groundwater abstractions, combined with a simplification of the overall framework for the issue of groundwater abstraction permits is seen as an appropriate way of mitigating groundwater overexploitation. However, in areas with numerous, already operating, private boreholes the exercise of proper control requires strong regulatory capacity and sufficient financial and human resources to regularly monitor adherence to permit conditions. Concerning approaches to **water saving**, questions set forth to stakeholders collaborating in the Pegeia Case Study were aimed at analysing their views on: (a) the incentive function of water tariffs, and the acceptance of high rates for excessive water use; (b) the introduction of dedicated taxes for those who continue to waste water, and the use of generated revenue in order to provide financial aid to those who decide to invest in water saving; and (c) the introduction of mandatory water saving standards for new developments. The last two options are largely accepted by respondents. Opinions were diversified in the first case; it was generally considered that encouragement would be more effective than penalization of water use; furthermore an increase of water tariffs could compromise the affordability of water charges for households of lower income, whereas high income households would be unaffected. As financial aid would be more effective and powerful, a combination of the two first options with specifically targeted grants is more acceptable.

The exacerbation of water stress problems, as a result of the continuing and prolonged drought, has brought forward an ongoing debate on whether there is need to **eliminate low-value water uses** (such as the cultivation of banana plantations) or alleviate pressures exerted on the public water supply system by forcing specific uses to develop their own water supply (e.g. small-scale desalination for hotel clusters and irrigation of golf courses). Mechanisms discussed for bringing about similar changes include:

- The offer of compensation to the corresponding users for shifting to other, less water consuming or more economically efficient activities;
- The increase of the corresponding water charges, so that water users are forced to develop other alternatives.

In general, responses portray that a combination of both approaches would be the most preferred option. Depending on the specific characteristics of each case, compensation measures are preferable in the case of low-income agricultural

activities. The second approach is supported for the tourism sector: hotels should pay more and eventually be required to become independent of the public water supply system. In addition, this option is considered to be fair, given the acute water shortage and the high income generated from tourism-related activities.

Current mechanisms for **cost sharing**, especially with regard to hydraulic infrastructure have been defined several years ago involving the allocation of costs for joint infrastructure (i.e. infrastructure for supplying both domestic and irrigation costs) on the basis of the quantities supplied to each use sector. Furthermore, and in line with the WFD implementation requirements, the Government is gradually pursuing the achievement of full financial cost recovery for bulk freshwater supply provided to both sectors. Despite the already established policies, there is great diversity of views on the objectives and mechanisms that need to be applied at local and national level for cost recovery and cost sharing for rehabilitation, operation and maintenance of existing and for the development of new infrastructure to cope with emerging needs. With regard to cost allocation issues, responses span the entire range of potential alternatives: according to the relative consumption share of each major water use sector, proportionality principles need to be adjusted to address national economic development priorities for specific water use sectors (e.g. tourism, agriculture, etc.), or differentiation between residential water use and consumption in economic sectors. On the other hand, there is agreement on objectives and principles for the definition of water tariffs, at least at local level. It is generally considered that full cost recovery through water tariffs is the appropriate and fair way for financing water services. Half of respondents further perceived that the current framework for the definition of water tariffs is transparent enough and that the water bill they are paying is appropriate for the water services received; enhancements could involve the regular publication (e.g. through the internet) of information concerning the calculation of the applied water rates, so that required data can be retrieved from those concerned.

The majority would be willing to pay more for an improved service. A similarly high share would be willing to pay more for ensuring that the current level of water service can continue despite increasing stress on the natural resource side. However, in the latter case, it is also supported that costs for coping with increasing water scarcity should not be passed on to residential users; instead, they should be allocated to the major water consuming economic sectors (e.g. tourism and agriculture), according to the benefits accrued and broader socio-economic considerations. Along the same line, it is believed that some users need to be charged more than others, according to their relative ability to pay and/or the externalities they are producing.

The **enhanced involvement of stakeholders and citizens** in decision-making is a policy objective that is being strongly pursued by all State and local authorities involved in water management in Cyprus. Public participation and civic engagement are not only a regulatory requirement imposed by the Water Framework Directive, but are regarded as a required response for raising awareness on the current water management crisis.

Strategies towards public participation are currently in status of implementation; however, users' perceptions on the deficiencies of the followed approach provide recommendations on how these processes could be further improved. The stakeholders that were asked to comment on the above pointed out the need of pursuing more deliberative processes that would give citizens a true opportunity to

express their views on water management decisions and policies. Despite the fact that information on water-related issues is readily available for public consultation and comment, most stakeholders (citizens in their majority) comment that only a small amount of this information is actually understandable. It was therefore suggested that efforts should be made to share information in a non-technical way that would allow individuals to form their own views and become more involved and aware of how water management problems affect people, the economy and the environment. Carefully scheduled, open and inclusive public hearings are proposed as means to share information and to offer opportunities for discussion and exchange of views; other suggestions include awareness campaigning, wider use of the mass media and the internet, dedicated local information desks etc.

3 CONCLUDING REMARKS

The enhancement of public participation processes for water management in Cyprus has been the focus of several projects, funded by the EC and by the Government of Cyprus, in view of the WFD implementation process. INECO, as a Coordination Action project, fostered a similar process at local level; the participatory approach for the management of the Pegeia Aquifer managed to bring together stakeholders and citizens of the area, to discuss the state of the aquifer, current policies and potential mitigation options.

A key requirement that emerged from INECO was the need for improving information sharing patterns; it became apparent that despite the significant efforts and resources invested, information regarding water management does not reach the general public, especially at local level. Within the framework of the project, the provision of information on the state of the aquifer and on current policies regarding water management in Cyprus managed to foster the active involvement of citizens, highlighting the importance of instruments for encouraging water conservation and developing a new culture on “responsible” water use. Along this line, it is generally perceived that public involvement at the local level needs to be further enhanced through open and inclusive public hearings, awareness campaigns, participation in round table discussions and other means to support exchange of views and ideas.

Recommendations regarding the potential for the adoption of technical options could also be drawn based on the INECO experience. These include the maximisation of water recycling and reuse in agriculture and in the domestic sector. Such efforts have been supported by the WDD through a series of incentives; the encouragement of conservation measures at home and in tourist units through intensification of these efforts is seen as a vital solution to water stress issues. In addition, the construction of small-scale desalination units for hotels, and the engagement into stricter standards for water saving, could enhance water conservation and alleviate pressures exerted in the public water supply system by large-scale consumers.

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REFERENCES

[1] Developing Strategies for Integrated Water Resources Management in Water Deficient Regions – Methodological Approach and Case Studies", WaterStrategyMan Project, June 2005.

[2] Water Framework Directive – March 2005 Report – Republic of Cyprus

[3] Simulation of Ground water flow conditions in the coastal aquifer of Pegeia' .E. Minles. P. Perrochet, C.Zambaz, university of Neuchatel, Dec, 2005

[4] Water Development Department, "Implementation of Articles 5& 6 of the Water Framework Directive 2000/60/EC" , December 2005.

[5] Charis Omorphos, "Coping with drought – The experiences of Cyprus", ARID Cluster International Conference, Coping with Drought and Water Deficiency: From Research to Policy Making, Lemesos Cyprus, May 2005.

[6] Demetriou, Ch., Georgiou, A. "Management of Groundwater Resources in Cyprus – Harmonisation with the EU Water Framework Directive", BALWOIS Conference on Water Observation and Information System for Decision Support, Ohrid, FY Republic of Macedonia, 25-19 May, 2004.

[7] Guidelines for Integrated Water Management – Regional Experiences and Management Methods Applicable to Water Stress Regions", WaterStrategyMan Project, March 2005.

[8] I. Iacovides, "The Cyprus experience in planning water resources management: Past and Future", The ARID Conference: Coping with drought and water deficiencies – from research to policy making, May 12-13 2005.

[9] Water Development Department, "Annual Reports 2002 – 2003 – 2004 – 2004 – 2005 – 2006 - 2007"

[10] V. Markantonis, P. Getimis, D. Zikos, "Current status of water sector liberalization in Cyprus", Sustainable Management and Quality of Water Project, 2002.

[11] Water Development Department, "Implementation of Articles 14(1)(A) and 14(1)(B) of the Water Framework Directive 2000/60/EC" , December 2006.

WATER STRESS MITIGATION IN THE DAMOUR RIVER BASIN, LEBANON

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ABSTRACT

Damour is a coastal village located 20 km to the south of Beirut, in an area with total population of 76,000 inhabitants approximately. The River Basin covers an area of 333 km² and faces considerable decrease in the quantities of surface and groundwater available and of sufficient quality to meet the local domestic, irrigation and industrial demands. The problem becomes particularly acute in the irrigated coastal plains of the basin, where farmers complain about the lack of water during the summer period. Groundwater resources are also under stress, due to the increasing volumes of water used to meet demands within and outside the River Basin.

This paper highlights the main water management challenges faced in the Damour River Basin today, describing the different issues that contribute to the exacerbation of water stress problems. The intensity of these issues, which is expected to increase in the coming years, requires the development of an Integrated Water Resources Management approach. Emphasis should be placed on implementing policy options that can effectively resolve local and inter-regional conflicts over water allocation and use; in addition, demand management and the need to raise awareness and foster civic engagement and participation emerge as the focus of new water management policies. In this context, the INECO project implemented a participatory approach for fostering the reaching of consensus on options suitable for the management of surface and groundwater resources in the region. The outcomes of this process, also outlined in this paper, concern the development of a common background and shared reference on what the real problems are, and highlight implications of different options and policy pathways towards water stress mitigation.

1 INTRODUCTION

The Damour River Basin covers an area of 333 km². The Damour village, an important tourist destination, is located in the lower part of the basin, at 20 km south of Beirut. The area is a necessary crossroad, linking Beirut to the Shouf Caza in the Mount Lebanon, and to other southern cities and villages, such as Saida, Tyr and Nabatiyeh. According to the records of the local municipal authorities, the total permanent population of the River Basin is currently around 76,000 persons. The River Basin has an agricultural profile, with bananas and vegetables being the main cultivations. In this regard, the Damour River is of socioeconomic significance as it is used for the irrigation of the agricultural coastal plains. Two dams, upstream and

downstream, were constructed to divert water for irrigation. Currently, the water is diverted at a rate of 1100 m^3/hr downstream, and 650 m^3/hr upstream.

The overexploitation of river water by upstream users leads to downstream water shortages, especially during the summer season. In turn, this affects downstream agricultural activities and induces conflicts between the Damour Municipality and upstream users, given also the lack of proper legislation for water allocation. A rough approximation of the Water Exploitation Index, using solely abstraction data for the Damour Municipality, gives values ranging between 10 and 20%, depending on annual precipitation levels. This reveals that there are pressures exerted on water resources, even without taking into account abstractions from the other municipalities of the area, for which data have not been made available. Moreover, environmental violations committed upstream affect river water quality, which in turn can adversely impact on crop production in the downstream plains.

Groundwater is the main source of drinking water supply in the area. Only in the village of Damour, there are 64 public and private wells. Sixteen (16) public wells, fourteen (14) belonging to Beirut Water Authority (BWA) and two (2) municipal wells, are used for domestic supply. With regard to private wells, 44 are used for domestic purposes, whereas 6 are used for irrigation. Forty-two (42) private wells are utilized in Saadiyat Area for meeting domestic water demand. Water extracted from the fourteen BWA wells is used to meet water needs outside the river basin for a 6-month period (typically from July to January). The volume of extracted water reaches up to 7.2 million m^3/yr. This practice puts pressure on the aquifer, leading to seawater intrusion, as confirmed by the elevated TDS and chloride levels in well water samples.

The above competition over the allocation of the (limited) water supply of the area has put the Damour River Basin at the focus of important research initiatives. Several projects have been launched, with the support of the Ministry of Energy and Water; however, issues still prevail, requiring the implementation of an integrated management approach, addressing local needs but also broader considerations in relation to socio-economic development patterns, water transfers in other areas, preservation of traditional activities etc.

In this regard, a Case Study was developed with the support of the INECO project; the aim was to arrive to a policy proposal for water stress mitigation, based on participatory tools for assessing the feasibility and applicability of alternative policy instruments. The overall process, which followed the Objective Oriented Planning method, was articulated around individual (preparatory or consultation) meetings with key stakeholders (decision and policy makers, representatives of key water users), as well as surveys, discussion fora, dedicated questionnaires, workshops and public meetings open to stakeholders and citizens concerned. The following paragraphs present the implementation of this approach in the Damour River Basin, describing also the main outcomes of each stage.

2 STAKEHOLDER ENGAGEMENT PROCESS OUTCOMES

2.1 Stakeholder analysis

The first step of the followed process concerned the analysis of the current situation regarding water management and use, current policies and instruments already in

place, as well as the identification of key stakeholders (users, water managers and policy-makers) with a role or interest in water management in the area, these being:

- The Beirut Water Authority (BWA), which exploits wells in the area in order to meet part of the increasing urban water demand of the Beirut Metropolitan area;
- The Damour Municipality, which is particularly concerned over the availability of water resources, and the quality of water provided both for drinking water supply and for irrigation purposes;
- Farmers of the area, who experience water shortage especially during the dry summer periods;
- Upstream users, whose practices are often cited as the main cause of water shortage and pollution downstream the Damour River.

Furthermore, the above players and actors were initially consulted, to map interests, priorities, challenges and issues of primary concern. Initial discussions revealed several conflicts over water use in the Damour area, particularly among:

- The stakeholders and the policy makers, and primarily between the local Municipalities and the Beirut Water Authority, since the former consider that the latter overexploits local groundwater resources.
- The stakeholders themselves, primarily between the Damour municipality and upstream water users.

From its part, the BWA is facing major problems in providing sufficient water to meet the constantly increasing water demand in Beirut, and needs to rely on external water supply sources (groundwater from Damour being one of these). On the other hand, the Municipality of Damour is concerned by the overall deterioration of groundwater quality, and particularly with the increased salinity of groundwater due to excessive pumping, and the lack of information on the quantity and quality of water abstracted. Furthermore, the municipality complains about inappropriate allocation of the Damour river water and excessive pollution upstream. The coastal agricultural plain is often suffering from water shortage due to overexploitation of surface water resources by upstream users. Nevertheless, upstream users are not willing to discuss the issue and reach consensus on the amounts of water to be used, whereas the enforcement of discharge standards is also considered insufficient.

2.2 Problem analysis

Following from the initial mapping of stakeholder views and perceptions, a first workshop was held on September 12th 2007 in Meshref. The event was attended by 43 participants, including representatives from Ministries, delegates of local authorities, local farmers and owners of agricultural lands, representatives of the Beirut & Mount Lebanon Water Office, NGOs, and experts working in the field of water resource and environmental management. The workshop was aimed at discussing the problem with the local stakeholders, through the development of a "Problem Tree" describing the causes and effects of the problem in a qualitative way.

The developed "Problem Tree" is presented in Fig.1. According to the perceptions of local stakeholders, the focal water management problem faced in the Damour River Basin can be best described as the **decrease in the total amount of surface and groundwater of adequate quality required for meeting the water needs of domestic, agricultural and industrial users (Water Stress)**. Contributing causes

include the uncontrolled discharge of industrial and domestic wastewater in surface water, uncontrolled surface water allocation, and seawater intrusion in groundwater. These are in turn attributed to limited law enforcement and inadequate regulation, limited capacity of authorities, limited financial resources, lack of a clear planning framework, lack of participation and coordination and inefficient monitoring. The issue of groundwater inter-basin transfers is particularly regarded as the main cause of groundwater quality deterioration in the coastal area. It is perceived that the problem is further exacerbated by lack of awareness and technical capacity, by social and political pressure from user groups, and lack of integrated management of the water resources of the area. Future effects can comprise conflicts among water users, and increased social costs due to health problems from the use of polluted water.

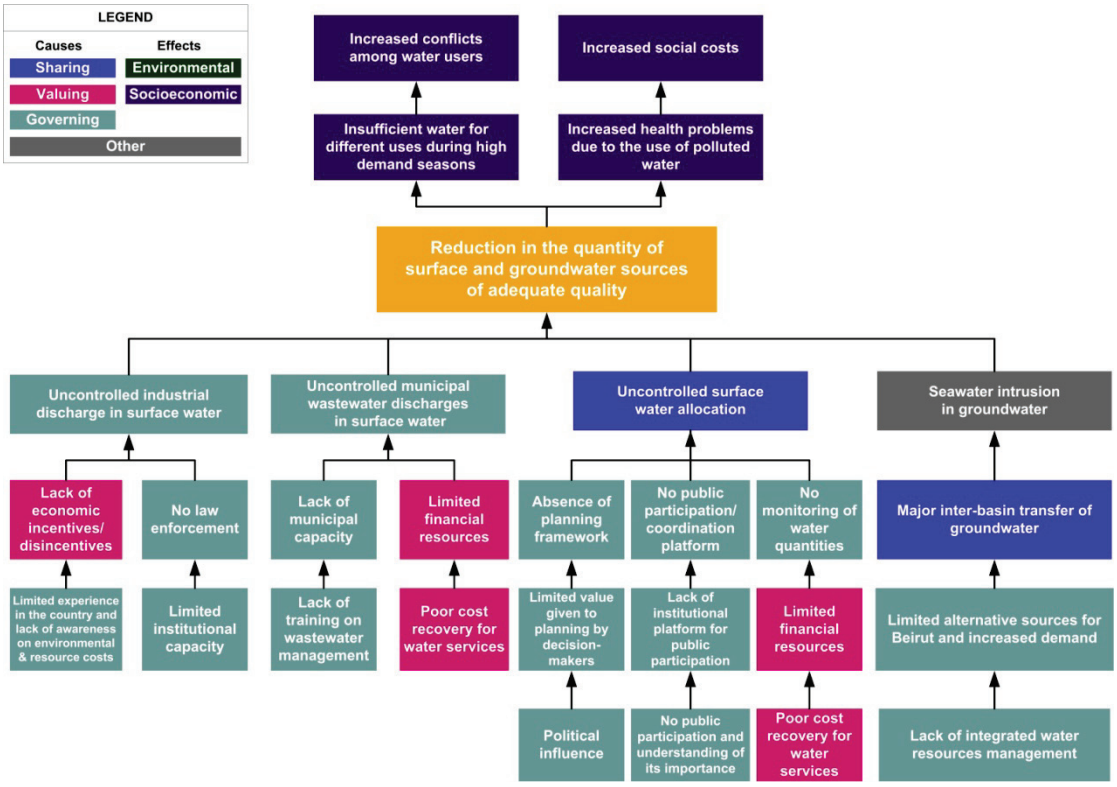

Figure 1: “Problem tree” analysis of causes and effects to water stress in the Damour River Basin

All workshop participants stressed the need for new infrastructure for water supply enhancement (mostly river damming and water recycling projects). However, several groups also pointed out the need of adopting a global water management scheme that would address the technical, environmental and health, financial and institutional issues at all water management levels and operations. Several participants converged to the requirement of closely monitoring water and environmental quality in the river basin. Medium and long-term solutions should seek to the long-term preservation of the natural capital and heritage and the development of a "water culture" among water users.

2.3 Definition of policy objectives and identification of instruments for problem mitigation

Following from the “Problem Analysis” step, individual consultation and discussion sessions were held with all local stakeholders and actors that participated in the first event, as well as additional groups that expressed their interest to join the process.

These meetings were aimed at: (a) consolidating the problem analysis of the previous workshop, and (b) identifying key policy objectives which should be pursued for problem mitigation. In this stage, the developed "Problem Tree" was used to identify and develop policy objectives for mitigating the issue at hand. The resulting "Objective Tree" was further elaborated to define a set of key policy objectives, to achieve the main goal of "Water Stress Mitigation", incorporating the views and goals of all stakeholders at the table. Overall, at the end of this process, four main policy objectives were identified, as well as potential options towards their achievement. These are discussed in the following paragraphs.

Objective A: *Control of groundwater abstractions*

The reduction of groundwater abstractions to sustainable levels is a commonly agreed policy objective. It is noteworthy that the relevant legislation in Lebanon foresees procedures for permit issuing for borehole drilling. In particular, extraction permits are subject to strict conditions and require Republican Order or Decree except for those under 150 meters depth and not exceeding 100 m^3/day. Abstraction from public boreholes normally complies with permits issued. However, questions arise as to the effectiveness of the system in the case of private boreholes and wells, or when alternative sources of water supply are not available or costly to exploit.

Infrastructure development is also being strongly supported as a potential option. Stakeholders demand the construction of a dam in the Damour River, with the aim to secure water supply during the dry summer months, and compensate for the transfer of the region's water resources to the Beirut Metropolitan Area. Additionally, the expansion of the public water supply system to supply deprived areas (e.g. the Saadiyat area) and the development of collective schemes for irrigation can help to mitigate groundwater overexploitation. Other solutions, such as the development of water reuse and recycling schemes are also gaining support.

Strict legislation enforcement, especially with regard to extractions from private boreholes and wells is also noted. It is however broadly recognized that the current technical and financial resources are not adequate for monitoring all groundwater extraction points in the region. Abstraction metering is considered a first step towards enforcement of stricter limitations in groundwater extraction from existing boreholes

Objective B: *Industrial and domestic pollution prevention and control*

Despite the absence of "heavy" industrial activity in the Damour area. there is uncontrolled discharge of industrial wastewater from small manufactories and facilities, as confirmed by measured COD concentrations. In this perspective, it is believed that:

- The implementation of effluent charge systems or the introduction of tradable emission permits (market-based instrument) are not considered applicable given the current institutional framework and the administrative situation;
- Legislation enforcement, through the establishment of a discharge permit system and the regular monitoring of industrial discharges, is strongly supported. The option can have the potential to achieve the suggested objective, provided that there is commitment from the part of the competent authorities;
- Voluntary agreements could provide the technical and financial resources necessary to implement water pollution mitigation measures.

Water pollution abatement in the River Basin would also require interventions in the management of domestic wastewater. To that end, suggestions mostly focus on the development of the pertinent infrastructure, through State or other funds, as it is estimated that the recovery of capital costs in this case can compromise the affordability of water service charges. It is also accepted that a reform of water tariffs should be implemented to recover at least the operation and maintenance costs of the required schemes. This reform could be accepted, provided that the increase is logical and charges are calculated in an open and transparent way.

Objective C: *Reaching agreement on surface water allocation*

The allocation of the water of the Damour River is an issue of conflict among upstream and downstream users in the River Basin. Options that are suggested to that end involved:

- The introduction of tradable water use rights for surface water.
- The establishment of a surface water abstraction permit system. Although such a system is already in place, there is need to re-define water use rights, as the current framework is considered outdated and does not take into account the change of river flow patterns and the socio-economic developments experienced in the last decade.
- Cooperative agreements between upstream and downstream users, possibly also involving “informal” water trading.

Finally, it is noted that consensus or mitigation of conflict over surface water allocation could be effected through additional infrastructure development (i.e. the construction of the pertinent dam in the Damour River Basin), provided that the reservoir’s operational rules are defined in accordance with the interests of both upstream and downstream users.

Objective D: *Improving efficiency in water use*

Improving efficiency in water use is a key objective broadly recognized by all consulted parties. Individual efforts are undertaken both at the national and local level, but a more systematic and professional approach that would include the provision of advice on technical issues (irrigation methods, irrigation scheduling, water saving in the home) needs to be pursued. Additional incentives, requiring financial resources from the State or water management authorities and water service providers, include the provision of grants, subsidies, soft loans and/or tax rebates for the installation of water saving equipment. Notably, reinforcing the incentives provided by water tariffs is an option that wins the acceptance of stakeholders, provided that the main objective in water pricing policy design and implementation is cost recovery and not penalization of water use. Currently, and due to the lack of an efficient water metering system, water pricing is based on a lump sum determined according to theoretical water consumption. Water pricing reforms can be oriented towards the introduction of a fixed charge, aimed at recovering maintenance cost, and a volumetric charge, provided that water meters are installed in households and that metering is regularly undertaken for all establishments.

2.4 Prioritization of suggested instruments

The first step towards the evaluation of suggested responses was their prioritization by local stakeholders, on the basis of a set of predefined criteria common to all the INECO Case Studies. The step was implemented from February to June 2008,

through a survey for ranking ten (10) broad categories of instruments. In total, 80 questionnaires were distributed. A total of 32 responses were received, representing all key stakeholders and user groups. Prior to the distribution of the surveys, several consultation meetings were held and continuous contact was pursued to answer potential queries and provide expert support. The results are presented in the spider chart of Fig. 2.

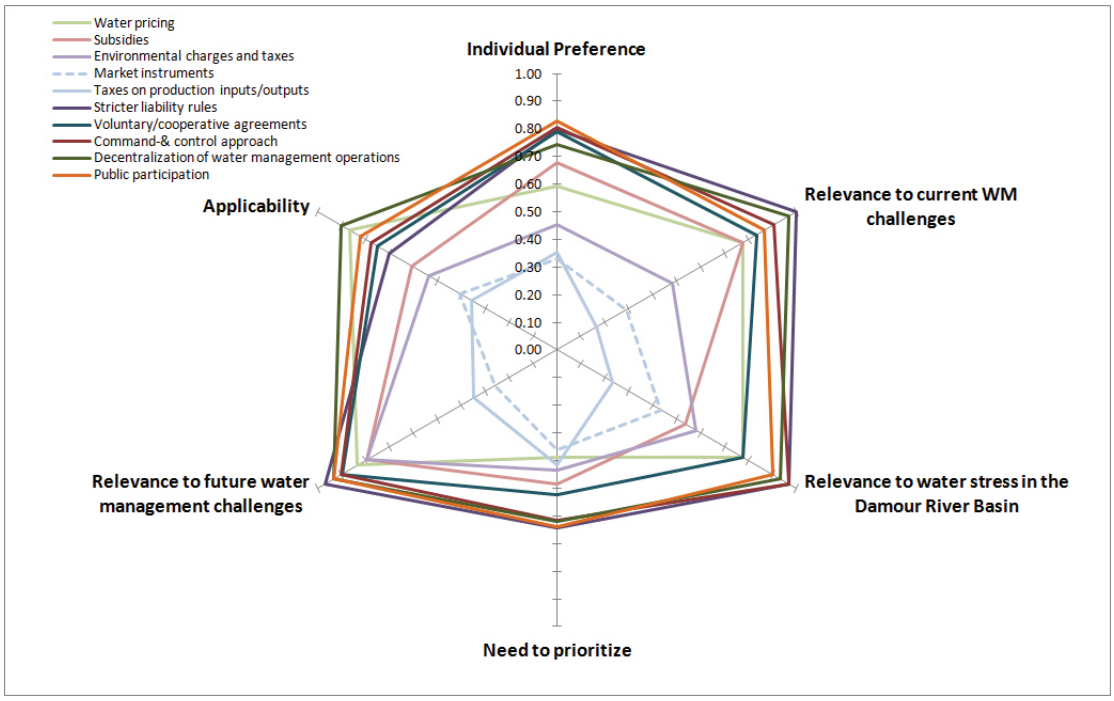

Figure 2: Prioritization of instruments for addressing current and future water management challenges

Answers from different stakeholder groups converged with regard to the solutions of the problem under discussion. Instruments and approaches that seemed to be most relevant and applicable comprise decentralization, public participation and increased liability of polluters. Instead of indirect taxes, there is preference for (financial) incentives, including voluntary agreements. With regard to the currently applied (or potentially applicable) instruments, opinions and suggestions can be summarized in the following:

- Water pricing does not seem problematic. Consequently it can be argued that the installation of water meters will be accepted by the local community. Tariff structures could be revised, introducing different elements, provided that their increase does not impose excessive additional cost. A possible differentiation among user groups could be envisaged by setting a low fixed charge and a volumetric charge. Professional categories, such as industries and tourist resorts would be subject to volumetric pricing, whereas in the case of households and farmers a fixed charge could be applied. Cost recovery would ameliorate substantially to achieve financial sustainability if water meters are installed and if the proposed differentiation of charges is also taken into consideration.
- A command-and-control approach which would imply the introduction of a discharge permit system, the definition of technology standards and the enforcement of the relevant penalties and sanctions, would be acceptable.

- Market-based instruments are neither a preferred nor an appreciated option. They are generally ignored by stakeholders, and are not presently considered applicable for different socio-economic reasons.
- Voluntary agreements, which have not yet been extensively applied, are clearly preferred.

Furthermore, decentralization is regarded as prerequisite for enabling the effective implementation of all water management options and development policies. Public participation is also strongly supported, and all contacted parties wish to be further involved in the planning process.

2.5 Consolidation of suggestions and formulation of a policy proposal

The process of identifying pathways towards the effective implementation of suggested instruments was articulated through individual interviews with Municipal Authorities, Water Authorities, water and environmental experts, and citizens and professionals from the Damour area. The interviews were articulated around four (4) main thematic areas: (a) cost recovery issues and cost sharing principles, (b) means for regulating abstractions, (c) ways of enhancing incentives towards water conservation, and (d) ways of enabling public participation and enhancing stakeholder involvement in decision-making. Results are discussed in the following paragraphs.

Cost recovery and cost sharing issues

The transparency and fairness of the current cost recovery system is an issue of debate, with a significant share of respondents considering that currently water tariffs are high compared to the quality of water services provided (frequent water supply interruptions). However, the majority would be willing to pay more provided that there is clear improvement in water services and that the stress problem on the natural resource side is alleviated. Full cost recovery through water tariffs was not considered appropriate; however, the majority would prefer paying for water directly, as customers of water services, rather than indirectly, through general taxation. The main arguments supporting this view were related to: (a) the fairness in the allocation of costs, as every consumer would pay according to the cost they incur to the system, (b) the lower complexity and (c) the increased transparency and efficiency in the system. Cross-subsidization between high and low income uses has been indicated by most respondents as a socio-economically justified way of allocating costs. In particular, the majority agrees with the option to charge some users more than others, believing that the tourist sector should pay more than households, or that it should even be “forced” through higher rates to develop its own water supply and sanitation. When it comes to irrigation, farmers argue that crop production costs are very high, and that additional water charges would create significant economic burden to an already poorly supported sector.

Regulation of abstractions and discharges

While the vast majority of stakeholders underlined the pertinence of regulation for groundwater abstractions and wastewater discharge, the same persons do not consider that the government is sufficiently empowered to do so, because of lack in efficiency, transparency and trust in the overall operation of the system, which is also subject to political influence. The majority is favourable towards the introduction of taxes as means of “compensating” environmental damage and reinforcing civic

responsibility. The acceptability of developing collective schemes in order to provide alternatives to individual abstractions and discharges is high; almost all respondents that consider the alternative acceptable also agree that the cost of these connections should be partially socialized (e.g. funded through cross-subsidies or by the government), so as to maintain affordability and provide additional incentives to individual users to connect.

Pathways towards water conservation

The incentive function of water tariffs is a controversial issue; almost half of respondents would not accept an increase of water tariffs justified solely by the need to provide disincentives to wasteful water use. An important share however would support their implementation, provided that there are additional incentives for adopting new technologies, and that tariff changes are applied progressively. Levying of dedicated taxes receives little support. Almost one third of interviewees consider that water saving standards should be mandatory for new buildings and new irrigation projects.

Furthermore, and as the Damour River Basin is mostly an agricultural area, issues related to irrigated agriculture are controversial, and receive significant attention by stakeholders. The majority believes that there are significant margins to reduce water use in the agricultural sector; at the same time, governmental support is required for modernizing agriculture, hydraulic infrastructure development, and for encouraging the adoption of modern irrigation methods. Opinions regarding change of cropping patterns are nearly unanimous; almost all interviewed persons believe that change should be encouraged, underlining also the importance of securing markets for agricultural produce.

Public involvement and participation

More than half of the persons that participated in the last survey did not comment at all on public participation, although they originally confirmed that it was an issue of utmost importance.A significant share of interviewees, however, stressed the importance of participatory approaches in promoting democratic management and accountability, as well as cooperation between decision-makers and water users. Furthermore, enhanced public participation and involvement would improve civic responsibility in matters of environmental protection and resource conservation. Local and national debates on water-related issues would be useful to allow people to express their views and develop a sense of “own responsibility”.

Manifesting commitment towards pursuing these initiatives, respondents stressed the need for: (a) training on different water management issues and alternative solutions, (b) organization of awareness campaigns, and (c) cooperation with public authorities to implement sustainable solutions, such as adaptation of the agricultural sector, demonstration projects for water recycling and reuse, development of infrastructure projects etc. However, citizens remain doubtful on the willingness of decision-makers to seriously consider the outputs of participatory processes, and often support the view that some groups are given more weight than others when decisions are made.

3 CONCLUDING REMARKS

The selection of the Damour River Basin in Lebanon for the implementation of an INECO Case Study was based on the relevance of the problems faced in the region

to the overall Project objectives and to the water management challenges faced throughout the country. The keen interest and willingness of local stakeholders representing several major and minor groups (farmers, tourist resorts, municipalities, water authorities, individuals) to participate in the Project activities highlighted the relevance of participatory approaches for promoting shared understanding of problems and developing shared goals and objectives.

The increasingly deteriorating state of water resources in Lebanon, in combination with the existing deficiencies in the water resources management framework, has prompted an in depth examination of the issues at hand by all participants. A number of solutions to the examined issues have been identified by the participating stakeholders throughout the INECO project implementation as pertinent, applicable and acceptable. Some stakeholders have expressed a preference for easy-to-implement measures, such as the installation of water meters, the invoicing according to water quantities used, and the strict control of water extraction. Others favour the introduction of new technologies, different cropping choices, and incentives, measures for which the government is responsible and requiring financing, to be sought from international donors or organizations. The construction of dams is a measure already supported by the government, and included in the “10-year-plan” for the management of water resources in Lebanon. Overall, stakeholders point out the need for transparency, good administrative organization, environmental stewardship and government responsibility.

ADDRESSING GROUNDWATER OVEREXPLOITATION IN TUNISIA

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ABSTRACT

This paper describes the work undertaken by the CITET team within the framework of the INECO project ("Institutional and Economic Instruments for sustainable water management in the Mediterranean Region"). INECO was a Coordination Action project, funded by the 6th Framework Programme of the European Commission (Contract No: INCO-CT-2006-517673). Its primary aim was to formulate guidelines on institutional and economic instruments addressing a wide spectrum of water management issues encountered in different Mediterranean areas. Project processes involved a strong participatory component, bringing together stakeholders from different regions.

The selected Case Study for Tunisia was related to the acute groundwater overexploitation problems experienced throughout the country, and particularly in coastal areas. Despite the considerable efforts undertaken at the national level towards water mobilization, which have played a dominant role in controlling water resources, there is still overexploitation of phreatic water tables. Currently, the average rate of exploitation is 106%, a fact that has resulted in the gradual depletion of productive aquifers and water tables and in increasing salinity levels in the coastal zone. The problem is mostly attributed to high water extraction rates to meet agricultural demands both inside and outside irrigated perimeters, and manifests the increasing competition over available freshwater supply in the country. In this regard, the adopted process for stakeholder engagement was aimed at mapping the underlying causes and expected impacts of this issue, at defining related policy objectives and at identifying and evaluating potential (institutional and economic) options for problem mitigation.

This paper summarizes the main outcomes, as derived through local workshops, consultation meetings and dedicated surveys. It concludes with broader policy considerations for mitigating groundwater overexploitation in the agricultural sector. Results highlight the importance of an appropriate, enabling, institutional environment for the collective management of groundwater, as well as the need to strengthen incentives for water saving and use of recycled water for crop irrigation.

1 INTRODUCTION

Since 1990 Tunisia engaged into an ambitious program for the mobilization of surface water resources. At the end of 2007 the main surface water sources comprised 29 large dams, 190 small dams and 700 artificial lakes (Mekki, 2007). However, still, phreatic, shallow, water tables are those most often exploited, as they

are easily attainable through large-diameter wells and boreholes. The total number of water tables in the country is estimated at 273, of which 71 are exploited at a rate of 146%. The renewable resources of these aquifers represent more than 52% of the total, and are estimated at 385 millions m³. It is expected that at this rhythm of exploitation, these aquifers will face significant risks resulting from pollution and overexploitation. The largest use of groundwater (350 million m³, i.e. 45%) is observed in the north-east region of the country.

The Tunisian government was aware of the trends in aquifer depletion and their resulting impact; in an effort to offer alternative supply sources, and thus mitigate overexploitation, the Government initiated in the mid 1960s a policy aimed at the reuse of treated wastewater in irrigated agriculture. At present, only a total volume of about 65 million m³ of treated effluent (approximately 30% of the total produced) is used for irrigation and aquifer recharge. Reclaimed water usage is slowly increasing in certain regions, but decreasing in others. Reported reasons include soil and groundwater contamination risks, resulting from the origin of the effluent and the insufficient treatment (only secondary). Policies also focus on demand management in the agricultural sector, by promoting the adoption of appropriate irrigation techniques by farmers, for reducing freshwater use in the agricultural sector.

The participatory approach adopted through INECO for stakeholder mobilisation and engagement was framed around this issue, in order to explore and develop recommendations for addressing the deficiencies of current policies in: (a) regulating individual and collective groundwater abstractions, (b) rationalising agricultural water demand and (c) introducing alternative, non-conventional water supply sources for crop irrigation.

The overall methodological framework for Case Study development was based on the “Objective-Oriented Planning” method, a variation of the Logical Framework Approach, which has been recommended by UN-Habitat as a tool for urban planning and management (UN-Habitat, 2001). The approach, is generally divided in three distinct stages, includes the consecutive steps of “Problem Analysis”, “Objective Analysis” and “Option Analysis”. Each step was implemented using different participation methods and tools, selected according to its scope, expected outcomes and level of professional knowledge of the participating stakeholders. All main stakeholders, including representatives of water users, with a role or interest in groundwater management were represented in the Case Study development process, both at local (area of Cap-Bon) and at national level.

The following paragraphs describe the tools employed in each stage; they further present main outcomes, highlighting different perspectives, areas of agreement and constraints faced and envisaged by decision-makers and user groups for implementing different policy approaches towards sound groundwater management.

2 THE IMPLEMENTATION OF THE PROCESS FOR STAKEHOLDER ENGAGEMENT

2.1 Stakeholder analysis and process initiation

The first step of the developed process concerned the identification of key stakeholders, with a role or interest in groundwater management, these being:

- Authorities involved in the management of water resources at national (Ministries) and at local level (Governorates, Water authorities, and Municipalities);
- Representatives of important users, such as farmer associations, agricultural development groups, hotel owners' associations;
- Professionals dealing with various issues related to groundwater exploitation and management, artificial aquifer recharge and use of treated wastewater for crop irrigation.

Two consultation meetings with key stakeholders, aimed at introducing the overall process and at identifying the main problems in water resource management in Tunisia, were organized in October 2006 and January 2007. Discussions during these events highlighted two main aspects: the significance of the water management issue and its relation to agricultural water use, especially outside irrigated perimeters and in the vicinity of coastal areas.

2.2 Problem analysis

The first workshop, which brought together 46 participants, was held on May 8th 2007, in Nabeul. Its main objective was to foster discussion and promote exchange of opinions and views on the focal water management problem of aquifer depletion. Subsequently, a second workshop on "Building a common vision for managing groundwater resources in Tunisia" was held in Nabeul on December 6th 2007. Its primary aim was to further discuss the problem with the local stakeholders, through the development of a "Problem Tree" describing the causes and effects of the problem in a qualitative way (Fig. 1).

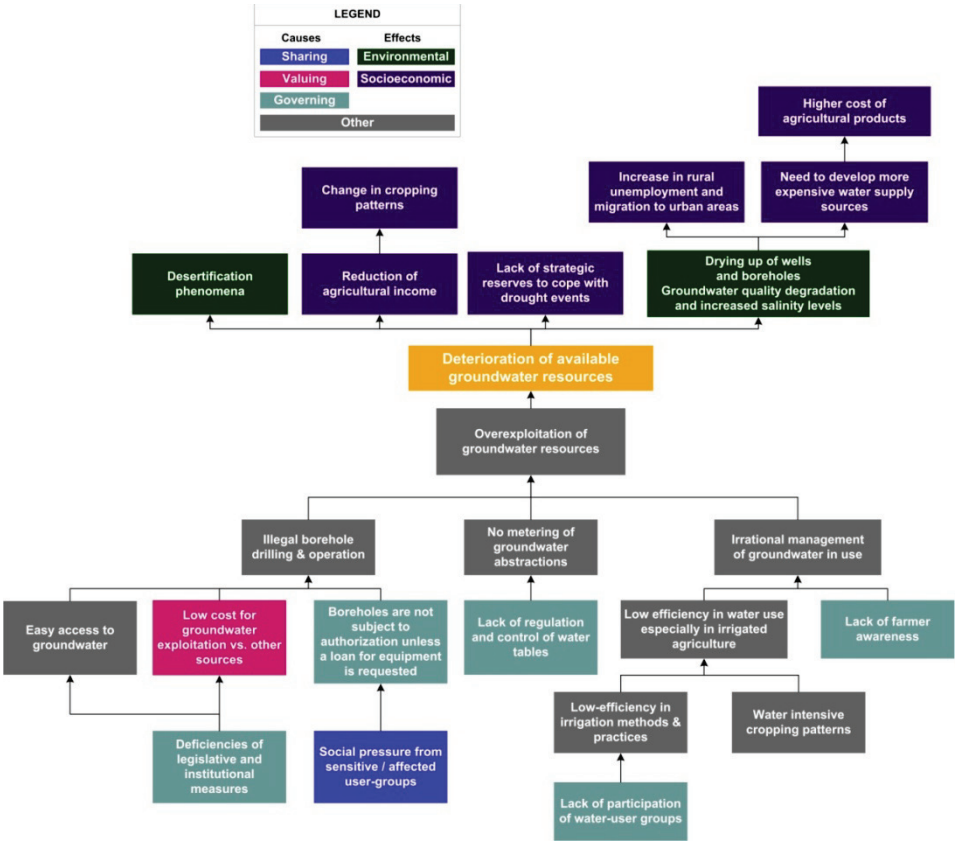

Figure 1. Problem tree analysis of the causes and effects of the deterioration of available groundwater resources in Tunisia

In addition to the above, a workshop questionnaire was used for mapping perceptions on the weight of the different causes and effects of the issue at hand. The most significant results of the survey can be summarized in the following:

- The majority of respondents agreed that the sector where action is needed immediately is agriculture (82% of replies). Overexploitation to meet increasing tourism demand is not perceived as significant (18% of replies).
- The most significant underlying causes to groundwater degradation are: (a) the lack of joint agreement and planning for groundwater extractions, and (b) the lack of awareness on efficient water use practices. Additional causes perceived as important are the limited enforcement of legislation on abstraction limits and the inefficient mobilisation of water users and the general public towards water conservation.
- All respondents perceive that public participation is the key for the successful implementation of policies. Effective methods could entail: (a) advisory committees, including experts and representatives of water users, and (b) public hearings and meetings for fostering the exchange of view on policy development and planned projects.

During the workshop, seven (7) main policy approaches and instruments were discussed. These were further ranked by the respondents of the survey, using a scale ranging from 1 (least effective) to 5 (most effective). Ranking results are presented in Fig. 2, and portray the pertinence of economic instruments in addressing the issue at hand.

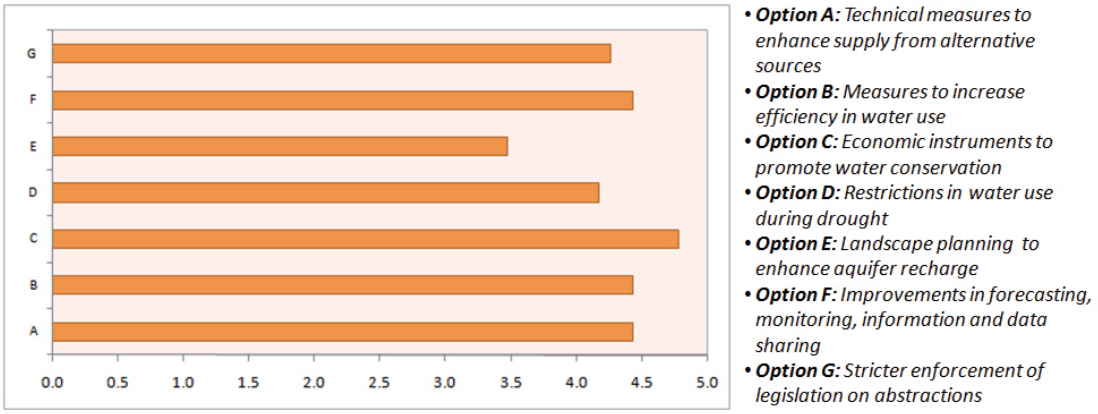

Figure 2. Ranking of instruments/approaches for achieving more sustainable management of groundwater resources

2.3 Definition of policy objectives

The outcomes of the "Problem Analysis" stage were subsequently used for the definition of policy objectives and the formulation of proposals on instruments that could be applied to attain these. The "problem tree" was further elaborated to define a set of key policy objectives, towards the main goal of **"Achieving regulated and rational use of groundwater resources"**, incorporating the views and goals of all stakeholders.

Two main policy objectives were defined through this process: (a) the control and regulation of groundwater abstractions, including licensing and operation of new boreholes; and (b) the rationalized use of groundwater in irrigated agriculture. Furthermore, and as all the consulted parties supported (i) the introduction of new water supply sources, such as treated wastewater, as means for substituting

freshwater use for crop irrigation, and (ii) the participative management of water tables, suggested options were also oriented towards the promotion of reuse in irrigated agriculture and the reinforcement of end-user participation in decision-making. These are outlined in the following paragraph.

2.4 Identification of instruments for mitigating groundwater overexploitation

Currently, the **monitoring of groundwater abstractions**, both public and private, is undertaken by the CRDAs. Authorisations for borehole drilling and the corresponding permits are provided by the CRDA if drilling depth is less than 50 m; otherwise, the drilling permit should be issued by the Ministry of Agriculture. No limits for borehole drilling are imposed unless there is clear evidence that the water table has been overexploited. An inventory of groundwater abstraction points has already been developed at the regional level. However, there is clear evidence that the enforcement of the corresponding penalties and fines in case of overabstraction from existing boreholes is rather slack, mostly due to social reasons. Furthermore, easy access to groundwater leads to the drilling of illegal boreholes, which cannot be easily controlled by the relevant authorities. It therefore becomes evident that regulation and control can only be achieved indirectly by developing (a) economic instruments, aimed at discouraging groundwater use; and (b) institutional reforms, shifting responsibilities to communities and empowering them to manage groundwater exploitation and use, especially outside irrigated perimeters where alternative supply is not available. There would be requirement for a legal establishment of public property rights for groundwater. Economic instruments can further address reform of irrigation water pricing policies with the aim to increase groundwater use costs, either by introducing abstraction charges or by increasing the cost of groundwater exploitation, e.g. through an increase of energy pricing in the agricultural sector. The objective could be further pursued through surface water supply charges, where surface water supply is available. It should be ensured that irrigation prices are not lowered significantly, in order to not encourage water waste, or that the reform is complemented with other policies, aimed at improving efficiency in irrigation water allocation and use.

The Government of Tunisia, within the framework of an overall strategy for promoting water saving, is taking specific measures to **enhance efficiency in irrigation water allocation and use**, in the form of financial assistance to those who apply improved irrigation methods. Currently modern irrigation techniques are applied in 70% of public irrigation schemes, and there is a significant effort for reinforcing awareness and training through appropriate campaigns and initiatives. As prices of cereals experienced a continuous increase, there could be shift to less water-intensive crops (e.g. rainfed wheat), if subsidies and tax incentives are applied. The results of undertaken policy measures (encouragement towards water saving and change of cropping patterns, rationalization of water tariffs, efficiency improvements in hydraulic infrastructure) are expected to become evident after 2010, through a decrease in irrigation water consumption. Furthermore, a change in the allocation of available supplies is to be expected, according to economic and social considerations.

Wastewater reuse is considered extremely important in the effort to meet the increasing demand in agriculture, industry and tourism, as projected water needs cannot be satisfied by freshwater resources alone. Estimates based on current urban growth patterns and change in land-use project that a total volume of 480 hm^3 of

treated wastewater will become available in 2030. This volume represents 10% of the total mobilized resources and can allow the irrigation of 100,000 ha. However, reuse can only be possible and beneficial if (a) specific standards are set for effluent quality, depending on the type of crop irrigated; and (b) funds are provided for the development of conveyance networks from wastewater treatment facilities, which in their majority are located near urban centres, to irrigation perimeters, separate distribution networks at the perimeter level, and facilities for inter-seasonal storage. The significant capital investment for infrastructure development cannot be recovered, as this would render the use of other, cheaper, water supply sources (namely groundwater) preferable. Furthermore, efforts need to be complemented with training of farmers and extensive awareness campaigning to improve acceptability by users and the general public. Currently, the **artificial recharge of overexploited water tables** with treated wastewater has not been extensively developed. Experiments and assessments prove that if this measure is to be practiced, the quality of treated wastewater should be improved through tertiary treatment, to eliminate all risks of contamination and further quality deterioration of available groundwater supplies.

The encouragement of **community groundwater management** is an option that is seriously considered both at the regional and national level. Efforts are being undertaken to promote the sharing of responsibilities and the participation of all users through the Agricultural Development Groups. The real involvement of users in the decision-making process and in the day-to-day management, rehabilitation and maintenance of hydraulic infrastructures requires a long and resource-intensive process for building human and technical capacity. In this regard, there is need for: (a) enhancing awareness and education; (b) providing further encouragement for the establishment of Agricultural Development Groups through the appropriate legislative reforms, and (c) foreseeing the development of institutional instruments for wider coordination and cooperation among the institutions involved.

2.5 Option prioritization

The prioritization of suggested instruments was implemented through a survey, aimed at evaluating the feasibility and applicability of different institutional and economic options. The step was implemented from February to June 2008, and involved the distribution and completion of a survey for ranking ten (10) broad categories of instruments. The survey was aimed at evaluating the feasibility and applicability of suggested responses, taking into account the local and the national water management context, current conditions and priorities, and future challenges facing the water sector. Results are summarized in the spider chart of Fig. 3. The main outcome was that answers from different stakeholder groups converged with regard to the solutions of the problem under discussion. Instruments and approaches that seemed to be most relevant and applicable comprise public participation in combination with decentralization of irrigation management and enhancement of regulatory approaches (stricter liability rules, command-and-control measures). Voluntary schemes are also considered relevant and applicable, given the current institutional framework. Stakeholders expect that their combination with stricter enforcement of the pertinent legislation could provide the basis for the development of effective policies to address both current and future water management challenges. Water pricing, as well as measures that would impose additional economic burden on water users, are not favoured when compared to other soft

approaches; it can be thus be argued that socio-economic considerations and broader agricultural policy goals are reflected both in the perceptions of the different water user groups, and of secondary stakeholders.

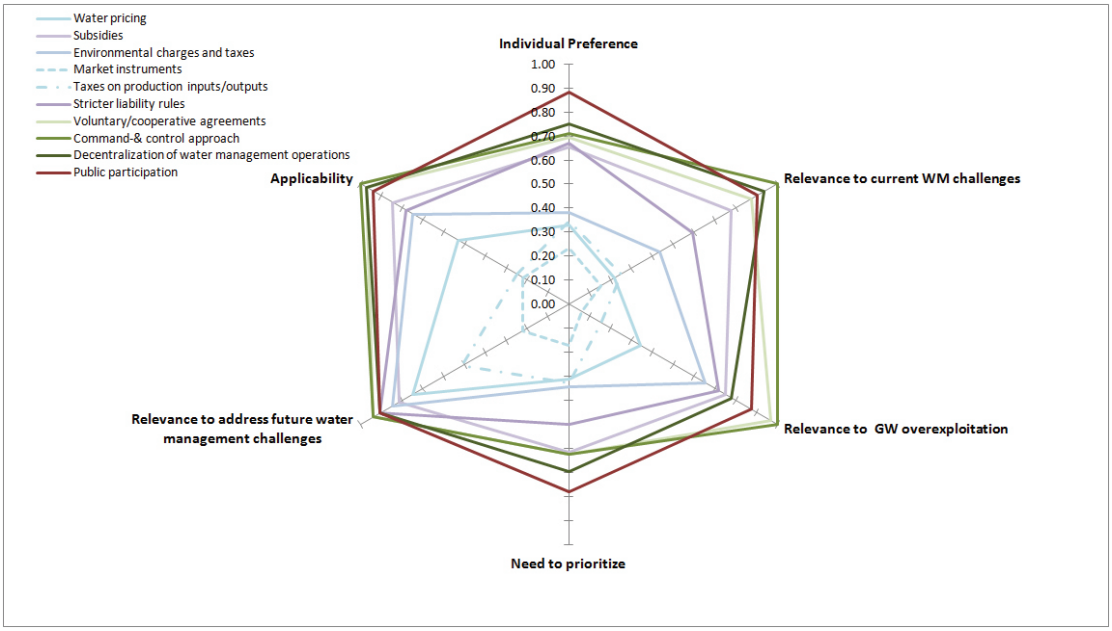

Figure 3. Prioritization of instruments for addressing current and future water management challenges

2.6 Outlining policy pathways for mitigating groundwater overexploitation in Tunisia

The overall process of evaluating potential policies for mitigating groundwater overexploitation was complemented through a last step, aimed at: (a) mapping perceptions and sharing views on prerequisites and (b) elaborating on further considerations for the implementation of proposed approaches. This step ran from November 2008 up to mid January 2009. Overall 70 stakeholders from different bodies and organizations (public, NGOs, Universities specializing in water-related issues, research centres, CRDAs, the ONAS, the INGREF, etc.) were contacted. Thirty-six (36) persons responded by completing the survey, representing all major secondary stakeholders and affected user groups. The outcomes of the survey were further discussed with the CRDA of the Nabeul Governorate and representatives of ONAS on 21/01/2009. Results presented in the following paragraphs relate to: (a) approaches towards demand management in the agricultural sector (i.e. ways of incentivizing water saving and changing demand patterns), (b) limitations and constraints in the regulation of groundwater abstractions, and (c) ways of fostering public participation and enhanced stakeholder involvement in decision-making processes.

Implementing demand management in the agricultural sector

The increase of productivity in water use, incentives towards water saving and mechanisms for phasing-out specific, water intensive and low value uses are of particular relevance to groundwater overexploitation. Alternative policies for demand regulation and management can entail: (a) the provision of (additional) incentives for efficient water use, and (b) mechanisms for addressing drivers of water demand and eliminating specific water uses that exert significant pressure on the public water

supply system and/or vulnerable water resources. Overall, the Case Study stakeholders believe that margins to reduce water use in agriculture are limited, particularly with regard to crop choices. A potential increase of water tariffs to discourage water waste or the levying of taxes as means to raise revenue for financing technology shifts receive limited acceptance; there is much concern over the affordability of water-related charges, as well as widespread belief that all efficiency improvements should be financed through other means (e.g. the general budget). Compensation for abandoning the cultivation of low-value, water intensive crops, but in line with the framework of the National Agricultural Policy, is preferred. It is generally considered that efficient water allocation policies require a strong social component, so that the interests and resources already invested in unsustainable water uses would not be compromised.

The issue of groundwater abstractions' regulation

As discussed above, the acceptability of control through regulation (e.g. ban on water abstractions; police control of discharges) is high. However, additional considerations may arise from the: (a) lack (or ineffectiveness) of procedures for licensing groundwater exploitation; (b) limited empowerment and capacity of public authorities and/or lack of political commitment, resulting also from socio-economic considerations and concerns; (c) inherent difficulties in enforcement, due to the large number of private boreholes operating in specific areas; and (d) social acceptance, as often effective control meets fierce opposition from owners of traditional, customary access rights. Overall, the enhanced regulation of individual groundwater abstractions is both accepted, and considered feasible to a large extent. Alternatively (or additionally), the problem could also be addressed through the development of collective systems instead of individual water supply. In the latter case the main question lies in how costs will be shared among users and the society. Within the framework of this Case Study, stakeholders underlined that corresponding costs would need to be partially socialized, in order to maintain acceptability and affordability, considering also that additional incentives should be offered to users, so as to substitute individual (private) with collective supply.

Enhanced stakeholder involvement and public participation

Enhanced involvement of stakeholders and water users, especially farmers, in decision-making is always identified as a key priority in the effort for the protection of groundwater bodies and enhancing the efficiency of irrigation practices. Stakeholder perceptions on how user involvement and public participation should be pursued are diverse, based on the common viewpoint that current efforts need to be strengthened. Approaches range from enhancing the involvement of the general public and water users, to the strengthening of the role of NGOs in pursuing inclusive processes and to awareness campaigning and reinforcement of civic responsibility.

It is also considered that efforts should be primarily based on the disclosure of information on significant water management issues, as only decision-makers currently have adequate access to sufficient data.

3 CONCLUDING REMARKS

In response to the observed trends in aquifer depletion, the Tunisian government has initiated efforts towards the mobilisation and safeguarding of water resources;

however, population growth, urbanisation, and the expansion of agriculture activities have led to uncontrolled situations. The approach adopted by the INECO project for dealing with the water stress problem, and the steps followed in the elaboration of cause-effect and objectives trees, have contributed to an in-depth analysis of the issues at hand. The participatory process adopted through targeted surveys and stakeholder workshops enabled the open exchange of ideas and solutions among persons who encounter water stress and groundwater management problems on a day-to-day basis; it also offered alternative perspectives of the problem, based on the elaboration of real solutions and options that can be useful, applicable and acceptable for determining suitable strategies for the mitigation of the problems faced.

Results from stakeholder consultation and workshops support a set of main options identified by the project, including the regulation and control of groundwater abstractions, the promotion of water reuse, efficiency improvements in irrigation water use and also strengthening the overall socio-economic and institutional environment. Answers indicate strong support for measures related to water saving, and particularly towards improving efficiency in irrigation, including the encouragement of different cropping choices by the government, the provision of assistance to big water consumers for water saving, and the adoption of water saving standards for new irrigation areas. Concerning public involvement and participation in water resources management, responses indicate that public participation is currently insufficient but very much desired; there is also support for cooperative agreements among water users concerning environmental taxation and charge systems. It is also clearly evident that access to information is considered insufficient by the majority of stakeholders questioned, and that the accessibility and relevance of available information need to be improved. However, there is also strong preference towards the enhancement of command and control regulatory measures, the modernisation of management systems and enhancement of the organisational level. It is generally perceived that recommendations derived by INECO can contribute to the mitigation of the deterioration of groundwater resources, particularly in the Cap-Bon region, provided that authorities commit to the implementation of the necessary changes and that public participation and community management of resources are encouraged through capacity building initiatives and empowerment of water users.

REFERENCES AND BIBLIOGRAPHY

Abdelaziz M. (2006), General situation of information and knowledge on water in Tunisia.

Bear J., Cheng, A.H-D, Sorek,S, Ouazar,D and Herrera I., eds (1999), Sea water intrusion in coastal Aquifer-Concepts, Methods and Practices, Kluwer academic, Dordrecht, The Netherlands.

DG/RE (1998), Long-term strategy for the water sector of Tunisia eau XXI.

DG/RE (1994), National network of Piezometers of Tunisia.

Hamza M., Khanfir R (1991), Potential and groundwater resources Evaluation in Tunisia, DG/RE.

Mekki H. (2007), Water resources management in Tunisia.

Mekki H. (2006), Presentation by DG/RE in the Water Directors' Conference of Euro-Mediterranean Countries and South-East Europe, Athens, 6-7 November 2006.

Ministry of Agriculture and Hydraulic Resources (1999), Water sector study, water sector strategic orientations and final report.

THE DEVELOPMENT OF RIVER BASIN MANAGEMENT PLANS IN CYPRUS: LESSONS LEARNT FROM THE PUBLIC CONSULTATION PROCESS

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EXTENDED ABSTRACT

The main water management issue faced in Cyprus today is the increasing water stress; the prolonged and frequent droughts, the high spatial variability in water availability and the increased water demand, particularly during the summer period, result in important problems both in terms of quantity and quality. Despite the intense past efforts towards water supply enhancement, there is still significant deficit in meeting domestic and irrigation demands. Furthermore, problems also arise from the decrease in river flows, the overabstraction of groundwater and the resulting sea-water intrusion in coastal aquifers, and from increasing pollution from diffuse and point sources. All the above issues are expected to exacerbate in the near future, as a result of climate change and the resulting increased frequency of extreme events.

Within the framework of the WFD implementation process, the Water Development Department is currently implementing processes towards enhanced public consultation and stakeholder involvement, according to the requirements of Art. 14. The first phase, which followed the identification of stakeholders, was implemented from April to October 2007. It involved extensive discussions with groups concerned on the design of public consultation processes, the time schedule for their implementation and decisions on required supporting measures. The second phase, implemented from December 2007 to June 2008, involved discussions on important water management issues and their prioritisation. The third phase, which will begin in October 2009 involves the discussion on the Draft River Basin Management Plan, the Programme of Measures, the Drought Management Plan and the formulation of proposals for a new National Water Management Policy.

From the early beginning of the process, the main goal was to reach, through extensive debate and participation, consensus on adopted solutions, while at the same time identifying feasible improvements to current water management practices. Specific objectives involved:

- The development of a transparent process for the formulation of River Basin Management Plans and water policies;
- The utilization of local experience and pexisting know-how of local authorities;
- Constructive dialogue with all stakeholder groups (farmers, local authorities etc.) so as to gain insight on local issues and develop innovative solutions;
- The timely identification of potential conflicts and their alleviation to arrive to an integrating and inclusive approach;

- The sensitisation of the public on environmental issues.

The main tools employed to foster stakeholder involvement and public participation involved: (a) the development and maintenance of a dedicated web page (www.wfd.wdd.moa.gov.cy); (b) the establishment of working groups on various issues (17 meetings have been held so far with different stakeholder groups); (c) exhibitions; (d) conferences; (e) workshops; (f) the production of relevant fliers and (g) the development and completion (on line and individually) of a dedicated questionnaire for prioritising issues and exploring potential areas of intervention.

All the above, revealed that currently the main concerns are related to: (1) water supply availability; (2) ensuring good water quality for the different uses and the environment; (3) the water pricing policy; and (4) rational and effective water management. Table 1 outlines the results of the questionnaire on the importance of the different water management issues.

Table 1: Prioritisation of significant water management issues – Outcomes of the relevant questionnaire

Ranking	Prioritisation of significant water management issues	%
1	Potable water shortage	85
2	Groundwater overabstraction Irrigation water shortage	75
3	Administrative issues inhibiting sustainable water management Diffuse pollution from agricultural sources Safeguarding of protected areas Pollution from urban wastewaters	70
4	Pollution (industry, mines, stormwater) Water pricing Geomorphological changes Impacts on coastal waters	65
5	Development patterns /Swimming pools/Golf cources Liability for the current situation	8
6	Water losses / Need for rehabilitating old distribution networks Environmental impacts / climate change Water intensive cropping patterns	<3

Respondents to the relevant survey further identified the main factors contributing to the water management issues perceived as most significant. Groundwater overexploitation was primarily attributed to water use patterns (76%) but also to the lack of legislation and enforcement mechanisms (66%) and administrative/organisational problems (51%). Water shortage was considered mostly due to natural conditions and constraints (65%), administrative/organisational problems (63%) and lack of infrastructure (52%). On the other hand, water pricing issues were, as expected, also attributed to administrative/organisational problems (63%) and to the lack of a regulatory and legislative framework (49%).

Potential interventions to alleviate and mitigate current issues involved the enhanced use of recycled water (90.5%), behavioural change and reinforcement of public awareness towards water conservation and responsible use (87.8%), enhanced use

of desalinated water (81.9%), further investment on water conservation (60.7%), improved practices by professionals (farmers, industrialists, etc.) for water pollution prevention (62.5%), and water price increase (44.1%).

Working groups were formed at regional level and focused primarily on the evaluation of significant water management issues. They had significant contribution in refining the relevant WFD report and in identifying potential measures for the next implementation phase, further allowing the identification of conflicting interests on the allocation of water resources, the local development pattern and potential water pricing and cost sharing policies. Their work will continue in the next phase, towards the identification of measures for the POM; suggestions received so far are related to:

- New legislation, defining water as a public good and not a resource that can be subject to private exploitation;
- Institutional issues, involving the establishment of an Independent Water Entity, responsible for the management of water resources at national level;
- Demand management, through: (a) the registration of private boreholes and the continuous monitoring of all abstractions; (b) the provision of incentives for the change of cropping patterns; (c) the identification of leakages and the reduction of losses in distribution networks; (d) higher fines and sanctions for wasteful water use;
- Supply enhancement, through: (a) the wider use of recycled water for irrigation purposes; (b) the re-evaluation of development policies (e.g. golf courses); (c) rainwater harvesting;
- Development of economic incentives for water saving appliances and water pricing (prices should be fair but they should also discourage water waste);
- Education by intensifying awareness campaigns and public participation processes.

So far, the implementation of this process has underlined its importance at national, regional and local level, and highlighted the role of Mass Media for disseminating information and raising public awareness. In the future, emphasis will be placed on bottom-up approaches, involving local meetings in large communities, and more events at regional level, so as to allow the strengthening of public involvement at local level and the reinforcement of citizen initiatives for water conservation and environmental protection. Furthermore, future plans involve the distribution of simplified surveys to target groups instead of the general public, in order to gain more insight on specific issues; more time and effort is also to be invested in working groups, as it is considered that they can lead to the development of win-win solutions based on experience and knowledge. Important factors of success as identified so far refer to the clear definition of the role of the different groups during the various stages, and to political commitment for the implementation of commonly agreed solutions and measures.

COPING WITH WATER STRESS IN THE OUM ER RBIA BASIN, MOROCCO

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ABSTRACT

This paper, prepared within the framework of the INECO project, is aimed at providing and analysing information in support of the stakeholder engagement process towards the identification of policy pathways for the regulation of water use, focusing particularly on agriculture, in the Oum Er Rbia River Basin, Morocco. The River Basin, the water resources of which are of strategic importance to the country, is facing significant and increasing water stress. The pertinent conditions are analysed and discussed so as to enable the identification of instruments and priorities for problem mitigation, as well as the constraints and prerequisites for implementing the options identified.

The information assessment presented herein was primarily achieved through extensive stakeholder consultation, in meetings and survey applications. The stakeholder preferences and suggestions have, overall, underlined the need for engaging into Integrated Water Resources Management schemes with particular focus on demand management and the fostering of farmers' participation in decision-making, in an effort to promote initiatives and facilitate the introduction of new technologies and methods in irrigation water use.

1 INTRODUCTION

Morocco is an arid to semi-arid country, with a fragile endowment of water resources. Water availability is greatly influenced by the pronounced inter-annual and seasonal variation of precipitation and the heterogeneity in its spatial distribution. This has a major effect on the national economy, where agriculture plays an important role. To address problems related to the increasing disparity between water supply and demand, the State undertook several actions, such as regulation of water flow, development of an extensive irrigation network, inter-basin transfers to ensure water supply in large cities, and engagement in a National Debate on water-related issues, with the aims to further promote the involvement of stakeholders and identify future policy directions for improved water management.

The Oum Er Rbia Hydraulic Basin, located in the mid-west part of Morocco is a River Basin of strategic importance for the country, which has already been the focus of important investments in hydraulic infrastructure. The Basin provides water to the strategic economic zone of Morocco (Tadla, Doukkala and the inshore zone Casablanca-Safi), sustains important economic activities (industry and agriculture), and hosts a significant share of the country's population. Currently, the Basin faces various natural and technical constraints, mostly concerning the sustainability and

availability of water in terms of both quantity and quality. The most important of these comprise: (a) the overexploitation of groundwater resources, due to overpumping but also to reduction in precipitation; (b) water quality deterioration; (c) low efficiency in water use; and (d) increased requirements for flood protection. As the largest part of available water resources has already been exploited, there are limited alternatives for increasing water supply; in this regard, the Oum Er Rbia Hydraulic Basin Agency focuses its efforts in regulating the demand for different water use sectors, and particularly in agriculture, which is the major water use.

Within the above framework, a Case Study was developed in the area, focusing on the definition and analysis of alternative policy instruments through stakeholder engagement processes. The Case Study focused on the issue of limited efficiency in irrigation water use, underlined as extremely significant by local decision-makers and water users. Currently, losses in the irrigation distribution networks of the Basin are estimated at 20%; however, water losses due to the applied irrigation methods and practices are of the order of 50%, whereas the agricultural land equipped with advanced irrigation systems is estimated at only 10%. In this regard, it becomes evident that additional measures need to be implemented for water conservation, in order to foster changes in water use patterns. Employed methods and tools, as well as outcomes from this Case Study, which followed the overall methodological approach adopted in the INECO project, are outlined in the next sections of this paper.

2 THE STAKEHOLDER ENGAGEMENT PROCESS: MAIN OUTCOMES

The INECO approach towards the development of a participatory process for discussing alternative institutional and economic instruments to address water management issues was based on the Objective Oriented Project Planning method, which is similar to the Logical Framework Approach. This method has been used to frame discussions with stakeholders, focusing on a water management problem that is commonly perceived as significant (focal) in the region of interest.

In the Oum Er Rbia Basin, this overall process was articulated through individual (preparatory or consultation) meetings with key stakeholders (decision and policy makers, representatives of key water users), a workshop open to stakeholders and all citizens concerned, surveys, discussion fora, and dedicated questionnaires. Throughout the process, emphasis was given to inform stakeholders of all outcomes and replies of other parties. Subsequent sections present the outcomes of each stage, focusing on “Problem Analysis”, the “Identification of priorities and instruments for problem mitigation” and the “Identification of policy pathways for implementing prioritized options”.

2.1 Stage 1: Analysis of the focal problem of “Water stress in the Oum Er Rbia River Basin”

The first stage of the developed process concerned the identification of key stakeholders, with a role or interest in irrigation water management, these being:

- Authorities involved in the management of water resources at the River Basin level (River Basin Agency) and at the local level for the management of irrigation perimeters (ORMVAs).

- Representatives of important users, such as farmer associations, and major industries.
- Professionals dealing with various issues related to irrigation water management.

The first workshop, open to all parties, was held in Afourer, near Beni Mellal, on March 21st 2008, in close collaboration with the Oum Er Rbia Hydraulic Basin Agency. The event brought together representatives from all institutions dealing with water management in the area. The workshop's primary aim was to elaborate on the problem, through the development of a "Problem Tree", describing the causes and effects of the issue at hand in a qualitative way. The event also offered the opportunity for a first exchange of views on policy objectives and potential options, whereas through a dedicated questionnaire, participants expressed their views on the relevant significance of the problem, and the importance of its effects and primary causes.

During the workshop, stakeholders were first asked to validate a preliminary "Problem Tree", drawn on the basis of previous consultations with the Oum Er Rbia Hydraulic Basin Agency (Fig. 1).

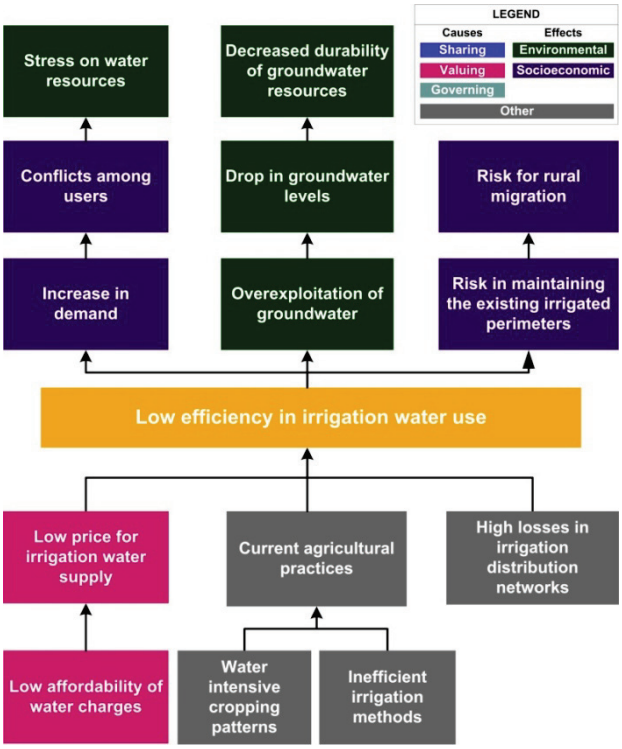

Figure 1: Problem tree analysis of the causes and effects of low efficiency in irrigation water use in the Oum Er Rbia River Basin

According to the diagramme of Fig. 1, the focal problem is related to the limited efficiency in water use in the agricultural sector. The problem stems from increased demand, combined with high losses, especially in irrigation distribution networks and through the current irrigation and agricultural practices (non-efficient irrigation methods and water intensive, non-economically sustainable cropping patterns). In addition, discussions during the workshops revealed the "sharing", "valuing" and "governing" challenges faced in irrigation water management and use. With regard to "water sharing", water available for irrigation is shared with municipal uses and is also used for hydroelectricity production. In the latter case, the intermittent nature of

flow for hydroelectricity, for meeting peak energy demands, causes problems in downstream irrigation. In this regard, and as the value of water in hydroelectricity is higher, it is necessary to ensure that the operational rules of the dam are known and understood by farmers, so to appropriately schedule irrigation programmes. In addition, the current economic incentives provided by the State for the installation of modern irrigation systems are not adequate, whereas there are obstacles to policy implementation which can possibly be overcome through the reinforcement of water user associations, to act as intermediaries between users and decision-makers.

2.2 Stage 2: Identifying instruments and priorities for problem mitigation

Following from the validation of the "Problem Tree" of Figure 1, workshop participants discussed on key policy objectives that should be pursued for enhancing efficiency in irrigation water supply and use, on the basis of the preliminary "Objective Tree" of Fig. 2. As depicted from the Objective Tree, the achievement of the main goal requires application of advanced irrigation methods, potential change of cropping patterns and rehabilitation of existing irrigation networks of facilities. Furthermore, reform of water pricing policies needs to be examined, taking into account affordability constraints and wider societal implications.

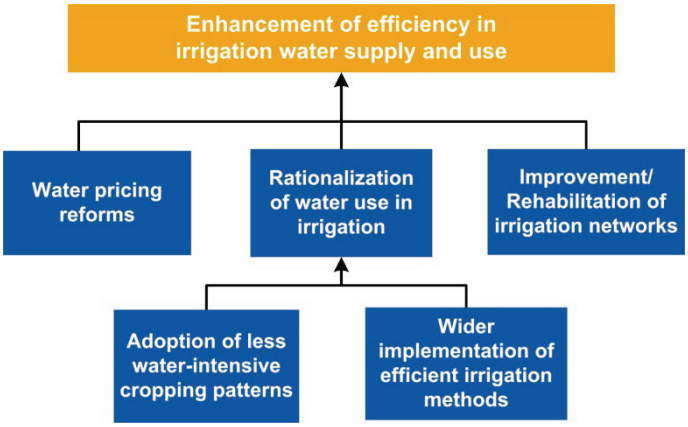

Figure 2: Objective tree for the enhancement of efficiency in irrigation water use in the Oum Er Rbia Basin

According to the views of local stakeholders, users and authorities, these preliminary objecttives are inherently linked to:

- The strengthening of economic incentives already provided to farmers for implementing modern irrigation methods and rehabilitating irrigation equipment (**Objective A**);
- The strengthening of the overall framework for water management in the area, addressing empowerment and capacity building of farmer associations, to facilitate technology uptake and participation in decision-making processes (**Objective B**).

The next section outlines "soft" responses that were suggested by stakeholders for achieving these objectives, taking into account constraints and outlining ways of overcoming deficiencies of already adopted policies towards water conservation.

Water saving in irrigated agriculture

Water conservation in all sectors, but primarily in irrigated agriculture is the backbone of any effort for demand management in the Oum Er Rbia Basin, and in Morocco in

general. Currently, important subsidies have been put in place to encourage shift towards modern irrigation methods, but their effectiveness has been rather limited. Potential options that would be further explored to address the issue at hand concern required changes in the funding programme already in place, as well as the overall strengthening of water saving programmes in the Hydraulic Basin.

Overall, decision-makers argue that the impact of policies targeting the agricultural sector can be extremely significant. Irrigation demand can be reduced as much as 30% through rationalization in scheduling, implementation of advanced methods for irrigation water delivery and field application, and change of cropping patterns.

In addition to the strengthening of financial incentives, there is also need to inform farmers and decision-makers on the wider economic benefits from improved water use practices. Assessments are required on the economic value of water in irrigated agriculture and the avoided costs from programme implementation. Outcomes on economic benefits for farmers should be effectively communicated to water users, so as to facilitate the uptake of incentives offered.

Economic and particularly cost recovery policies need to re-examine the issue of cost allocation among different users and regions that share the same hydraulic infrastructure (storage reservoirs and conveyance networks). It is pointed out that costs relating to the maintenance and rehabilitation of existing infrastructure need to be shared more equitably among water users, taking also into account the wider economic, environmental and social benefits of the different uses involved.

Strengthening the socio-economic and institutional environment

The significant progress of the water sector is manifested by the enhanced effectiveness of water management operations at all functions. However, deficiencies still exist at local and regional level, requiring the implementation of further initiatives for capacity building and enhanced participation.

The establishment of the Basin Agencies (ABHs), starting from 1999, provided a boost in water management in the country, helping at better coordinating water management efforts at regional level. Stakeholders perceive that the role of the ABHs must be strengthened in order to avoid overlaps between institutions and agencies and help alleviate conflicts over water allocation and use. In addition, public participation and stakeholder involvement in decision-making need to be fostered in two ways: (a) through the strengthening of water user associations: and (b) through the enhanced involvement of politicians, researchers and users (farmers, ORMVAs, professional associations, etc.) in the design and implementation of demand management policies, so as to ensure commitment from all parties to decisions taken.

Additional means to improve the overall water management framework concern the building of the capacity required to ensure technology uptake and introduction of new plans and methods for demand management. The positive experience gained in the provision of urban water services points out the need to further encourage public-private partnerships. Other proposals concern the development of a “strategic tracking unit”, for assimilating experience from practices adopted in other areas and transferring these to the local context and particularities.

2.3 Stage 3: Identifying policy pathways for implementing prioritized options

The evaluation of policy approaches for water stress mitigation was implemented through a last step, aimed also at investigating prerequisites and implications of alternative (regulatory and incentive-based) approaches towards water conservation. The process was articulated through individual interviews with local authorities and major water users, including the Oum Er Rbia Hydraulic Basin Agency (ABHOER), the local Regional Offices for Agricultural Development of Tadla (ORMVAT) and Haouz (ORMVAH), the National Office for Electricity (ONE), the National Office for Potable Water Supply (ONEP), the Regional Directorate for Agriculture (DPA) of Beni Mellal, and the Agency of the neighbouring Souss-Massa Hydraulic Basin.

The outcomes of this step are presented in the following paragraphs, which elaborate on issues relating to: (a) incentives towards water saving and water conservation in irrigated agriculture; (b) cost recovery and cost sharing; and (c) ways of enhancing stakeholder involvement and public participation in decision-making.

Incentives towards water saving – Water conservation in irrigated agriculture

Means employed to provide incentives for the adoption of improved water use practices could entail the enhanced application of volumetric charges, the development of financing mechanisms to provide aid to those who decide to invest in new technologies, and also the introduction and enforcement of mandatory technology standards for new buildings and irrigation schemes. All approaches proposed are favourably viewed by the majority of stakeholders. An increase of water charges, even in irrigation, would be supported, provided that it would be at “logical” levels. Interviewees further underline the role of the State in the reform of pricing principles and policies. Grants and financial aid towards those who invest in water saving are already applied for the change of irrigation methods. Stakeholders note that this effort needs to be strengthened, as small-scale farmers, who constitute the majority, cannot afford the cost for the installation of new systems, even with the important subsidy of 60%. On the other hand, there are also supporters of the view that grants and subsidies should not be the primary mechanism for water saving, and that users should be encouraged through other policy approaches.

The enhanced efficiency in irrigation water supply and use is the main policy objective, inherently linked to sustainable water management in the Oum Er Rbia Basin. In this regard, questions set forth to the interviewed stakeholders concerned the possibilities to further enhance efficiency in water use, adaptation of crop choices to water availability, ways of promoting a more efficient way of sharing available water supply among the different water users, and social equitability of water conservation programmes, especially with regard to small-scale, subsistence agriculture. Overall, there is agreement that there are significant margins for improving efficiency in irrigation water use, focusing on irrigation methods, systems and distribution network efficiency, choice of crops and water reuse. The majority further perceives that different cropping choices need to be encouraged by the State, under the broader perspective of national policies and taking into account market conditions, profitability for the farmers and the need to preserve water resources. However, they further point out the need to convince and educate farmers to that direction. The free trading of water use rights among farmers is controversial: Stakeholders in support of this alternative underline that any similar framework needs to be integrated with national policies and legislation, respecting the fact that water is

a public good, and that access to the resource needs to be guaranteed at all times. Prerequisites towards any endeavour to enhance efficiency in water allocation concern the training of farmers, the establishment of Water User Associations and the building of the capacity required to sustainably manage water resources at the users' level.

Cost recovery and cost sharing issues

Stakeholders, in their majority, support the view that operation and maintenance costs for all water-related infrastructure should be recovered by the users, according to the overall costs they incur to the system. However, capital intensive projects, such as additional hydraulic infrastructure or significant network expansions and rehabilitation programmes, should be funded by the State. Mechanisms to that end can involve direct funding, through dedicated programmes or use of revenue from water-related charges. The different use sectors should be charged differently according to the priority in use, the user's income and ability to pay. In the agricultural sector, a distinction would be preferable, depending on the type of crop, but also on the outputs (farming vs. cultivation of high-value export crops). Views concerning the fairness, equity and transparency of the current cost recovery systems are diverse: the current framework for drinking water supply and sanitation is considered both equitable and fair. However, overall, the system is perceived as partially transparent: users know which expenses are covered by each tariff component, but have limited knowledge on how the different charges are in fact calculated, in relation to the condition of infrastructure and water consumption. Overall, full cost recovery is not accepted by several stakeholders, who consider that partial financing of water services is required, particularly for supporting infrastructure development in basins that face more difficult water stress situations than others.

Public participation and stakeholder involvement

Current efforts for improved water management at the regional and national level, stress on the need to involve all those with a role or interest in water management in the planning and decision-making process. All the parties involved underlined the importance of public participation in achieving good governance and integrated water management and the need for commitment from all parties to ensure the success of undertaken efforts. Public participation is broadly perceived as open and transparent dialogue on all aspects concerning water management, among users and their associations, decision-makers, elected representatives, and the general public. Involvement is envisaged not only for a specific subject/project, but also during the planning process, the elaboration of new legislation, the definition of levies and water-related charges. In the case of agriculture or rural supply, it further extends to the development of partnerships for the management, service and maintenance of facilities, and also entails the organization of users through associations (professional and civil), so as to ensure their representation in the decision-making process. Overall, respondents were rather confident that the outcomes of participatory processes would be considered by decision-makers, stressing the role of the Basin Agencies for the strengthening of means to ensure successful representation of all user groups. They further noted that participation processes need to become more inclusive, integrating farmer associations, trade associations and groups that have not been yet consulted.

3 CONCLUSIONS

The significant water stress faced in Morocco has motivated a shift towards Integrated Water Resources Management, encouraging a global vision that integrates technical aspects, policy coordination and diverse interests and opinions among the different players. Demand management is currently the main pillar of water management policies, with particular focus on irrigated agriculture, which is the main water use and a significant production sector, both in terms of economic output and employment.

The Oum Er Rbia Hydraulic Basin, which is the area where the first Hydraulic Basin Agency was established, has been in the focus of many research and demonstration projects dealing with agricultural water use. The recognition of the significance to better coordinate decisions has dominated water management decisions at regional level. Efforts to strengthen the role of water user associations and to develop fora for debate on water management plans are gradually starting to yield important results for future policies in agriculture and water management.

In INECO, the developed open forum managed to bring together decision-makers from all important institutions of the area and farmer representatives. Results portrayed that stakeholder engagement needs to be further pursued, by providing an open floor to farmers to express problems they face in the day-to-day reality, in order to arrive to an effective implementation of water management decisions and programmes. Within the effort to promote water saving, further attention should be paid to bureaucratic issues and to effective communication in order to facilitate uptake of initiatives, ensuring that farmers receive the background information required to engage into similar programmes. In this regard, and as pointed out during various events and research efforts, the role of water user associations as intermediaries, is crucial for more inclusive and meaningful participatory processes.

WATER PRICING POLICIES IN CYPRUS

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EXTENDED ABSTRACT

This presentation deals with the implementation of article 9 of the Water Framework Directive (2000/60/EC) in Cyprus. One of the main innovative elements of the WFD lies in the introduction of economic principles and tools as the fundamental tools for attaining environmental objectives. The economic analyses of the WFD focus on the characterisation of main water uses, the identification of water services, of investments targeting the water sector, the analysis of cost sharing mechanisms, and the estimation of current cost recovery levels for water services, taking into account financial costs (including capital costs for existing and foreseen investments), but also environmental and resource costs. The WFD further requires transparency of cost recovery mechanisms, through the identification and reporting of subsidies provided to the water sector and cross-subsidies among different uses and users.

Water pricing policies are described by the Directive as a main instrument for achieving the environmental objectives set. As defined through Art. 9, prices and cost recovery mechanisms should reflect the value of water but they also need to:

- Provide appropriate incentives towards efficient water use;
- Be set in a way that the different water uses adequately contribute to the cost of water services, taking into account the “polluter-pays” and “user-pays” principles.

The WFD does not explicitly require Member States to ensure full cost recovery of water service costs, but a fair and transparent way of sharing these among the different uses. Member States can adjust pricing policies according to local social, environmental and economic impacts of cost recovery, taking into account local conditions (climatic, geographical, environmental, economic and social), and justify deviations for specific areas or activities, depending on local circumstances. Pricing policies should not compromise access to basic water services, but focus on being equitable, effective in providing incentives, and developed in a transparent way. According to the provisions of Art. 9, Member States should develop pricing policies based on the above premises by the end of 2010; furthermore, water pricing has been advocated as one of the main instruments for coping with water scarcity and drought in the relevant EC Communication of 2007.

Currently, water pricing policies in Cyprus distinguish between surface and groundwater supply:

- In irrigation, and for surface water supplied by the Government Water Works or from Irrigation Divisions and Associations, water supply is metered, and volumetric rates are applied. Current water prices recover a large share of financial costs, whereas high rates are applied in case of overconsumption.

For groundwater supply, financial costs are borne by the users and concern borehole drillings, distribution networks, pumping costs etc.

- Domestic water supply is provided by the Government Water Works, by Water Boards in the main metropolitan areas and by local authorities (municipalities). Pricing is volumetric at all supply points and all quantities are metered. At the user level, water tariffs follow the Increasing Block Tariff structure.

The work undertaken in Cyprus so far has focused on the completion of the work required for the implementation of Art. 5. Work towards the implementation of Art. 9 first involved the collection of data and their organisation into a comprehensive and easily updatable data management system. Alternative proposals are currently under development and assessment with regard to their local impacts; they will be set at the table for public consultation and extensive discussion, to arrive to a proposal that is accepted and perceived fair by all parties concerned.

TOWARDS ENHANCED POLICIES FOR ADDRESSING WATER QUALITY DEGRADATION IN THE BARADA RIVER BASIN SYRIA

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ABSTRACT

Economic and institutional instruments analysed in the Case Study presented in this paper are related to water pollution issues faced in the Barada River Basin in Syria. The Barada River, which traverses the Greater Damascus Area, receives high loads of industrial and domestic waste and wastewater exceeding the river's self purification capacity. The state of the river is aggravated by the decrease in river flow, resulting from rainfall decrease and the use of the Feige Spring for drinking water supply. Water pollution has caused the collapse of the Barada river ecosystem, which also sustains the large forest of "Ghouta", a cultural heritage area and environmental hotspot in the region.

In response to the above issues, the Case Study processes outlined in this paper identified policy instruments that could be applied by the government and the local authorities in collaboration with water users, so as to address the issue at hand. These address: (a) the enhancement of human resources at all administrative and decision levels and of the awareness of water users through education, best practices, and technology transfer; (b) the encouragement of industries to relocate to designated zones, (c) the introduction of a “water pollution tax” for those who caused damage to the water resources or not treat their wastewaters; (c) institutional reform, so as to address the issues of responsibility fragmentation, and the establishment of a Higher Committee for monitoring all activities and operations that affect the water resources of the Basin; and (d) the encouragement of farmers to shift to modern irrigation technologies and the launch of awareness campaigns on best management practices in agriculture.

1 INTRODUCTION

The Barada Basin is located in the southwest part of Syria, and stretches from the western mountainous part of Damascus, including Sheikh and Kalamon Mountain in the north, to the Qunatera and Jolan highlands in the south and from Lebanon in the west to the Syrian Desert in the east. Covering an area of 8,630 km², the Basin can be divided into two distinct regions based on geomorphology: (a) the mountainous area in the north-western mountain range and (b) the plain comprising the Ghouta oasis and surrounding areas.

The Basin includes the prefectures of Damascus and parts of the Rural Damascus, Darra and Sweida prefectures (70%, 11% and 19% respectively). The total population is more than 4.5 million inhabitants, accounting for approximately 30% of

the total population of Syria. Population growth rates vary between 1.68% in the city of Damascus and 4.48% in other, rapidly developing zones of the Basin.

Being the area where the capital of Syria, Damascus, is located and, therefore, the area that hosts a significant share of economic activities, the River Basin faces serious environmental issues. According to the list of policy priorities set by the Ministry of Local Administration and Environment, an immediate action plan should be drafted and implemented in order to address local water pollution issues. At present, and with the exception of Damascus city and few suburban areas, all settlements discharge their wastewater onto land or in the two main rivers of the Basin. The disposal of significant volumes of solid waste contributes to contamination, transforming the river bed into a waste bank. Furthermore, and with the exception of some large, rather new, factories, nearly all of the wastewater generated from industrial activities is discharged without prior treatment to the Barada River. It is estimated that the BOD resulting from industrial effluents only is 12.5 ton/d. Added to this, there is significant disposal of toxic chemical products, primarily from lead industries and battery manufactories. Although groundwater contamination has not yet been confirmed, it is quite probable as aquifers are recharged by river water.

In the above context, a Case Study was implemented in the area, aimed at formulating a policy proposal through dialogue and evaluation of alternative policy instruments among stakeholders, decision-makers and citizens concerned over the experienced environmental degradation. The Case Study followed the overall methodological framework implemented in INECO; in addition to fostering dialogue, adopted processes also offered an opportunity to build more informed processes for water management, and to develop policy recommendations for addressing a complex issue, affected by different policies concerning land use and industrial development.

2 THE CURRENT INSTITUTIONAL FRAMEWORK – STAKEHOLDER ANALYSIS

Water management in Syria falls primarily under the authority of the Ministry of Irrigation. The Ministry is responsible for developing water resources and for guaranteeing the availability of water of suitable quality to all water use sectors. In the above framework, the responsibility of issuing permits for domestic and industrial discharge has also been allocated to the Ministry of Irrigation. However, other Ministries are involved in the different functions:

- The Ministry of Local Administration and the Environment, through the corresponding Governorate authorities, issues licenses for discharge in the sewerage system.
- Within the Ministry of Housing and Construction, the Drinking Water Directorate is responsible for planning, designing and constructing municipal drinking water treatment plants and distribution systems. The Sewerage Management Directorate is responsible for the development of sewage collection systems in urban areas and municipal wastewater treatment plants. Once the facilities have been developed, responsibility for operation and maintenance is allocated to regional and local authorities.

- The Ministry of Industry (MoI) is responsible for all industrial activities, public and private.

According to the existing legislation, in the event of non-compliance with discharge regulations, the Ministry of Irrigation is the authority responsible for taking appropriate action. At present, actual enforcement is almost non-existent, due to a lack of funds, as well as broader economic and employment considerations. On the other hand, the staff of the Ministry of Local Administration and Environment (MoLAE) is being trained to enforce Environmental Impact Assessment (EIA) requirements; however, there is no legal basis for enforcement, as the pertinent legislation is still lacking.

Overall, and with regard to decision-making, it can be argued that the strong centralization of water management responsibilities results in reduced flexibility of local water authorities. Furthermore, there is a slight overlap in responsibilities, which requires the implementation of coordination, and data and information exchange mechanisms.

Particularly with regard to the Barada River Basin, efforts undertaken in order to address the problem remain incomplete due to: (a) the inadequate enforcement of environmental law, (b) legislative limitations, and (c) lack of environmental awareness. In addition, the spatial dispersion of micro- and small-scale industries hinders the effective control over discharges. It can thus be argued that the current lack of an integrated environmental management approach, specifically targeting the industrial sector, is an important cause to the problem. The lack of joint strategy and concerted action is partly due to bureaucracy, but also to the lack of expertise and experience in dealing with such issues.

3 PROBLEM ANALYSIS

The first step of the developed process involved the implementation of a workshop, open to all actors and authorities involved in water quality management in the Barada River basin. The workshop, which was held in September 2007, brought together, among others, representatives from the Damascus Governorate, the Directorates of the different Ministries involved in water management, municipalities of the area, professional associations and NGOs. Participating stakeholders were asked to validate a preliminary “Problem Tree”, drawn for the purposes of the workshop, which is presented in Fig. 1.

According to the problem tree diagramme, on a first level, causes to the problem comprise the discharge of untreated sewage and industrial effluents. Illegal connections to networks and arbitrary disposal of sewage onto lands in the vicinity of populated areas, resulting also from the lack of infrastructure, are rather common. With regard to industrial wastewater, the pertinent legislation imposes pre-treatment prior to discharge to the sewerage network. However, sometimes industrial wastewaters are mixed untreated with municipal wastewater. The current agricultural practices, which often involve the uninformed and uncontrolled excessive application of fertilizers, contribute to the exacerbation of the problem: nitrate and ammonia ion concentrations in some wells in the Damascus countryside have exceeded the standards for drinking water quality. Overall, the current water pricing system can be considered inefficient, as sewage collection and wastewater treatment costs are not fully charged to the users. Furthermore, costs for industrial wastewater treatment are not recovered, whereas fines for exceeding the current discharge standards are not

applied. Presently, the decreasing ability of industry to pay wastewater fees, the poor management and maintenance of industrial wastewater treatment plants, the lack of systematic, periodical monitoring and poor law enforcement play an important role. The limited financial resources and capacity of water and wastewater service providers, resulting also from poor cost recovery, inhibit the expansion of existing sanitation programmes and the implementation of new ones. Additionally, erosion of existing sewerage systems, also resulting from poor maintenance, is often reported.

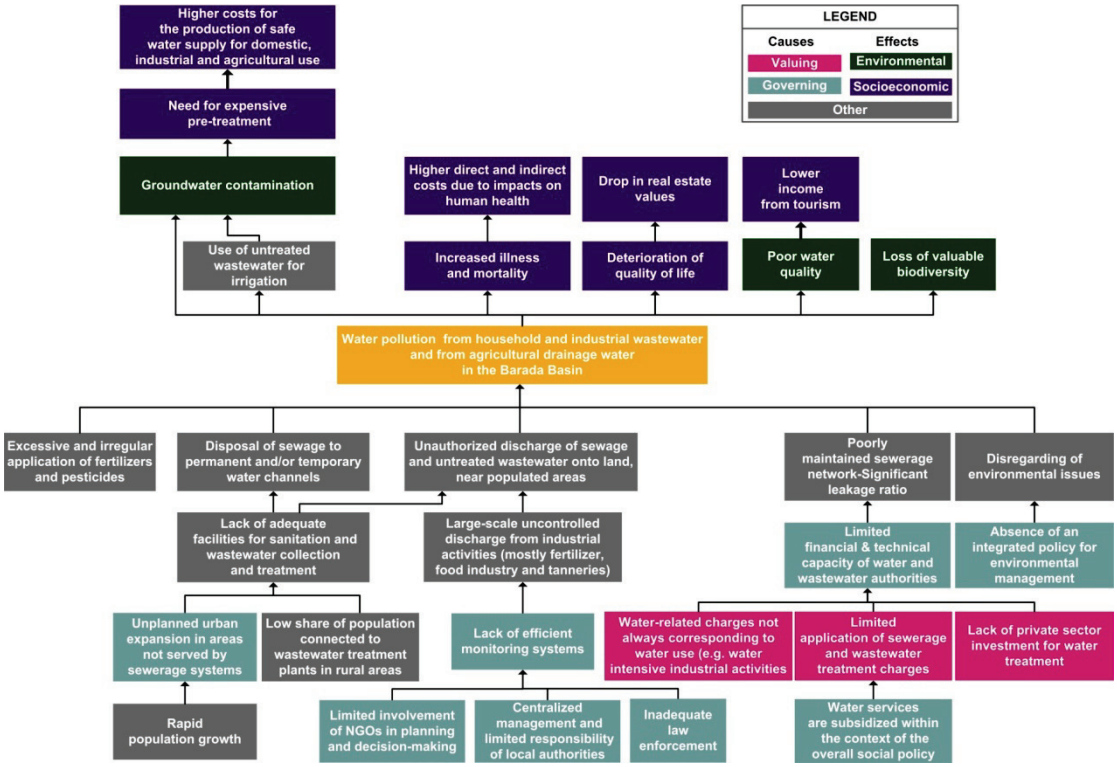

Figure 1: Problem tree analysis for water pollution in the Barada River Basin

4 DEFINITION OF POLICY OBJECTIVES AND IDENTIFICATION OF INSTRUMENTS FOR PROBLEM MITIGATION

In the second stage, a series of meetings were held with stakeholders and actors that participated in the workshop, as well as additional groups that expressed their interest to join the process. These meetings were aimed at (a) consolidating the problem analysis of the previous workshop; and (b) identifying key policy objectives which should be pursued for problem mitigation. In this stage, the developed “Problem Tree” was used to identify and develop policy objectives for mitigating the issue at hand. The resulting “Objective Tree” was further elaborated to define a set of key policy objectives, to achieve the main goal of water pollution mitigation and water quality improvement, incorporating the views and goals of all stakeholders participating in the process. Overall, at the end of this process which involved consultation meetings, four key policy objectives were identified, as well as potential options towards their achievement. These are presented in the following paragraphs, which also comment on barriers that have (or could) inhibit the implementation of suggested responses.

Objective A: *Industrial pollution prevention and control*

The majority of stakeholders consulted within the framework of INECO have agreed that industrial pollution prevention and control is presently one of the key objectives that need to be pursued. The Government of Syria has initiated a programme for relocating polluting industrial activities in a new area, outside of Damascus. However, the incentives provided are not considered adequate by the users, and there is delay in the implementation of the programme. Additional motivation, as suggested by industrialists, can be provided through preferential prices for water, electricity and wastewater treatment in the designated industrial zone. Stricter enforcement of the existing legislation on discharge standards is an option in line with the overall policy directions. On the other hand, the introduction of stricter standards (for emissions but also for technologies in specific industrial processes) will impose an additional economic burden to the industrial sector if it is not combined with other (economic) incentives. The designation of additional protected areas along the Barada River, in order to protect vital ecosystems and/or abstraction points can also be favoured. Although effluent charge systems could be applied, they would require an enhanced knowledge base, as well as significant institutional reforms for the development of the corresponding form of institutional organization at the River Basin level. As Environmental Impact Assessments are gradually being introduced for new facilities, the development of assurance regimes, targeted at specific, new industrial activities can be a valuable tool providing additional incentives for the adoption of environmentally friendly practices.

The key issue for ensuring the environmental protection of the River and its tributaries, without compromising industrial growth, is the **encouragement** of businesses towards environmental protection. To that end, voluntary agreements with specific (polluting) industrial sectors can provide appropriate incentives on two levels: (a) ensuring compliance with existing legislative provisions and (b) providing further incentives for industries to reduce emissions to levels below the standards. Motivation provided can be in the form of grants, low interest loans or tax rebates, continuous training of personnel on improved practices or through eco-labelling schemes.

Objective B: *Regulation in the use of agrochemicals*

The current agricultural practices are not considered major contributors to the degradation in river water quality. However, and taking into account the deterioration of groundwater quality in the rural parts of the basin, stakeholders pointed out the need to explore instruments that could support farmers in rationalizing the application of agrochemicals. Suggestions included indirect taxation of similar agricultural inputs, voluntary agreements with farmers to reduce agrochemical use, promotion of organic farming in the Barada area, and dedicated training programmes through WUAs, supported by the Ministry of Irrigation.

As to purely economic instruments, indirect taxation on agricultural inputs (fertilizers, pesticides and herbicides) is unlikely to produce concrete results, as it would require strong regulatory capacity to ensure that the increased production cost is not transferred to the final consumer. However, encouragement can primarily be provided through information campaigning, awareness raising and training of farmers on best management practices in agriculture. Such initiatives can be further elaborated to promote organic farming in the River Basin, through targeted subsidies.

The establishment of voluntary or cooperative agreements between farmers and water management authorities can be a promising instrument. This would require raising the financial resources necessary for payments compensating the loss of agricultural production resulting from restrictions in the application of agrochemicals. On the other hand, compensation payments can be lower than the increasing cost for producing safe drinking water (samples from wells in the area reveal very high nitrate concentrations and therefore alternative water supply sources should be developed).

Objective C: *Institutional reforms and capacity building of the water sector*

As outlined above, the multiplicity of authorities and actors involved in urban planning and the issuing of permits for industrial activities is a significant impediment for the development and effective implementation of coordinated policies for water pollution prevention and control. Given the intensity of the problem, there is need to pursue concerted management and integration of functions among all Ministries involved. This can be achieved through:

- The establishment of one authority responsible for the implementation of all policies in the Barada River Basin, and/or through
- The establishment of Inter-ministerial committee, for the better coordination of actions among authorities.

Similarly, there is need to enhance the knowledge base on water quality and quantity issues; it is therefore proposed to develop the corresponding inventories on platforms that are shared by all authorities involved in authorization and monitoring. Along the same lines, regular campaigns targeting specific categories of users (e.g. tanning industry) and the general public can be implemented in order to raise awareness on (a) pollution prevention, and (b) the need to pursue the protection of the river through governmental policies but also through citizen initiatives. Finally, there is need to develop and empower Water User Associations, in order to support the enhanced involvement of water users in the decision-making process.

5 OPTION PRIORITIZATION

The first step towards the evaluation of suggested responses was their prioritization by local stakeholders, on the basis of a set of predefined criteria common to all the INECO Case Studies. The step was implemented from February to June 2008, and included the distribution and completion of a survey for ranking ten (10) broad categories of instruments. Prior to the distribution of the surveys, several consultation meetings were held and continuous contact was pursued to answer queries and provide expert support. Results omes are summarized in the spider chart of Fig. 2.

The main was that answers from different stakeholder groups converged with regard to potential policy instruments. Most relevant approaches comprise strict legislation enforcement in combination with financial encouragement through subsidies and other forms of financial aid. There is preference for voluntary agreements, and possibly for introduction of environmental charges and taxes. With regard to the currently applied (or potentially applicable) instruments, opinions and suggestions can be summarized in the following:

- The ‘polluter pays’ principle should be implemented, possibly in combination with incentives for environmentally friendly practices.

- Subsidies are required to create additional incentives for the relocation of industries, and for encouraging businesses to invest in water-efficient equipment, reduce water usage and improve water quality.
- There is need to support technology transfer in the agricultural sector, through education and training. Specific measures should be taken to support small and medium-scale farmers.
- A more effective water pricing system would enable authorities to recover costs relating to water supply provision; however clear distinction needs to be made between industrial, agricultural and residential water use. An institutional and legislative reform would be required to provide more liberty to water and wastewater authorities in establishing water tariffs.
- Costs relating to borehole and well licensing need to be flexible, and adapted to the state of the exploited groundwater body.

Strict legislation enforcement is considered by far the most effective way of addressing the problem; however, distinctions between the public and the private sector need to be eliminated, so as to enhance transparency in the system.

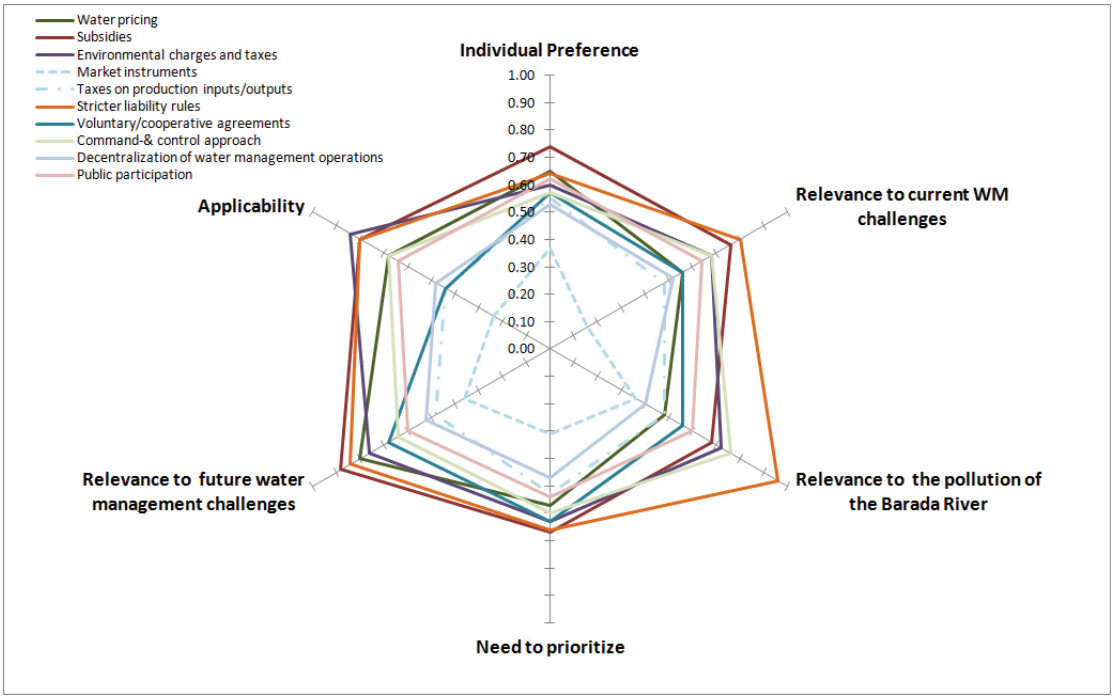

Figure 2: Prioritization of instruments for addressing current and future water management challenges

6 OUTLINING POLICY PATHWAYS FOR INDUSTRIAL POLLUTION PREVENTION AND CONTROL

The overall process of identifying potential policies for mitigating water pollution in the Barada River Basin was complemented through a last step, aimed at mapping perceptions and sharing views on prerequisites and further considerations for industrial pollution prevention and control. The step was implemented through individual interviews with decision-makers from the ministries involved and from the Water Resources Directorate of Damascus.

Stakeholder views were diverse with regard to the affordability of compliance costs to stricter emission/technology standards. Overall it is believed that such costs would be affordable for major industries and those that address the local market only, as the competitiveness of the sector will not be compromised. The case is however different for the majority of small and medium scale enterprises, which would probably not afford advanced wastewater treatment or industrial process change. In this case, the transition of the industrial sector should be helped through grants and soft loans, but with due consideration to specific conditions.

The imposition of dedicated taxes to those who continue to pollute and the use of the generated revenue to finance investment for those who reduce pollution is not accepted by the majority. It is perceived that revenues will not be sufficient to have notable effect. Instead, it is supported that other measures need to be prioritized, such as: (a) restoration of water courses and aquifers; (b) strict enforcement of the law; and (c) validation and updating of data on water quality and availability and on pollution sources. Additionally, it is also noted that environmental compliance costs would be reflected in the market prices of end-products, negatively affecting small and medium enterprises and favouring large businesses.

It is further widely believed that industry does not have the technical and the managerial capacity required. Technical change (rehabilitation, modernization of equipment, change of processes) also needs to be pursued through development of expertise, implementation of dedicated training programmes, and transfer of know-how from private companies and other countries, more experienced in the field. Eco-labelling and award schemes are also regarded positively, as they would allow signaling efforts towards environmental protection to society, at least in the early stages. Such programmes would however be effective only if combined with intensified efforts to raise societal awareness. Respondents with positive view of such schemes point out the role of mass media in enhancing public acknowledgement on the wider benefits to the environment and consumer health.

The rather widely adopted EU policy of socializing water-related external costs through dedicated taxes and charges collected by special purpose authorities is provisionally accepted. It is further believed that the participatory element in defining cost-sharing principles has to be tested on the ground and that education and awareness campaigning are required beforehand. Those who consider the process not applicable stress the fact that instruments should be adapted to the Syrian tradition and reality and take into account current economic and social limitations.

As also underlined from the previous step of the Case Study development process, control through regulation is widely accepted. It is generally believed that the State has the means necessary to identify pollution sources and the political willingness to enforce the pertinent legislation on polluters. Other responses however stress the following dimensions:

- The needs of communities and enterprises are not well known. Efforts are thus required to fill data gaps to allow more informed decision-making, as well as elaboration and enforcement of regulations;
- Regulation needs to be complemented with wider dissemination of traditional practices for the protection of water sources, so as to raise societal awareness on water-related issues;

- There are often problems in enforcement, due to the uncontrollable nature of the problem. These should be addressed in an integrated way, by also developing other alternatives.

An alternative way to allow more effective prevention of individual (insufficiently treated) industrial discharge would be the development of collective schemes for wastewater treatment. Such efforts are already under implementation in the industrial city of Adra, and gain support by most of the decision-makers. However, for remotely located industries, other more cost-effective solutions should be examined, even if these are temporary. It is generally argued that the cost of such systems should be primarily shared between water authorities and users, in order to ensure acceptability of the option and maintain affordability. Some respondents point out that private investors in general should be charged at full cost.

7 CONCLUDING REMARKS

Mitigation options for coping with the serious environmental issues encountered in the Barada River Basin, as identified through the INECO processes, address the whole spectrum of water related issues present in the area; they are targeting the minimisation of pollution from industrial effluents through engaging into the 'polluter pays' principle and to environmental friendly practices, the regulation of the use of agrochemicals, the rehabilitation or enhancement of existing infrastructure, and the strengthening of the socio-economic environment through public and institutional empowerment.

As response to the options identified, focus needs to be placed on developing policies and strategic planning frameworks for the water sector, targeting short, medium and long-term objectives. Priorities need to address the introduction of cost recovery policies (respecting affordability concerns), the regulation of agricultural water use and crop production patterns, decentralization of responsibilities and coordinated efforts to reduce overlap between different bodies and governmental agencies. The training of experts on new technologies, transparency and information sharing, as well as the increase of public awareness on water saving practices at household level are essential in promoting holistic and integrated water management.

The water management issues analysed for the Barada River Basin reflect the overall conditions, concerns, and responses also at national level. As with the above mentioned responses, the national water management strategy needs to focus on strengthening public involvement, adopting new economic and technical instruments in the sectors of industry and agriculture, and planning for interventions at administrative and institutional level. Starting from the latter, comprehensive management of water resources is regarded essential for coping with the water stress issues faced nationwide. Therefore, the need for further training the employees of the relevant authorities in water management initiatives, so as to update them with the new applicable standards, is essential. Focus also needs to be placed on strict legislation enforcement when water regulations are violated, and on reforms for placing water use rights under the supervision of the competent authorities.

EFFORTS TO ADDRESS WATER QUALITY DETERIORATION IN THE BAHR BASANDEILA CANAL, EGYPT

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ABSTRACT

This paper presents the work undertaken by International Consultants-Egypt within the framework of the INECO project ("Institutional and Economic Instruments for sustainable water management in the Mediterranean Region"). INECO was a Coordination Action project, funded by the 6th Framework Programme of the European Commission (Contract No: INCO-CT-2006-517673). Its primary aim was to formulate guidelines on institutional and economic instruments adaptive to specific water management issues encountered in different Mediterranean areas. Project processes involved a strong participatory component, with the overall goal to establish a local and inter-regional network of stakeholders, through the development of regional Case Studies.

The Case Study developed for Egypt within the framework of this project focused on water quality deterioration problems experienced in the Bahr-Basandeila area of the Dakahlia Governorate. The degradation of water quality of the pertinent canal, which seriously affects the quality of drinking water supply and impacts on population health, reflects the conditions experienced throughout the Nile distribution network. The relevant Case Study, which was developed on the basis of the overall INECO methodological approach, was primarily aimed at fostering discussions among citizens, stakeholders and local water management authorities, in order to identify deficiencies and suggest instruments that could assist in addressing the underlying causes to the issue. This paper summarizes the main outcomes, as derived through local workshops, consultation meetings and dedicated surveys. It concludes with broader policy considerations for addressing water quality degradation, highlighting the importance of governance reforms and of introducing new policy instruments for addressing the main drivers that contribute to the exacerbation of water-related problems at local and broader contexts.

1 INTRODUCTION

Water quality degradation is becoming alarming in Egypt. A recent study revealed that industrial facilities are directly discharging polluted wastewater in the Nile at an annual rate of 100 million m³. These facilities produce fertilizers, chemicals, oil, soap, iron, steel, sugar, cement, and petroleum products. As can be expected, the mid-stream conditions of the Nile are still, on average, at a fairly clean level due to the dilution and degradation of the discharged pollutants. The riverbanks, however, are much more polluted. Inefficient production in some industries (e.g. oil and soap) generates waste that contains raw material as well as products, a costly burden to

the national economy and the consumer. Evidently, efficient production would reduce pollution. Cleaner production, defined by UNEP's Industry and Environment Program Activity Center as “the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to humans and the environment”, is emerging as the primary solution to industrial pollution in Egypt.

The problem of water quality degradation is exacerbated by the alarming increase of discharge rates of municipal and domestic waste. In the rural areas, which accommodate about half of the population (35 million persons), 95% of households does not have access to sewer systems or wastewater treatment facilities. Septic tanks are the most common disposal facility, where excreta and a limited amount of sludge water can be collected for biological digestion. The digested excreta leach into the soil surrounding the tank, thus subjecting shallow groundwater to pollution.

In urban but also in rural areas, the occasional primary treatment of sewage is considered insufficient to prevent further deterioration of vital water streams. Furthermore, secondary treatment cannot be satisfactory to provide the quality of wastewater required for reuse or for preventing further pollution with pathogenic bacteria and other microorganisms. In the Nile Delta, Bahr-El-Baqar is an example of highly polluted waterway. Furthermore, the mixing of drainage water with freshwater for irrigation purposes imposes risks to public health.

In the above context, the INECO project pursued the development of Case Study on water pollution in the Bahr-Basandeila region, located in the Dakahlia Governorate. In this, rather small, area there is increasing concern over the degradation of water quality in the local canal, which is used for drinking water supply. Lack of infrastructure for sewage treatment, inefficient provision of water services, pollution from industrial effluents, and possibly excessive use of agrochemicals have led to water quality issues similar to those encountered throughout the Nile distribution network. The following paragraphs describe the main tools employed for the development of the Case Study and the main outcomes of each stage of the process.

2 MAIN OUTCOMES FROM THE CASE STUDY DEVELOPMENT PROCESS

2.1 Situation analysis

The Basandeila Region is located in the Dakahlia Governorate, and includes three large villages: El Hawadaia, Damlash and El Gawadia, in addition to 16 smaller ones. The total area of the region is 5739 feddans, whereas the cultivated area is 5524 feddans, representing 96.3% of the total. Currently, the area hosts around 45,000 inhabitants. The canal network that covers the region originates from the Bahr Basandeila Canal and has a total length of 12 km, whereas the drainage network length is about 8 km. The main water supply source is the Bahr Basandeila Canal, which receives water from Bahr Shibin, from El Rayah El Abbassy Canal, and from the Damietta Branch of the River Nile. The Bahr Basandeila Canal is located at the end of Bahr Shibin Canal and is used for the irrigation of a cultivated area of around 3000 acres in Basandeila village, which, according to recent estimates, has a population of 25,000.

The area experiences significant water quality problems. Concentrations of BOD and COD in canal water range between 4 and 12 mg/l and 10 and 14 mg/l respectively.

Pollution from nutrients, originating from agricultural activities is not as important: measured concentrations are in the range of 0.02 to 0.2 mg/l, depending on the season. Quality measurements reveal that current water quality degradation results from pollution of domestic/industrial origin. Fig.1 presents the water quality index.

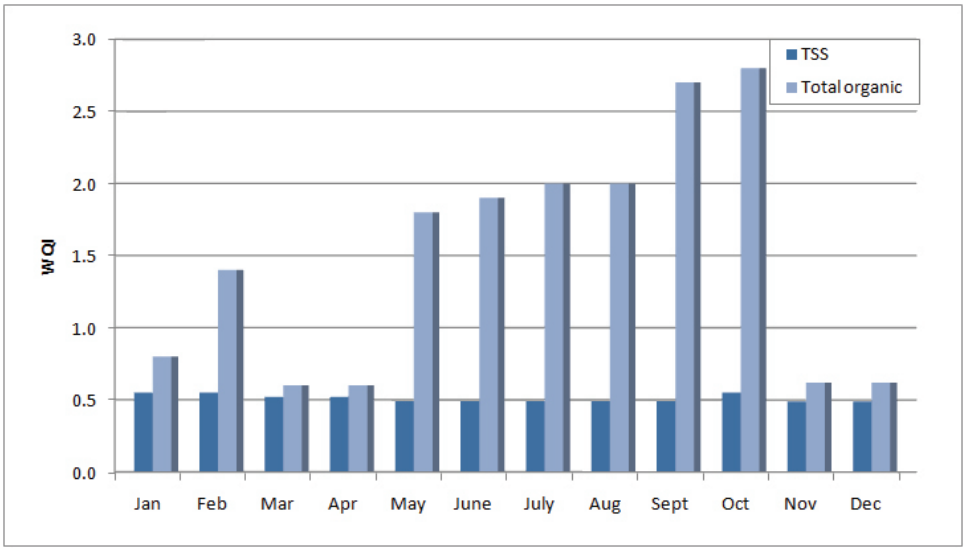

Figure 1: Water quality index for the Bahr Basandeila Canal (Ref. value = 1)

Currently, 84% of the total population of the area is connected to the sewerage network. 15% is served by septic tanks, while 1% of the total population discharges its sewage to open drains. However, houses that have been built illegally in the area cannot be connected to the sewerage network, and are not included in the estimation of the above indicators. Although sewerage coverage is acceptable according to the above official data, the current capacity for sewage treatment is inadequate. In fact, the proportion of the wastewater generated by the community that receives acceptable levels of treatment prior to discharge is only 27%. Furthermore, the peak volume of wastewater produced corresponds to 364% of the total capacity of wastewater facilities. It is additionally estimated that only 2% of all the manufactories that need to implement wastewater treatment is actually equipped with the corresponding facilities.

The degradation of surface water quality has a serious impact on population health. With regard to health incidents linked to inadequate water treatment and lack of sanitation, only in 2007 there were four outbreaks (typhoid, diarrhoea and gastroenteritis), each represented by more than 200 cases, with incidents being more acute during the summer. Overall, and despite the current efforts to provide safe drinking water through the installation of purification stations, it is estimated that only 65% of the total population has access to safe drinking water. The local water utility regularly performs the tests required according to existing regulations. However, only 80% of the total tests of treated water per year comply with the applicable standards.

2.2 Analysis of the focal problem of water quality deterioration in Bahr Basandeila region

From the early stages of the development of the INECO Case Study in the Bahr Basandeila area, it was realized that awareness and cooperation with local actors are milestones for addressing the alarming dimensions of water quality degradation in the area. For this purpose, and in order to foster the overall process and integrate existing research efforts from local institutions, three preliminary events were

implemented within the framework of INECO to strengthen cooperation and establish a dialogue platform, on 12/03/2007, 23/05/2007 and on 19/06/2007.

Following from these first stakeholder mobilization efforts, the main workshop event of INECO was organized in Mansoura, on July 21st 2007. The event was attended by 120 persons and was primarily aimed at discussing the issue at hand. The discussion involved the consolidation of a "Problem Tree" diagramme, illustrating the causes and effects of "water quality deterioration". According to this analysis (Fig.2), in the region of the Bahr Basandeila Canal, water pollution is mostly due to the discharge of industrial and municipal effluents without prior treatment. Furthermore, it was considered that current agricultural practices, which entail the excessive application of fertilizers and pesticides, result in high nutrient concentrations in the canal surface water. Large amounts of wastewater (domestic, industrial, and agricultural) are discharged onto land, and through run-off are transferred to the Damietta Branch of the River Nile, posing a threat on human health, agricultural production and the local ecosystem.

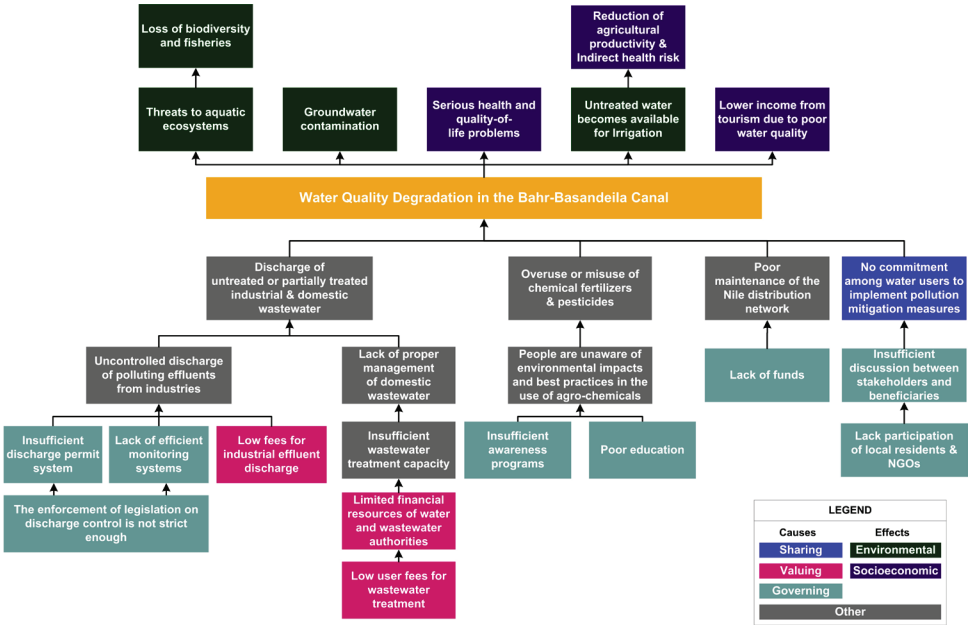

Figure 2: Problem tree analysis of the effects and causes of water quality degradation in the Bahr-Basandeila Canal

The workshop event was followed by a visit in the village of Basandeila, on July 22nd 2007, in order to discuss the pollution of the Basandeila Nile Branch with citizens and involve social actors and water management authorities. During the visit, it became evident that drinking water quality problems exist and can be associated with the state of the water distribution network. Participants jointly decided that local initiatives are required for addressing the quality problem, and discussed the following course of action:

- The Water Utility would check connecting pipes along the distribution network to ensure that there is no leakage or contamination of potable water with domestic sewage.
- Residents and local actors should help in identifying problematic areas and inform the Water Utility on the future needs of the region in potable water, so that the local capacity expansion plan is updated correctly.

- All actors should work to enhance awareness among local residents on ways to protect the waters of the canal (water intake), and discourage the disposal of domestic waste, sewage and residues from animal husbandry activities.

Suggestions, comments and issues raised formed the basis for the discussion on policy objectives and potential options, discussed in the following sections.

2.3 Definition of policy objectives and identification of instruments for problem mitigation

Following from the participatory consolidation of the "Problem Tree", individual consultation and discussion sessions were held with all local stakeholders and actors. These meetings were aimed at: (a) defining the key policy objectives that should be pursued for problem mitigation; (b) collecting additional suggestions on options that could be applied to attain the defined objectives. Firstly, the results of the previous stage ("Problem Analysis") were used to draw a preliminary "Objective Tree", translating the original cause-effect diagram to means-to-ends relations. This "tree" was then further elaborated to define a set of key policy objectives to achieve the main goal, incorporating the views of all stakeholders. Overall, at the end of this process, four key policy objectives were identified, as well as potential options towards their achievement, described below.

Objective A: *Control over the discharge of industrial effluents*

Currently, discharge permits for industrial premises are obtained from the Ministry of Health and Population (MoHP), which also periodically checks conformity to the terms of the permit. In case that violations are identified and there is no immediate danger for human health, the industry is given a 3-month grace period to comply with standards. All discharge to the Nile, irrigation canals, drains, lakes and groundwater requires obtaining a discharge license from the Ministry of Water Resources and Irrigation. Licenses can be issued only for the discharge of effluents that meet standards and each license specifies the quantity and quality permitted to be discharged. Fines are levied for unlicensed discharges and licenses can be revoked if industrial facilities fail to comply with standards after a grace period of 3 months. However, in spite of the considerable efforts undertaken, the actual enforcement for cases involving public facilities (state-owned industries and municipal wastewater), which are the main pollution sources, is almost non-existent due to: (a) lack of funds to comply with standards and (b) other economic and employment considerations. As Environmental Impact Assessment (EIA) laws are gradually being introduced, major industries are being visited due to non-compliance with wastewater treatment regulations. Compliance Action Plans (CAPS) are being agreed upon to obtain a grace period for compliance.

With regard to the particular area of Bahr Basandeila and the Governorate of Dakahlia in general, efforts and pilot actions can primarily concentrate on:

- The development of voluntary agreements, which have never been introduced or considered in the study area. In the Damietta branch, the major water pollution sources comprise the Talkha Fertilizers Factory, the High Serw Drain and the High Serw Power Station. It is noteworthy that industries would be willing to participate in an eventual voluntary scheme, if they are advised to its importance as a potential tool for water quality improvement.

- Additional economic incentives can be provided through the Environmental Fund, from where money from different sources is made available for environmental protection projects. Regarding the water sector, the fund provides soft loans to industrial firms for pollution abatement projects, such as recycling and reuse of treated effluents, as well as for setting up small-scale pilot demonstration projects.

Currently, legislative efforts concentrate on the reform of the system for effluent charges. Effluent fees are about to be increased fifteen-fold, according to a proposal awaiting legislative approval. The driving principle behind all reforms and efforts is that the strict enforcement of regulations would mean very large investments by industry and municipalities. Their enforcement is currently considered unrealistic and even counterproductive. In this regard, the focus is set on providing the appropriate combination of incentives to the industrial sector to comply with standards, rather than enforce these disregarding wider socio-economic implications and costs.

Objective B: *Regulated use of chemical fertilizers and pesticides*

Pollution from agrochemicals, and especially fertilizers, does not seem relevant for the Bahr Basandeila area, as the corresponding water quality parameters do not show significant contribution of agriculture to degradation of the canal water quality. However, during the consultation meetings and the workshop discussions, stakeholders showed particular concern over the excessive use of agrochemicals.

The suggestion is based on the building of management practice systems (i.e. combination of management practices), including structural works, such as waste treatment lagoons, terraces, sediment basins, fences to prevent run-off from the field, and agronomic measures, such as prescribed grazing, nutrient, pest and residue management etc. The main concern is how farmers can be encouraged to adopt such systems. In this regard, the introduction of voluntary or compensation schemes can be considered a promising option. Economic incentives can involve sharing of the corresponding costs with the local government or the water utility. The main consideration concerns education, training and awareness, through information and education programmes, campaigning on environmental issues and how they impact on own quality of life, and broader community support. Voluntary schemes or specifically designed financial assistance (e.g. grants, compensation payments, tax reductions/exemptions) have never been implemented in the past.

To that end, an additional option for the protection of the canal could involve the introduction of organic farming. The country has a well-developed and still rapidly growing organic sector. About 24,548 ha of land are under organic management, accounting for 0.72% of the country's total agricultural area. Organic production presently concentrates on about 500 farming enterprises. Major obstacles to that end comprise again the lack of education and training, to overcome the traditional practice of intensive cultivation on a relatively small agricultural area with a high rate of pesticide and fertilizer use.

Objective C: *Technical and financial sustainability of water services for reliable drinking water supply and sanitation*

A major issue of concern in the Bahr Basandeila area and the Dakahlia Governorate is the quality of drinking water supply and the reliability in its provision, as there are frequent interruptions. Ensuring access to water supply and sanitation is a national policy goal; however, in small urban centres and rural areas similar to Basandeila,

the sustainability of these systems is questionable if they are not further subsidized by the State. Full recovery of costs would have a vast impact on individual bills and may lead to serious social problems. It is estimated that recovery of operational costs only would require an increase of about 300% in water utility revenues. In this regard, all costs related to the rehabilitation and expansion of drinking water supply networks are provided through State funds.

Although tariff increases for generating adequate revenue to ensure the technical sustainability of the system cannot be fully considered, there are options for improving cost recovery at the level of water providers. A maximum level of tariff increase that would be tolerable is 25% of the current tariff. Furthermore, and despite the fact that presently all decisions related to water tariffs are under the control of the Government, there can be possibilities in differentiating among customers (e.g. depending on household income) by generating cross-subsidies, thus alleviating pressures from the poorer households.

Another issue that requires further attention is accountability in water service provision and disclosure of all information related to potable water quality. Presently, the complaints by customers regarding the provision of drinking water supply and sanitation services are submitted to local authorities and the People Council and not directly to the operators. Usually however, there is a positive reaction, depending on financing ability. A more direct approach would possibly facilitate communication and allow more immediate response to technical and quality problems.

Objective D: *Strengthening of the socio-economic and institutional environment*

Incentive-based approaches towards water pollution prevention and control are based on three milestones: (a) user and consumer awareness, (b) training and education and (c) financial/fiscal incentives. With regard to points (a) and (b), several actions are undertaken such as information campaigns regarding pollution from industrial sources, best management practices in agriculture. All these efforts have proven rather effective in the reduction of water pollution and water saving.

Furthermore, recent efforts have been undertaken for the establishment of user associations, especially in agriculture (e.g. Water User Associations, Water Boards etc.). However, further strengthening the role of water users and communities and support to community participation in the management of water services, especially in rural areas can be a policy priority.

2.4 Option prioritisation

The first step towards the evaluation of suggested responses was their prioritization by local stockholders, on the basis of a set of predefined criteria, common to all the INECO Case Studies.

The overall process was supported by the Water Management Research Institute of the Ministry of Water Resources and Irrigation, and by the Soils, Water and Environment Research Institute of the Ministry of Agriculture and Land Reclamation. Overall, 20 responses were received to the pertinent survey, by key decision-makers and representatives of user groups (industries and farmers) of the Dakahlia Governorate.

Replies revealed consensus on potential instruments that could contribute towards the mitigation of the focal problem, both at local and at regional level. Instruments and approaches that seemed to be most relevant and applicable comprise

decentralization, public participation and increased liability of polluters. Instead of indirect taxes, preference was articulated for direct and indirect forms of financial aid and voluntary schemes, including State support for developing the required capacity.

2.5 Towards the development of a policy proposal

The overall process of evaluating potential policies for mitigating water quality deterioration and water stress were complemented through a last step, aimed at mapping perceptions and sharing views on prerequisites and further considerations for the implementation of proposed approaches. The step was implemented through individual interviews and meetings with representatives from local user associations, NGOs, representatives of local and regional authorities, and researchers and professionals dealing with the water management issues experienced in the area and their socio-economic impacts. In addition to individual communications, outcomes of presented and discussed in a Symposium on April 1st 2009, with the presence of all local authorities. The following paragraphs describe the outcomes of this last evaluation step, elaborating on issues relating to: (a) industrial pollution prevention and control, (b) approaches towards water saving, and (c) ways of enhancing public participation and involvement in decision-making.

Industrial pollution prevention and control

Although industry is not considered the primary water pollution source in the area of interest, relevant issues receive significant attention by the majority of local stakeholders. It is generally perceived that there is need to enhance the weight given to environmental protection, by enabling industries to comply with the pertinent legislation, whereas at the same time efforts should also be made for developing the capacity required for enforcing the relevant legislation, without compromising wider socio-economic interests.

The majority of respondents considered that tighter effluent standards would be affordable, and that the capacity exists for their implementation. However, forms of financial assistance, as well as other means of support (e.g. training programmes, managerial support) are perceived important, in order to facilitate compliance and at the same time safeguard the competitiveness of the industrial sector, especially with regard to SMEs and public industries. The application of dedicated environmental taxes is also considered an appropriate mechanism for raising the funds required for the provision of grants for pollution reduction.

The implementation of award schemes to signal efforts for improved environmental performance to society are perceived as equally important. However, and despite the considerable efforts undertaken in the past few years, it is also underlined that there is need to invest in raising societal awareness on the wider benefits of cleaner industrial production, stressing also the role of mass media, primary education and civil organizations in the endeavour. In addition, most stakeholders support enhanced regulation, as an effective way to environmental protection. The vast majority further underlines the capacity and willingness of the State to develop and implement such approaches. Rather reluctant support is provided to taxes as means of compensating for environmental damage incurred by specific activities: stakeholders consider that this would require an in-depth assessment of the current situation and it would probably incur significant economic burden to low-income groups and activities.

At local level, the mitigation of industrial pollution issues could be effected through the relocation and/or the phasing out of specific, low-value and highly polluting

industrial activities. Appropriate incentives could entail the offer of compensation or other forms of financial aid. On the other hand, a potential increase of water and pollution charges could be put into practice, so that high-value uses can continue while low-value ones will give up or urged to relocate. Both alternatives were viewed equally positively by the interviewed stakeholders, implying that potential policies could employ both approaches to effectively incentivize water users. However, and in accordance to responses received to similar questions, the raising of water or pollution charges for specific industrial activities receives some opposition, due to socio-economic concerns and reluctance towards water pricing policies.

Incentives for water saving

Means employed for providing incentives towards the adoption of improved water use practices could involve: (a) the reinforcement of the incentive function of water tariffs, e.g. through the enhanced application of volumetric charges; (b) the development of financing mechanisms for providing aid to those who decide to invest in water saving, as well as (c) the establishment of mandatory technology standards for new buildings and irrigation projects. Results indicated that there is controversy concerning potential pricing policies for water conservation: a significant share of respondents considered unacceptable an increase of water tariffs justified solely by the need to provide disincentives for wasteful water use. Similarly, the levying of dedicated taxes, to generate the funds required for providing financial aid for water saving investments is not accepted. On the other hand, the enforcement of water saving standards, at least for new buildings or irrigation projects is largely accepted.

Public participation and stakeholder involvement

During the past years, significant efforts have been invested in building the capacity required to enhance the involvement of water users in infrastructure management and in decision-making. The establishment of Water Users Associations is gradually progressing in several areas, whereas awareness campaigning and citizen mobilization for the protection of water resources are gaining momentum. In line with these developments, public participation is broadly supported, with all stakeholders underlining its importance for sustainable water management and reinforcement of civic responsibility and engagement. Stakeholders stress the need to further involve user associations and local authorities in decision-making processes, to share information on planned projects and to reinforce public education initiatives, through training and the mass media. Further to the above, and in line with current broader national policy objectives, stakeholders underline the need for: (a) training of users and user associations on new technologies; (b) organization of intensive awareness campaigns and fostering of public education initiatives and (c) cooperation with public authorities for demonstrating and implementing sustainable solutions in the agricultural, domestic and industrial sectors.

3 CONCLUSIONS

The future availability of water resources in Egypt remains highly uncertain, and projections for the next 30 years reflect factors most uncertain and important, such as population growth, economic development patterns and climate change impacts on water availability. Currently, the country uses 120% of its renewable water resources, meaning that 20% of freshwater supply is recycled and used several times. Along the

same line, the main directions of the medium-term 2022 National Water Management Strategy comprise: (a) the recycling of agricultural drainage waters and their further use for irrigation purposes, with strict quality control to reduce risks for the degradation of agricultural lands; (b) the use of shallow groundwater tables for irrigation; (c) the exploitation of the Nubian Aquifer for reclaiming lands in isolated areas; (d) the modernization of irrigation methods to reduce water use by 50%; and (e) the change of cropping patterns to cope with reduced water availability, an issue that is currently researched by institutes undertaking agricultural research.

As evident, the implementation of this strategy requires the in-depth assessment of water quality problems, as these impact both on potential recycling projects and on the quality of groundwater extracted from shallow groundwater tables. In this regard, the INECO Egypt Case Study was oriented at analysing water quality degradation issues at the micro-level, focusing on problems experienced in the Bahr Basandeila Canal. The main outcomes of the Case Study, stemming from this participatory process and surveys undertaken in the area underline the pertinence of strict enforcement of environmental law, and of the development of an Integrated Water Management plan addressing also the problems and needs of the local society. To that end, programmes need to be established for enhancing coordination and cooperation among the different institutions dealing with water management and use but also for strengthening awareness and participatory processes at local level, and ensuring representation of the interests of rural societies at higher decision-making levels.

WASTEWATER REUSE IN CYPRUS

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EXTENDED ABSTRACT

Water reuse is continuously gaining ground in Cyprus. In addition to the eight (8) large wastewater treatment plants already operating in the country, two more are currently under construction in Nicosia, while operation licences have been issued for numerous plants to serve communities of population up to 10,000.

Currently, recycled water, which accounts approximately 100,000 m^3/day, is mainly used for irrigation (85% of the produced recycled water is used for the irrigation of all types of crops with the exception of vegetables and bulbs consumed raw), and for the replenishment of aquifers (e.g. Ezousas aquifer in the area of Paphos). Groundwater is abstracted through borehole drillings and is also conveyed to storage reservoirs. Amounts of the treated water are also disposed to the sea, especially during winter months when the water demand is reduced, or when storage capacity has been exceeded. The discharge into the sea follows strict regulations regarding the concentrations of total phosphorous and nitrogen, so as to avoid eutrophication of the receiving body. Furthermore, water recycled from rural communities is used to cover the agricultural needs and for the irrigation of open green spaces. Recycled water from hospitals and army barracks is mostly used for landscaping purposes.

The cost of recycled water ranges from 0.05 €/m^3 for the irrigation of agricultural land to 21 €/m^3 for golf courses, while it can increase by 50% for excess use. On the other hand, the cost of untreated fresh water ranges between 15 €/m^3 and 36 €/m^3. Recycled water used in public parks or agricultural land within the same community can be free of charge.

The authority responsible for the quality control of the recycled water is the Environmental Service of the Ministry of Agriculture, Natural Resources and the Environment (MANR&E). The overall framework follows the provisions of the Urban Wastewater Directive, 91/271/EC. Discharge permits, in compliance to the limits set by the Directive, are allocated by the Minister of Agriculture, Natural Resources and Environment to the Water Development Department and the Sewerage Boards. The permits further define the quality of effluents and the periodicity of quality monitoring.

The authority responsible for the provision of recycled water in the large metropolitan areas is the Water Development Department; in this regard, the costs related to the construction, operation and maintenance of tertiary treatment plants are undertaken by the Government. Furthermore, the Environmental Service monitors, for each plant, compliance with the provisions of the corresponding discharge permit, by performing its own chemical and biological analyses. Additional sampling and monitoring of effluent quality is undertaken by the Water Development Department and the Sewerage Boards.

Overall, through the National Implementation Plan for the implementation of the Directive 91/271/EC, sewerage systems and treatment plants will be constructed in all rural and urban areas where equivalent population exceeds 2,000 persons. As a result of this development, it is expected that the total volume of recycled water will reach 65 million m^3 in 2015 and 85 million m^3. It will thus have an important contribution in the water budget of the country, alleviating pressures exerted on surface and groundwater bodies and mitigating drought risks.

ADDRESSING WATER QUALITY DEGRADATION IN THE SEYBOUSE RIVER BASIN, ALGERIA

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ABSTRACT

This paper presents the outcomes of the case study undertaken by the INECO Project in Algeria, focusing on water pollution issues faced in the Seybouse River Basin (northeast of Algeria). Currently the River Basin, which hosts significant industrial and agricultural activities and rapidly expanding urban areas, faces alarming water quality degradation, mainly attributed to industrial and domestic pollution sources.

Current efforts focus on developing the infrastructure required to address pollution from domestic sewage: State programmes are being implemented for the development of urban wastewater treatment facilities for large agglomerations. However, a comprehensive strategic plan is also required for industrial pollution and control. More than 80 industrial facilities are currently operating in the area, producing significant amounts of wastewaters, which are discharged (with or without prior treatment) to surface water courses and sewerage networks.

In the Seybouse area, the INECO project focused on fostering a constructive dialogue process on alternative institutional and economic instruments to address water pollution issues. In response to the concerns of stakeholders, who are increasingly motivated by the significant degradation of river water quality, associated environmental impacts and health risks entailed, discussed options focused on ways to enable the effective implementation of pollution prevention measures and on developing wider processes towards enhancing civic responsibility and engagement for environmental protection.

1 INTRODUCTION

The Seybouse River Basin extends over an area of 6,471 km², is located in the northern part of Algeria and has a permanent population of approximately 1,300,000 inhabitants. It lies within the territories of the wilayas of Guelma, El-Tarf (by Drean) and Annab, and is limited in the north by the Mediterranean Sea, in the south by the Wilaya of Souk-Ahras, in the west by the Edough Massif, lake Fetzara, Ain Berda, and in the east by the Mafraghoued. The Seybouse River, of 240 km total length, is an important water source, used mainly for the irrigation of large agricultural plains, extending from the Guelma region up to the city of Annaba. Overall the basin extends over the administrative boundaries of 68 municipalities located in 7 wilayas. Agriculture is the main economic activity in the upper Charef Basin, whereas irrigated cultivations, equipped according to modern standards, can be found in the lower Seybouse. Industrial activities are very important in the area, and are mostly

concentrated around the cities of Annaba (steel, chemical fertilizers and industrial tomato industries) and Guelma (sugar industry and motorcycle manufacturing). There is increased competition among the allocation of available water supply; overall, agriculture consumes more than 95% of the available water, while the domestic and industrial sectors utilise the remaining 5%. With regard to groundwater, nearly two-thirds (2/3) are used for irrigation and 1/3 for potable and industrial use.

Furthermore, the Seybouse River receives heavy pollutant loads through wastewater from many cities (e.g. Berriche, Guelma, Bouchegouf, Drean) and industries. Excessive pollution renders the water unsuitable for human use and crop irrigation, particularly in the downstream areas of the Basin. In addition to water quality deterioration, land degradation is also becoming a serious problem: erosion is the main cause for siltation problems in storage reservoirs.

In order to evaluate the current state of the river and local aquifers, a survey was carried out during the period 1998-2003. Measured quality parameters included nitrates, nitrites, chloride, conductivity and turbidity, COD and BOD, dissolved oxygen and ammonia. The survey revealed an increase of the concentrations of various pollutants, originating from agricultural, industrial and domestic sources. Furthermore, results indicated that there has been a significant gradual deterioration of water quality during the examined 5 year-period, affecting both surface and groundwater resources. As projects for the development of sewage collection and treatment plants are underway and will have been fully implemented by 2012, urgent measures are needed for reducing pollution of industrial and agricultural origin to also protect riverbed aquifers.

In the above context, the following paragraphs describe the implementation of a relevant Case Study, based on the common methodology deployed by the INECO project, for formulating a policy proposal on potential policy instruments for the mitigation of significant water management issues in regions of interest. The different steps of this process were implemented with the contribution of all main stakeholders of the area and are described in terms of tools employed and main outcomes.

2 STAKEHOLDER AND PROBLEM ANALYSIS

The first stage of the developed process concerned the identification of key stakeholders with a role or concern over the pollution of the Seybouse River, including:

- Authorities involved in the management of water resources and pollution abatement, namely the ANRH (Agence Nationale des Ressources Hydrauliques - National Agency of Hydraulic Resources), the Ministry of the Environment, the local River Basin Agency (ABHCSM) as well as the local administration (wilayas and municipalities).
- Representatives of industrial associations and major industries of the area;
- Local university researchers and members of the academia, involved in research concerning hydrology and the assessment of pressures exerted on the water bodies of the Basin.

The first workshop, open to all parties, was held on January 19th 2008, in Annaba. The event gathered 50 participants, including representatives of public authorities, NGOs, water user associations and members of the local research and academic community. The primary aim of the workshop was to discuss the problem with the

local stakeholders, through the development and consolidation of a “Problem Tree”, depicted in Fig.1. The validated diagramme highlights the “governing” and “valuing” dimension of the issue at hand, demonstrating the need for capacity building at all decision-making levels and for the development of incentives towards industrial water pollution prevention and control.

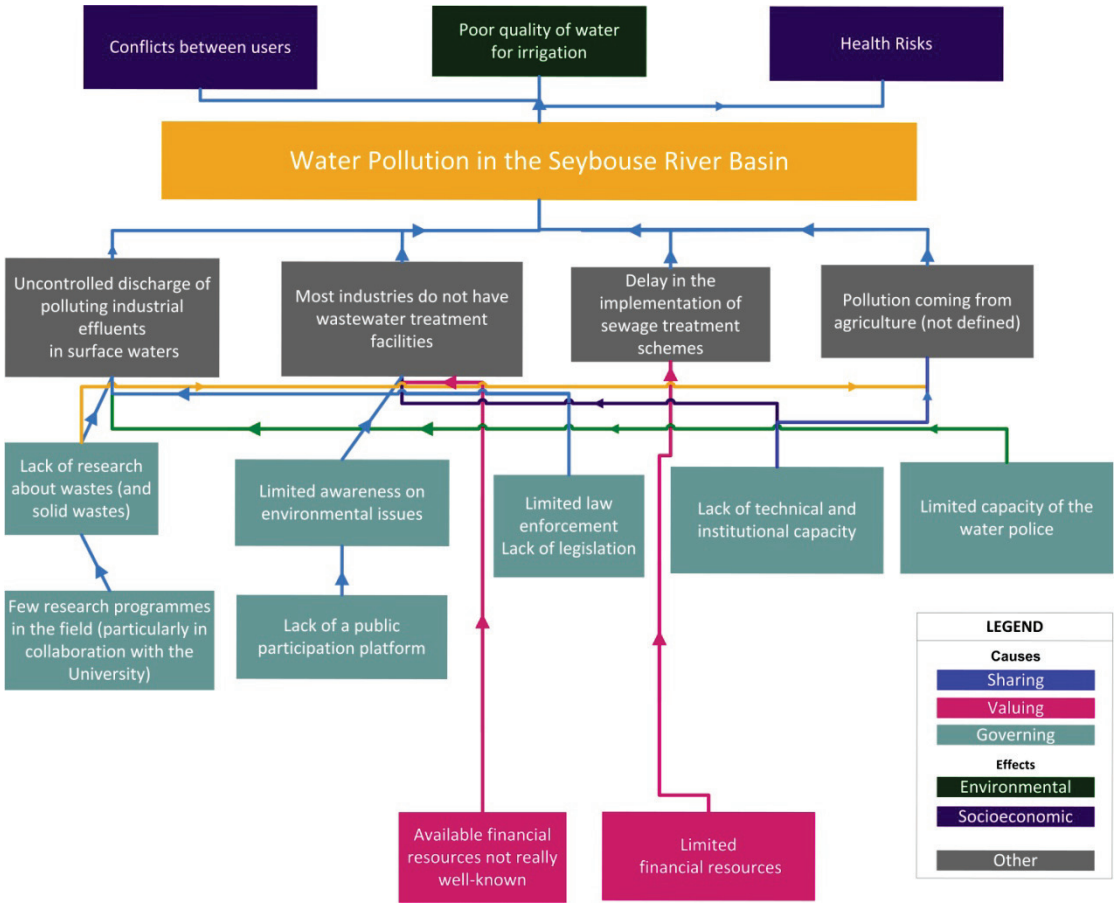

Figure 1: Problem tree analysis of the causes and effects of water pollution in the Seybouse River Basin

The “Problem Analysis” workshop also involved the implementation of a survey, aimed at revealing the perceptions of stakeholders as to the significance of causes and effects to the problem and potential areas of intervention. The most significant results of the survey were the following:

- The majority of respondents perceived that water pollution is indeed the most significant water management issue faced in the Basin (54.8% of replies), followed by the lack of infrastructure for sewage treatment (35.7% of replies). The uncontrolled discharge of industrial effluents is considered by far the primary cause of the problem (78.6% of replies).
- As to the underlying causes of the problem, respondents have identified deficiencies in the enforcement of the pertinent legislation (76.2% of replies) and lack of mobilization of the general public, polluters included (47.6% of replies).
- The majority of respondents agreed that public participation is a prerequisite for developing sound and successful water management policies. Favoured measures to that end comprise the implementation and operation of “Advisory

Committees" and the introduction of "Notice and Comment" procedures on water management plans and measures.

Suggestions, comments and issues raised formed the basis for the discussion on policy objectives and potential options, described in the following sections.

3 DEFINITION OF POLICY OBJECTIVES

Following from the participatory consolidation of the "Problem Tree", individual consultation and discussion sessions were held with stakeholders and actors that participated in the workshop event. These meetings were aimed at: (a) defining the key policy objectives that should be pursued for problem mitigation, and (b) collecting additional suggestions on options that could be applied to attain the defined objectives. Firstly, the results of the previous stage ("Problem Analysis") were used to draw a preliminary "Objective Tree", translating the original cause-effect diagram to means-to-ends relations. This "tree" was then further elaborated to define a set of key policy objectives towards achieving the main goal of "Mitigating industrial pollution in the Seybouse River Basin".

The first objective corresponding to the commonly agreed goal was defined as "the minimization of pollution from industrial effluents", to be achieved through (a) the offer of economic incentives/disincentives to industries for developing and operating individual wastewater treatment facilities, and (b) the enhancement of the institutional and regulatory capacity of water management authorities for monitoring compliance with the relevant legislation. The second objective corresponded to the need to raise awareness on environmental, societal and economic benefits from cleaner industrial production, and fostering the actual development and implementation of public participation processes.

4 IDENTIFICATION OF POLICY INSTRUMENTS AND DEFICIENCIES OF CURRENT POLICIES

With regard to **industrial pollution prevention and control**, currently industries have to obtain discharge permits and comply with specific standards concerning the quality of effluents. Furthermore, there are areas that have been designated as protected in the vicinity of vulnerable ecosystems or drinking water abstraction points. Plans and programmes are pursued for the restoration of environmentally degraded lakes, rivers (perennial or temporary) and for the prevention of future water quality degradation. Penalties and sanctions for the violation of discharge standards are applied by the ANPE and Environmental Directorates. As these authorities operate at the local level, the system is considered adequately decentralized to allow effective control of polluting industrial units and implementation of the corresponding legislative provisions of the Decree of September 2007. However, the situation is problematic, as the relevant Decree does not appear to be clear enough when it comes to implementation aspects. Furthermore, problems arise from the lack of knowledge and information; activities for data collection, effective monitoring of water quality and identification of pollution hot-spots have just been initiated.

In this regard, suggested options include: (a) the introduction of technology standards for particular industrial processes, complementary to the existing discharge standards; (b) the implementation of pollution charges, proportional to the amount of

pollution generated; and (c) instruments to further encourage the industrial sector towards the adoption of more environmentally friendly practices and cleaner production concepts, in order to avoid undermining competitiveness, and to ensure further development according to the broader economic policies and goals.

Pollution charges are in fact introducible given the current legislative framework; however, the problems directly related to their implementation are: (a) the delay in the definition of the corresponding legislative decrees and (b) the lack of knowledge on pollution loads/discharged volumes, as mentioned above. Furthermore, additional provisions need to be introduced with regard to the use of the revenue generated from these charges; it is noted that charges would be more easily accepted if revenue is earmarked and re-allocated for investments in environmental protection (locally, in the River Basin, or at national level).

Further incentives to the industrial sector can entail the wider application of voluntary schemes. Voluntary agreements concerning compliance to existing standards are already promoted by the Algerian Government, but their implementation in the Seybouse River Basin is still limited. Cited reasons include the lack of relevant information and inadequate incentives. In this regard, the initiation of a dialogue with industrial parties could promote a better understanding of the true obstacles faced, and identify those incentives that would better promote voluntary schemes.

Direct financial aid to specific industries for developing end-of-pipe systems could be provided through dedicated funds of the Ministry of Water Resources or the Ministry of the Environment. The grant can represent a share of the cost of the wastewater treatment unit, to be provided after an in-depth assessment of environmental impacts and costs by the local administrations or agencies. Otherwise, financial and fiscal incentives could be introduced (e.g. tax rebates or reduction of water tariffs and charges). With regard to relocation, it is notable that there have never been efforts to relocate specific industries to a designated area in order to develop a collective wastewater treatment scheme. This alternative is not considered feasible for the moment, due to high cost and employment considerations.

The key problem for water pollution prevention and control is related to the **lack of data, knowledge and regulatory capacity**. Effective monitoring, development and maintenance of the corresponding inventories and empowerment of local authorities to enforce legislation are all prerequisites for the implementation of enhanced policies. In this regard, the full implementation of the system of “redevances”, already advocated in the legislation, could assist in the generation of resources required, and therefore in the development of locally concerted action for problem mitigation.

During the past years, there has been increased awareness of the fact that the pollution of the Seybouse River is becoming a major problem. As mentioned above, this has resulted to the launch of a State programme for the construction of sewage treatment plants in urban areas, in an effort to meet sanitation goals and eliminate domestic pollution. However, the approach required for the prevention or the elimination of pollution of agricultural or industrial origin is not as straightforward.

In this regard, significant efforts have been developed by the ANPEP (National Association for the Protection of the Environment and Water Pollution Abatement) through extensive awareness campaigns targeting the general public, organization of conferences with the aim to promote innovative technologies for wastewater treatment, etc. Along this line, initiatives undertaken by the ABHCSM, also through the framework of INECO, were aimed at:

- Fostering dialogue, by organizing workshop sessions with industries and local administrative authorities;
- Establishing a closer collaboration with the University of Annaba, to propose and undertake specific research work, adapted to the local problem.

Additional efforts are being pursued to develop the established forum by involving the different institutions dealing with hydraulic infrastructure and environmental issues in the River Basin, and reinforce the role of associations and NGOs dealing with environmental protection. Options to further strengthen these initiatives can involve the official establishment of permanent fora, Advisory Committees or public hearings, etc.

5 OPTION PRIORITISATION

The next important step of the Case Study process concerned the prioritisation of suggested responses by local stakeholders, through the distribution and completion of a survey questionnaire for ranking ten (10) broad categories of instruments, in combination with additional consultation meetings with key user groups and decision-makers to explain the main objective of the prioritisation exercise, i.e. to assess feasibility and applicability, taking into account the local and the national water management context, current conditions and priorities, and future challenges facing the water sector. The processed results from the 27 replies, representing local industries, NGOs, members of the academia and local decision makers are summarized in the spider chart of Fig. 2.

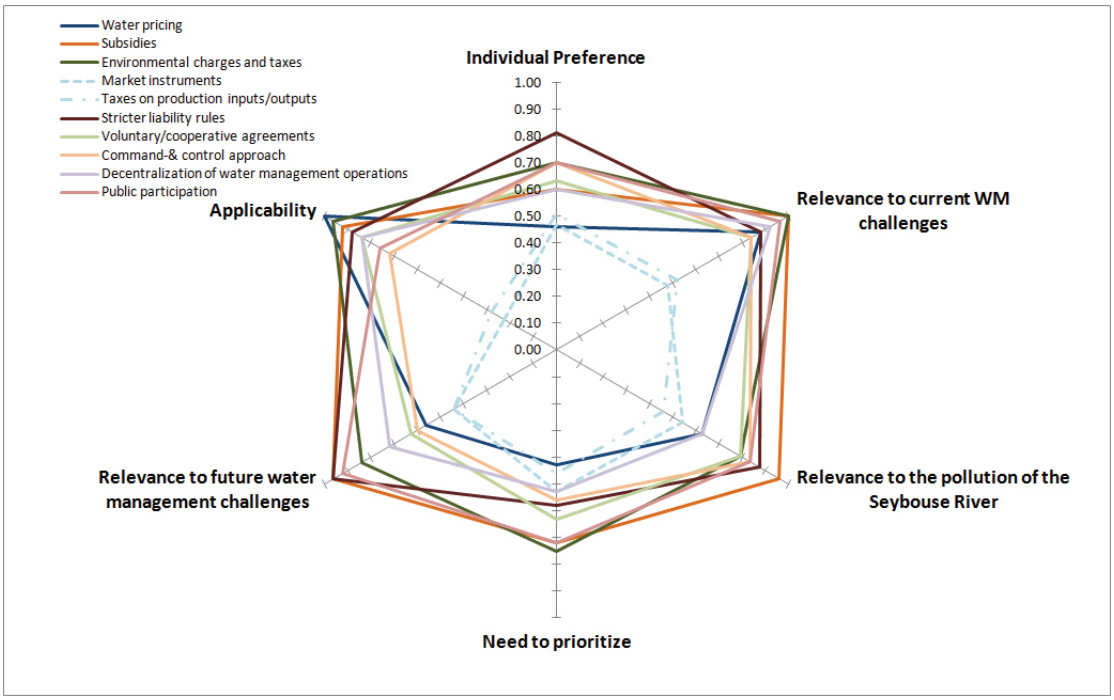

Figure 2: Prioritization of instruments for addressing current and future water management challenges

The need to change the way that industrial pollution issues are handled both by the users and by the administration was highlighted by all respondents. With regard to the currently applied (or potentially applicable) instruments, opinions and suggestions can be summarized in the following:

- Acceleration of the implementation or the rehabilitation of treatment stations for the most significant polluting industries and agglomerations that discharge directly in the Seybouse River, especially those in Guelma and Annaba;
- Strict application of environmental regulations.

Ways of enabling public participation and enhancing awareness, also through the establishment of water user associations, are also perceived as important means towards resource conservation and successful implementation of water management programmes. In this regard, the encouragement of actions and initiatives undertaken by different associations and NGOs is considered crucial as means to sensitize the public and develop concerted action.

6 OUTLINING POLICY PATHWAYS FOR POLLUTION MITIGATION

The overall process of evaluating potential policies for addressing industrial pollution in the Seybouse River Basin was complemented through a last step, aimed at identifying policy pathways for the implementation of proposed approaches. The process was articulated through individual interviews and meetings, held between December 2008 and January 2009, with representatives from all major institutions dealing with water management, Universities and Industrial Groups from different areas of the target region (Annaba, Constantine and Guelma). Issues discussed and elaborated upon in the following paragraphs are related to: (a) industrial pollution prevention and control, (b) cost recovery and cost sharing with regard to infrastructure operation, maintenance and development, and (c) ways of enabling public participation and involvement in decision-making.

Overall, stricter effluent standards are perceived affordable by most industries; however, it is also considered that subsidies, grants and other financial incentives would be helpful and could assist faster and enhanced compliance without compromising competitiveness. Environmental charges and taxes are widely accepted as means of raising the revenue required to provide financial assistance to those who decide to invest in improved environmental performance and cleaner production. Ecolabelling and award schemes are also considered positively, as they would allow signalling efforts towards environmental and consumer protection to society. Control through regulation is also pertinent, but a significant share of respondents perceived that the relevant authorities are not sufficiently empowered and willing to enforce existing regulations on polluters. Financial forms of compensation for environmental damage are broadly accepted. It was further underlined that there is need to inform users on the legislation and regulations in force, and to have dedicated facilities (laboratories) to analyse effluent samples and compare results to national and international discharge standards. In case of significantly polluting industries there should be regular monitoring to ensure compliance. The need to enhance the knowledge base and develop a national-wide database for individual discharges and abstractions was also pointed out by the vast majority of respondents.

Concerning cost recovery and cost sharing, full cost recovery is not accepted. It is generally supported that the costs relating to maintenance, improvement and expansion of the infrastructure base should be shared between the different public authorities (municipalities, River Basin Agency, Ministry) and the consumers, in order to maintain affordability of water charges. The lack of transparency is also underlined

as important, and problems relating to water consumption metering are also reported, since there is little information available on the process of defining water charges and meter reading is often unreliable.

When it comes to the forms of public participation envisaged by the different stakeholder groups, opinions vary to a significant degree, ranging from enhanced awareness to more open and democratic water management. Suggestions towards the latter include:

- Enhancing the role of NGOs and consumer associations in decision-making through their representation in basin committees and/or in the decision board of water management agencies.
- Organizing open debates on water-related issues and ensuring representation of all stakeholders in decision-making.
- Providing means for control over water management decisions and operations.

A commonly underlying factor is the need to raise awareness among all levels of society, in order to enhance civic responsibility towards water use and pollution prevention. Enhanced stakeholder involvement cannot be implemented without access to relevant information. In relation to this issue, several respondents underlined significant lack of data, limited or no access to information and lack of transparency. Furthermore, it is also noted that there are cases when information becomes available very late to be useful. Although information and communication systems have been established in the area (the ABHCSM regularly publishes information on the Seybouse on its web site), respondents also point out that relevant, reliable and comprehensive information should be provided at all levels and to the general public, in other regions and on a variety of water management issues. Ideally, data collection and management should be the responsibility of one institution, and relevant information needs to be disclosed through the internet and the mass media, and effectively communicated to the general public.

7 CONCLUDING REMARKS

The Case Study of the Seybouse River Basin highlights the importance of water quality degradation as a problem of equal importance to water scarcity; the deterioration of water quality, stemming from inadequate infrastructure, deficiencies in legislation enforcement, knowledge and data gaps and limitations in water sector capacity, is an essential element of water stress faced both at the river basin and at the national level. Specific objectives that could be pursued in order to enhance the conditions and mitigate problems in the area include industrial pollution reduction, agricultural pollution reduction, and enhancement of knowledge on conditions governing all water-related issues.

Participative processes undertaken for the development of the Case Study have indicated that there is general consensus on the significance and potential of certain pollution mitigation measures. Stakeholders highlight the significance of pollution impacts, and agree on the need to enhance efforts to strictly control and reduce industrial and agricultural effluents, enforcing the relevant legislation. It is broadly agreed that polluters must pay; however stakeholders are also favourable towards the introduction of pollution reduction incentives. To achieve reduction in agricultural pollution, incentives are advocated for the adoption of less polluting organic farming

practices. In addition, the wider implementation of economic instruments to encourage the adoption of advanced technological options by industries and less water consuming and less polluting techniques/approaches by farmers are widely accepted. The reduction of industrial pollution is strongly advocated through the creation of pollution taxation, proportional to the environmental damage incurred, in order to promote the adoption of pollution reduction equipment by polluters, as well as the enforcement of legislation upholding the “polluter pays” principle.

Overall, measures viewed as necessary by stakeholders comprise the empowerment of the water police for basin monitoring and legislation implementation, and the improvement and upgrading of water and sanitation services, possibly including the encouragement of private sector involvement under the overview of the State; price increases are viewed as acceptable, provided that the quality of services provided is improved. The improvement of knowledge of the cost of water, which is an important parameter in building consumer confidence, requires the undertaking of economic studies on the real price of water, implemented with full transparency, and the communication of results to the general public. This would enable the determination of appropriate cost recovery policies and the potential subsequent introduction of subsidies by the government with full knowledge of the factors at play. Finally, the reinforcement and dissemination of available information on water consumption, pollution and discharges are viewed as a priority in order to exercise better management of water resources.

ECONOMIC INSTRUMENTS AND PRICING FOR INTEGRATED WATER RESOURCES MANAGEMENT

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1 INTRODUCTION

Everyone knows that water is a *limited* resource; the reasons why water is *scarce* are not always well understood, and belong to economics at least as much as to hydrology. More than 80% of the population in OECD countries and 75% at world scale are predicted to be living in more or less water-stressed areas by 2030 (OECD, 2008). Nonetheless, raw water that is available either at the continental or the sub-continental scale exceeds by far any foreseeable human demand for the next centuries. Although this statement becomes less true when we increase the territorial detail, what remains incontestable is the fact that we can think to invest, at high but finite cost, in artificial assets that can make available any quantity of usable water we may want. The question then becomes: are we willing and able to pay this cost? In most of the cases, the answer is "No": water is simply too heavy to conceive long distance transfer, except for those few uses for which the associated value is high enough. This statement becomes even truer if all costs, including externalities, are accounted for.

Therefore, water is not scarce because it is available in a finite quantity, but rather because the management system that is in place in a given location at a given moment can only supply a finite quantity. This quantity might be increased, but this implies an additional cost that (i) might happen to be higher than the benefits or (ii) might not be affordable given the current level of income, or finally (iii) might not be feasible in the existing institutional and political context.

Water resources management (WRM) and water/sanitation services (WATSAN) are thus two rather different concepts that should be kept separate. On the other hand, there are obvious links between them: water resources availability sets the conditions for WATSAN provision, whereas demand for WATSAN impacts on water resources. More precisely, WATSAN represents the intermediary between human activities impacting on water resources and the resource itself. It ensures that access to the natural capital is organized and that its impact is kept under control. Most users do not have direct access to the resource; rather, they decide whether to connect to a system and how much water to demand according to the kind of service that is proposed and the way that it is charged.

In this perspective, water pricing, can be seen as (one of the) instruments aimed at ensuring that WATSAN provision and investment in WATSAN infrastructure are reconciled, contributing to the wider objective of sound water resources management. Obviously, the way that water services are priced and infrastructure costs are recovered affects demand. The approach adopted by WATSAN operators

(e.g. oriented towards satisfying water requirements on a supply-side basis or towards managing water demand to maintain it within the limits implied by sustainable WRM) constitutes an important driver of impacts on water resources.

It is thus fundamental to distinguish between two rather different water policy (and consequently water pricing) aims. The first concerns *allocation of natural capital* among competing uses. The second concerns the operation and maintenance of the artificial WSS system, as well as the need to invest in these, in order to *increase the productivity of the natural capital*. In other words, water policies cannot be separated from economic policies, and water policy objectives should be understood by considering at the same time both the economics of the natural resource and the economics of water services and water infrastructure.

Natural resource economics stress the importance of allocating the – finite – natural resource, while network industries' economics instead deal with the allocation of economic resources (labour, capital etc.) that are required for increasing the resource base, or better to say its capacity to produce valuable services. Both perspectives pose their own sustainability issues and create a case for public policy, for very different reasons.

2 WATER SUSTAINABILITY AT A GLANCE

As outlined above, water is not scarce because it is available in a finite quantity, but rather because *cheap water* is available at a finite quantity. Using more than that quantity normally entails costs that are significantly higher than the benefits received.

Environmental sustainability **Discourage depletion of critical natural capital** • Guarantee ecological functions of water natural capital • Minimize the recourse to "supply side" • Minimize the alteration of natural outflow patterns	**Equity** **Guarantee that "merit uses" have due access to water resources under fair and equitable conditions** • Identify "water needs" (⇔ basic environmental functions) • Keep level and dynamics of prices below the threshold that makes it unaffordable for some users • Achieve an equitable and democratically accepted way to share the cost of managing water resources
• Guarantee financial stability of water systems • Compensate adequately economic resources that are used as inputs • Cash flows should guarantee the conservation of value of physical assets • Each new infrastructure binds the next generation to cover its cost in the future ⇔ minimize the creation of artificial capital **Financial sustainability** **Guarantee long term reproduction of physical assets**	• Allocative efficiency: available water should be allocated in order to privilege uses with the highest social value • Allocative efficiency: the cost of provision of water services (to non-merit uses) should be confronted to their value • X-efficiency: costs should be as close as possibile to the minimum (intended in dynamic terms) • Not encourage over-capacity, over-staffing, gold-plating etc • Cost coverage should be intended as for efficient costs only • Regulation should ensure an optimal allocation of risks among shareholders, users and taxpayers **Efficiency** **Guarantee that water is allocated to its most beneficial uses and economic resources are not wasted**

Figure 1. Dimensions of water sustainability

This statement is becoming every day truer, for at least two reasons. First, we have learned that financial costs are not the only costs to be considered. All externalities should also be accounted for and considered in the evaluation. Externalities arise because water has a scarcity value (i.e. other valuable uses have to be sacrificed) or because intensive water use threatens ecosystems that are based on the natural availability of water as flow ("blue water") and as stock ("green water"). Second, experience has also shown that we can learn how to obtain the same benefits using less raw water and more intelligence and technology. Sometimes it may be less costly to repair leakage than to build a new dam. In other cases, it is much more

worthy to abandon certain activities that extract from water only a very low added value (e.g. irrigation of certain crops) than to invest for increasing their water productivity.

This introductory remark is fundamental for understanding why water policies cannot be viewed separately from economic policies. From the natural resource perspective, what is at stake is the need to ensure that the profile of resource renewability is not modified, that relevant ecosystem services are maintained, that accessibility is guaranteed to all relevant uses, and that resources are allocated efficiently (i.e. used in the most productive way). The main difficulties arise from the pervasiveness of externalities and the difficulty to properly establish and enforce property rights. From the public service perspective, the problem is to ensure that capital invested in the systems is restored and recovered, that investment in water services is justified in cost-benefit terms, that the management of water utilities is efficient, and that access to basic services is ensured. The main difficulties arise from the monopolistic nature of the industry, further emphasized by the predominance of infrastructure costs on variable costs and the very long economic life of assets.

It is thus fundamental to distinguish between two rather different aims of water policies (and consequently of water pricing). The first concerns the allocation of natural capital among competing uses; the second concerns the operation and maintenance of the artificial WSS system. The rather different set of objectives that arise from both issues generate some potential trade-offs among them, outlined in Fig. 2.

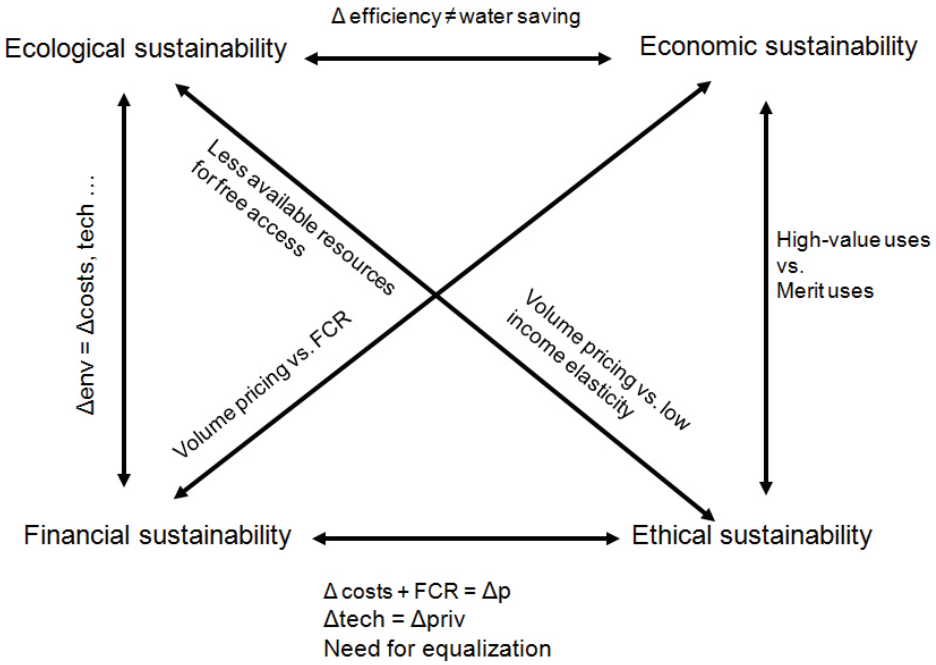


Figure 2. Trade-offs between water sustainability dimensions and pricing

2.1 The dilemma of water stress

Water stress ultimately arises from a mismatch between supply and demand (Fig. 3). It eventually depends on the contemporary difficulty in expanding supply, due to budget constraints and evidence of externalities, and in maintaining the status quo (permanent tendency to overexploit the existing resource base and undermine the basis for its reproduction). Escaping this situation entails either an investment in the water management system aimed at increasing its “productivity” (i.e. its capacity to

obtain the same benefit by reducing the impact on the resource base) or an innovative governance system, which would reallocate water use rights in order to accommodate new demands. However, all alternatives imply a higher economic cost or institutional change. The capacity of the community to agree to this new scenario (allocation of costs and of water rights) cannot be taken for granted, and this is ultimately the reason why unsustainable water management practices cannot be easily abandoned.

Table 1. Alternative strategies for coping with water stress

Strategy	Examples	Remarks
Expand supply	Dams; Water transfers Desalination	Very costly, most of the times inefficient Subsidizes also uses that do not need to be subsidized Usually not affordable if FCR (and not even for the state) Implies that other communities are affected and forced to share problems with the water-stressed one (developing institutions at a larger territorial scale ⇔ reduced local control
Increasing productivity	Leakage reduction Wastewater reuse Adopt water saving appliances Treatment of polluted water	Saving water ≠ saving money (it actually costs a lot of money) How will this extra cost be shared? need to ensure that low-value uses are not excluded and extra cost remains affordable Need for public subsidies at least in the initial phase Requires professional managing systems ⇔ delegation + regulation + confidence
Segregation of water uses	Force new users to adopt more costly systems in order to reserve cheap water for "incumbents" and "politically preferred" ones Force tourist resorts and industry to build desalination; Force urban supply to buy long-distance supplies and leave local resources to agriculture and hydropower Force new developers to pay higher connection fees Promote specific methods for some uses	Relatively inefficient Affordable only for high value uses Not necessarily equitable (incumbents are preferred to new uses), but often acceptable as a second-best solution
Phasing out some uses	Reducing irrigated surface	Socially or politically difficult; enforcement problems if based on C&C Drivers of demand should be addressed as well (e.g. pressure for urban development) Compensation can alleviate political opposition

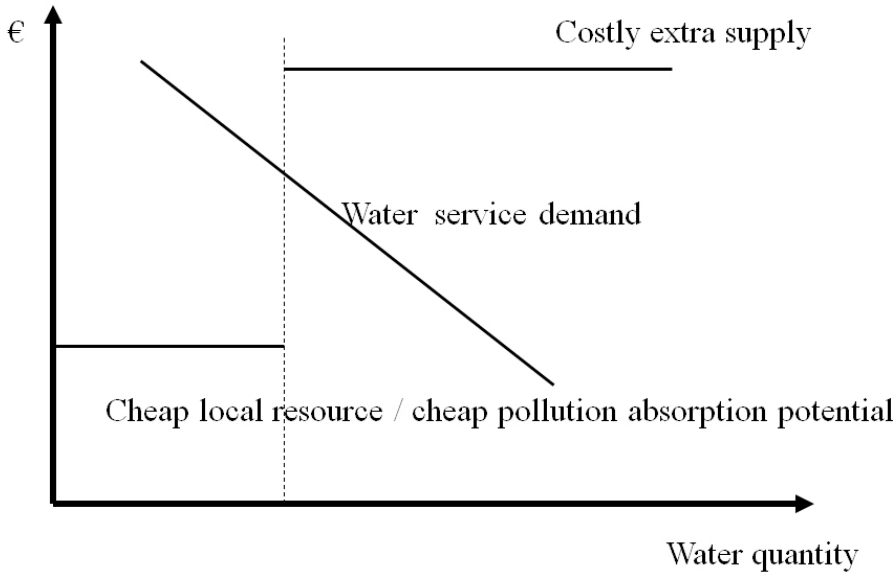


Figure 3. An economic interpretation of water stress

3 THE ECONOMIC RATIONALE FOR WATER PRICING

3.1 The economically optimal pricing rules: allocative efficiency under first-best conditions

According to the economic theory, optimal pricing of any private good or service should reflect its long-run marginal cost (LRMC). Each customer should pay for any *additional unit* according to the *additional cost* that its demand requires. In this case, and only in this case, the price functions as a signal of economic scarcity. Each user will decide to purchase an extra amount of water only if its price is greater than its value. As long as the price includes all relevant cost dimensions, we can be sure that society as a whole improves its welfare: the utility obtained is greater than the disutility created. It is quite intuitive to understand why this happens. If the marginal value is greater than the marginal cost, there would be a potential welfare gain through the supply of an additional quantity. Vice-versa, if marginal cost would be higher, there would be a welfare gain from reducing supply[1].Therefore, if for some reason prices diverge from marginal cost, water users will receive a distorted signal. For example, with water price lower than MC, users will be encouraged to demand more water than actually efficient.

This conceptual scheme can be applied for example in order to evaluate the opportunity to build a new water supply scheme (with higher marginal cost) in order to supply additional quantities of water. There are many concrete examples of similar questions in Europe, as, for example, when agriculture uses the cheapest local resources, forcing public water supply to rely on long-distance transfers.

[1] Considering long-run costs instead than short-run ones means that investment costs should be considered as well. This is appropriate as far as new investment decisions are concerned. For example, if the additional value created by an irrigation project is lower than the investment cost plus the marginal operational costs, the project would not be economically efficient. On the other hand, when dealing with already existing investments, short-run costs might be more appropriate as term of reference. For example, if a reservoir already exists, the decision whether to use it for supplying water or not should be based on the short-run marginal cost only (since the fixed cost has already been paid).

As we can see from Fig. 3, from the pure point of view of economic efficiency, it is preferable that existing water is shared so as to satisfy all water requests of household supply first, and then leave the remaining to agriculture without building the new facility. The total welfare (sum of benefits of farmers and households) is higher in this case, rather than in case when household supply is obtained from long distance transfers and all cheap local water is used by agriculture. In other words, domestic users would be ready to buy water from farmers, paying a price that is higher than the agricultural income that would be otherwise obtained, and lower than the price of long-distance water.

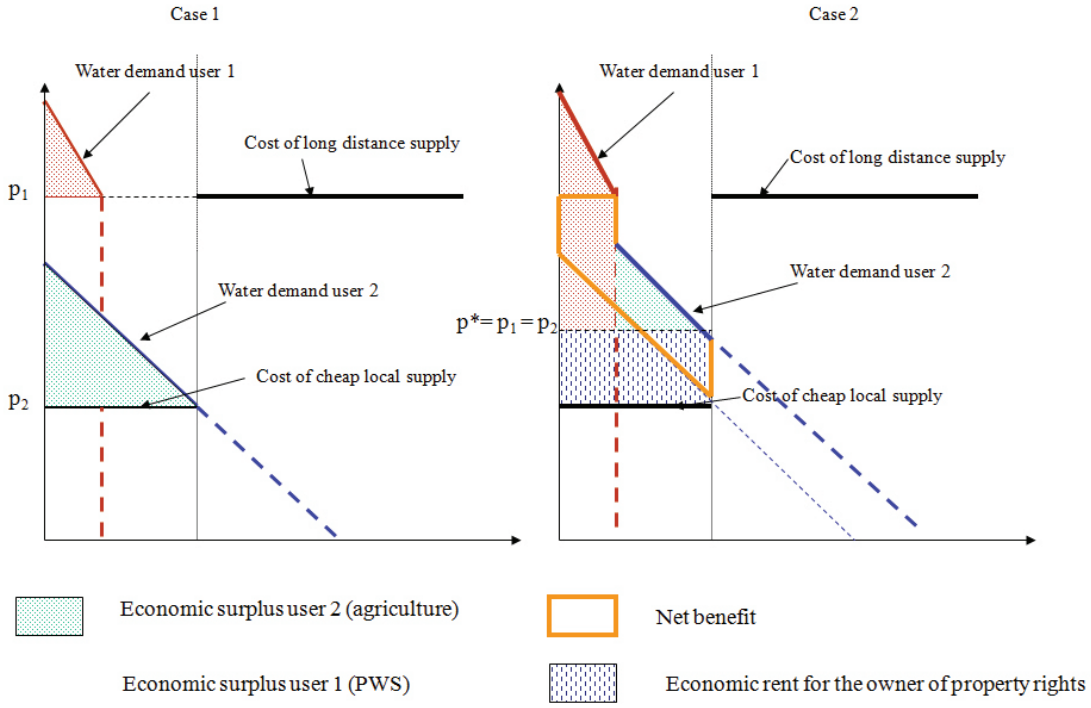


Figure 4. Pricing as an allocation instrumentWhile the application of the marginal cost rule is universal, in certain cases – namely, when costs are sub-additive and/or marginal costs are difficult or complex to calculate – the willingness to recover fixed costs has suggested second-best alternatives. As a matter of fact, when average costs are decreasing because of economies of scale, the marginal cost is lower than average cost.

We can note from Figure 6 that collective welfare continues to be maximized by the application of marginal cost, but this causes a loss to the service operator[2]. In such cases, we can either imagine that the State could cover this deficit through money transfers or accept a minor welfare loss, by allowing the operator to charge the average instead of the marginal cost. Alternatively, if the operator is able to apply different prices to different categories of consumers (and this “price discrimination” is legally accepted), the same effect could be obtained by charging different groups of consumers the marginal cost plus a quota of the fixed cost that is inversely proportional to their demand elasticity (Ramsey pricing).

[2] If the price would be equal to average cost, demand would be Qac. Collective welfare could be improved by increasing output levels up to Q*: social benefit (the area below the demand curve between Qac and Q*) is greater than social cost (the area below marginal cost curve in the same reach).

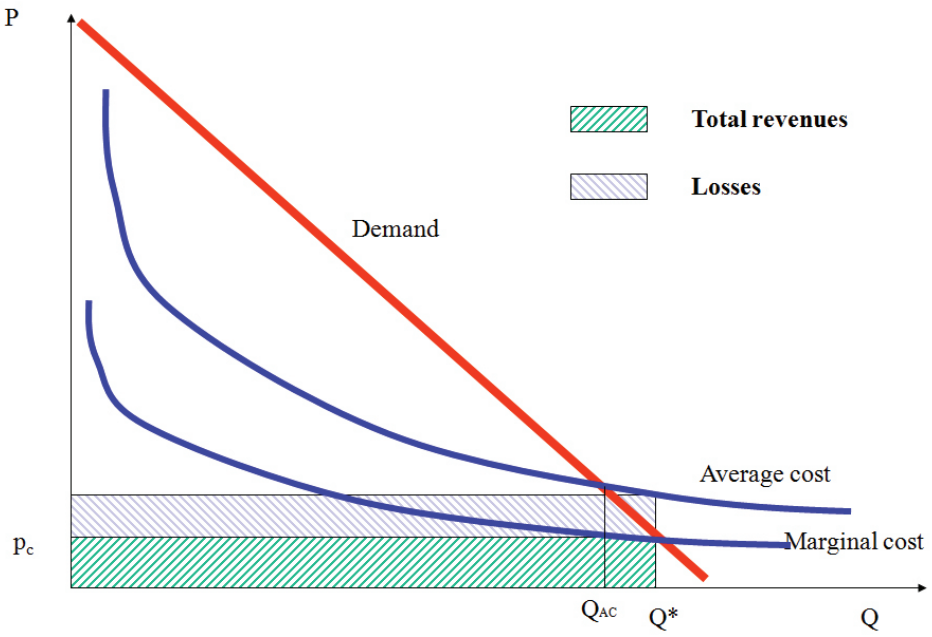


Figure 5. Average cost and marginal cost pricing**Economic pricing under second-best conditions**

Full cost recovery, in its strict meaning, is a further relaxation of both concepts: it requires a correspondence between total costs and total revenues, without going too precisely into the issue of which customers pay for which costs[3].

The limits to the application of marginal cost pricing depend on many reasons:

- In the long run, the recovery of fixed costs might not be guaranteed by SRMC, and maybe also not by LRMC if we assume that average costs are declining (economies of scale in the provision of water services). Since fixed cost represent a large part of the total cost, this will result in low recovery in total.
- The marginal cost principle is an optimal pricing rule only if the monitoring of individual consumption is not difficult/costly. Transactions costs implied by metering should be considered as well while comparing the relative advantages of different pricing structures.
- The benefits of marginal cost pricing depend on demand elasticity. If demand is inelastic, the welfare gain of charging the MC instead than average costs or flat tariffs is lower. Empirical studies in general provide evidence that elasticity is actually low.
- Water services usually entail a public good dimension as well as a private good one. Therefore, we should include among the benefits also components of collective utility that individuals do not consider (or consider only partially). In some cases, it might be appropriate to use taxation instead of prices based on MC.

[3] Normally, the Full Cost Recovery is specified as if the full cost be matched by charges on each territorial unit in which the service is supplied by an independent operator. Yet this very criterion leads to very different outcomes in Europe: to make only an example, England and Wales have only 10 large water supply and sewerage systems, while Italy or France count the separate undertakings in the order of 10,000. It is clearly not the same thing to require balance of costs and revenues for each individual undertaking or for larger aggregates.

- Allocative efficiency is not the only goal of public agencies. Once the allocative benefit of the marginal cost pricing is lost, the price paid acquires a fiscal nature, and there is no reason but a political one to use the polluter-pays principle instead of a progressive criterion for allocating the tax burden. Distributive issues might be relevant as well: in other words, society is not necessarily indifferent with regard to the concrete distribution of costs and benefits.
- Costs belong to different categories, and each category may have different explanatory variables for MC. For example, resource costs depend on water quantity, while infrastructure costs depend on the size of the network, the number of connections. Sanitation costs vary with pollution loads and not with water quantity, etc.
- Some cost components, and notably resource and environmental costs, vary across space and time. They simply cannot be attached to a certain use (e.g. irrigation), but should consider local contingencies. The same water use can imply a high resource cost when there are other competing uses of the same water, and conversely not imply any resource cost in other cases. Resource costs may appear in a dry year, and not at all in normal years.

3.3 Water prices as environmental policy instruments

Independently on marginal cost issues, water prices might be used by water authorities as demand management tools, and therefore maneuvered in order to achieve given water policy targets.

The rationale for this use of prices lies in the well-known theory of environmental taxes starting from the work of Pigou in the 30s until the work of Baumol and Oates (1989) that is considered as the standard reference[4]. It is based on the idea that demand reacts negatively to price variations, for the same reason described above, i.e. that users will purchase an additional unit of water until the additional expenditure (the price of the additional unit) is lower than the economic value (utility). As utility decreases with quantity (additional quantities produce diminishing additional utility), this results in a demand curve with a negative slope, similar to the one presented in Figure 4. At lower prices, users demand more water; at higher prices, demand is reduced.

From the same Figure, it is easy to understand the mechanism through which water prices can provide an incentive to curb down water demand: supposing that the demand target is D*, this is not achieved at the current price P_0 (since at that price, demand is Q_0). The water authority could then impose a water tax (an additional water price) so that the final sum paid by the water user becomes P*. We can assume then that each increase of the water price, however motivated, would have the same effect. It is important to note that the effect occurs because users pay an additional quantity of money for additional quantities of water, and not because their total expenditure for water is higher. In other words, it is important not to make

[4] The main innovation introduced by Baumol and Oates lies in the fact that Pigou considered that taxes should be calculated in such a way to completely internalize externalities, in order to foster an optimal allocation of environmental resources. Baumol and Oates recognize the difficulty to measure externalities and therefore advocate the use of taxes even if the target has been determined exogenously.

confusion between cost recovery and incentive pricing, since the latter requires that prices are some function of the quantity that is actually demanded.

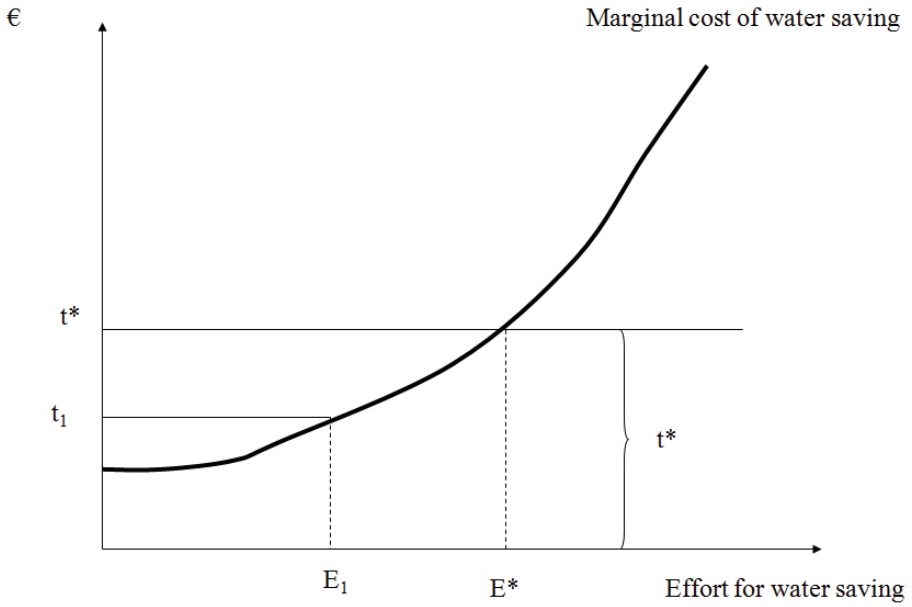


Figure 6. Water prices as environmental taxesFull-cost pricing of water is perfectly compatible with a poorly incentivising system (e.g. if rules for allocating water and pricing methods continue to be based on flat rates). On the other side, an incentivising pricing system could be designed even if the total revenue does not recover the full cost. In any case, the economic literature invites us to be at least cautious in retaining that pricing water alone could be sufficient in order to promote water sustainability. Nonetheless, it can be a very useful policy instrument provided that it is structured in an incentivising manner. The incentive effect depends on the shape of the demand curve: the more elastic the demand curve, the more effective is the price signal. Since what is important is the cost of the last quantity of water purchased (and not the total or the average cost), it can be believed that an increasing-block tariff structure could reach this effect more easily (above a certain quantity, the additional cost of a new unit grows higher).

3.4 Financial equilibrium of operators and the public budget

As we have seen in the previous sections, allocative benefits of water pricing occur only if it follows the marginal cost rule, while environmental incentivation simply requires that prices are in some relation with quantity (hopefully, a monotonic growing function of quantity such as in the increasing-block model). In both cases, there is no strict requirement for FCR (in the sense that allocative and environmental objectives can be pursued even if FCR is not achieved). On the other hand, the achievement of FCR per se does not necessarily imply allocative or environmental benefits.

The last argument in favour of FCR has nothing to do with incentives. It is rather based on the need to guarantee that water management systems can be self-sufficient from a financial point of view. This argument is either motivated by public budget constraints, or by the belief that independent, service-oriented water management systems are more keen to behave efficiently than state agencies.

The first motivation can be considered as a de facto statement rather than a normative judgment. Regardless political preferences in favour or against state

intervention in the economy, the supply of state-financed goods requires public spending and therefore taxation or creation of public debt. Most OECD economies are facing a crisis in this respect: the growth of the size of the public sector has already reached a critical point. Fiscal policies are thus constrained and better concentrated in those areas of public intervention that require redistribution of resources. In this sense, expenditure for water services should be faced through the direct involvement of users, even when it maintains some elements of taxation.

Water pricing can thus be seen as an indispensable ingredient of any privatisation policy, since it is the only way through which water management agencies can have access to the private capital market. This model of financing is more suitable for "ordinary" management of water systems (requiring smaller but continuous investment, instead than massive and concentrated in time), being less conditioned by the tendency of public expenditure to depend on economic cycles.

Once the initial investment is done, direct responsibility for service operators on long term maintenance would decrease the risk of opportunistic behaviour, encourage the adoption of good management practices and stimulate cost reduction. Otherwise, a concrete risk of running into a "vicious circle of public spending" would be faced: if ordinary management is not able to generate enough financial resources for keeping the system in good condition, sooner or later new public investments will be needed to replace the infrastructure.

The second motivation relies on the fact that independent service-oriented agencies, being forced to provide value for money to their customers, will not be able to incur into deficits and will thus be stimulated to adopt cost saving and not to invest in overcapacity. On the other hand, users will develop a cost-conscious attitude towards the service. This motivation is also linked to a political preference, well rooted into the sustainability debate, for user-governed self-regulating systems for managing environmental resources, towards their equitable sharing.

While these arguments lead in the direction of "cost recovery" rather than of economic pricing, it should also be noted that in many cases adopting full-cost recovery (i.e. obliging each system of users to repay the 100% of the total cost) might lead to pricing levels that are likely to exceed the threshold of affordability. This is particularly the case when investment in new infrastructure is foreseen. For this reason, some authors have developed the concept of "sustainability cost" (or "quasi-full-cost recovery") meaning that prices should not necessarily cover the total cost, but rather be able to finance the long-term maintenance of the capital infrastructure, including natural capital. In other words, there might well be a public contribution for the initial investment, provided that later on users will be able to continue financing operation and depreciation of the system in order to prevent its value from reducing (and therefore preventing the need for new public contributions in the future).

4 A TAXONOMY OF TARIFF STRUCTURES

4.1 The structure of the value chain

Figure 8 represents the value chain of WSS distinguishing 4 levels. At the top we have the owner of the water resource (normally the state). Value created at this stage is only depending on the scarcity rent and administrative activities that concern regulatory institutions. At the bottom level there are users, who might bear some costs (e.g. for drilling a private borehole). Between the top and the bottom there

(might) be two further levels, whose costs represent further value added for the WSS. The retail service consists in all the abstraction, treatment and distribution activities normally performed by WSS operators. Between retail and resource ownership in some cases there are further activities concerned with the management of the water resource (they can include for example bulk supply, storage, flow regulation, artificial aquifer recharge). The reason for considering this level as a separate one lies basically in its different organization, which usually involves the State and/or collective institutions.

In principle, each of the four levels contributes to the value added and has to match costs and revenues. For example, for the retail WSS, total revenues (both from WSS retail price and subsidies) should recover the sum of inputs' market prices and resource bulk price and use fees. The total added value should correspond to users' WTP. In practice, however, the balance of each level can be ensured in many different ways, by involving different layers of taxation, and there is no guarantee that a matching is actually obtained in each level.

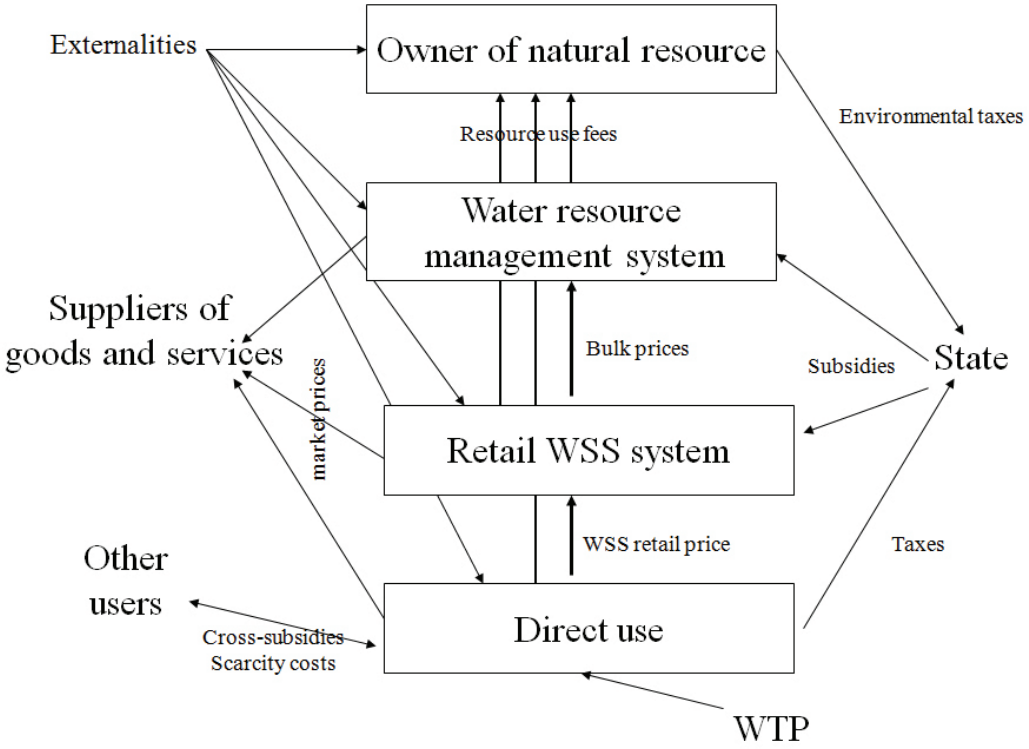


Figure 7. The value chain of WSS

4.2 Transactions along the value chain

Fig. 8 helps us better understand the economic nature of the different sets of transactions that occur along the value chain of WSS. The system has been framed the system in 4 main categories of transactions: those between WSS operators and entities having responsibility for service provision (Market I); between operators and suppliers of goods and services along the value chain (Market II); between operators and resource owners (market III); and finally between WSS operators and final customers (Market IV).

Market I has relevance in particular for the issue of allocating capital risk among responsible entities (e.g. municipalities and operators). Many different schemes can be imagined, ranging from the pure concession to lease contracts and public-private

partnerships. Municipalities can also extract monopoly rents, in form of dividends, royalties, concession fees, etc. Along Market II we can find the largest part of the value added. The most important distinctive aspects concern the governance of transactions (market vs. vertical integration). Market III is structured by arrangements concerning property rights on resources and eventually by the presence of resource management systems, organized as separate entities. Transactions are in most cases heavily regulated and prices are set on political grounds. Finally, Market IV regards the delivery of the final service to customers. The basic issues here concern the way the total cost is spread, what costs, originating in the previous markets, are actually transferred to customers etc. Between the four markets, a deeply entrenched system of fiscal transactions is also present. Citizens pay taxes both to the responsible entity and the state, both general and earmarked, and these may return back as subsidies.

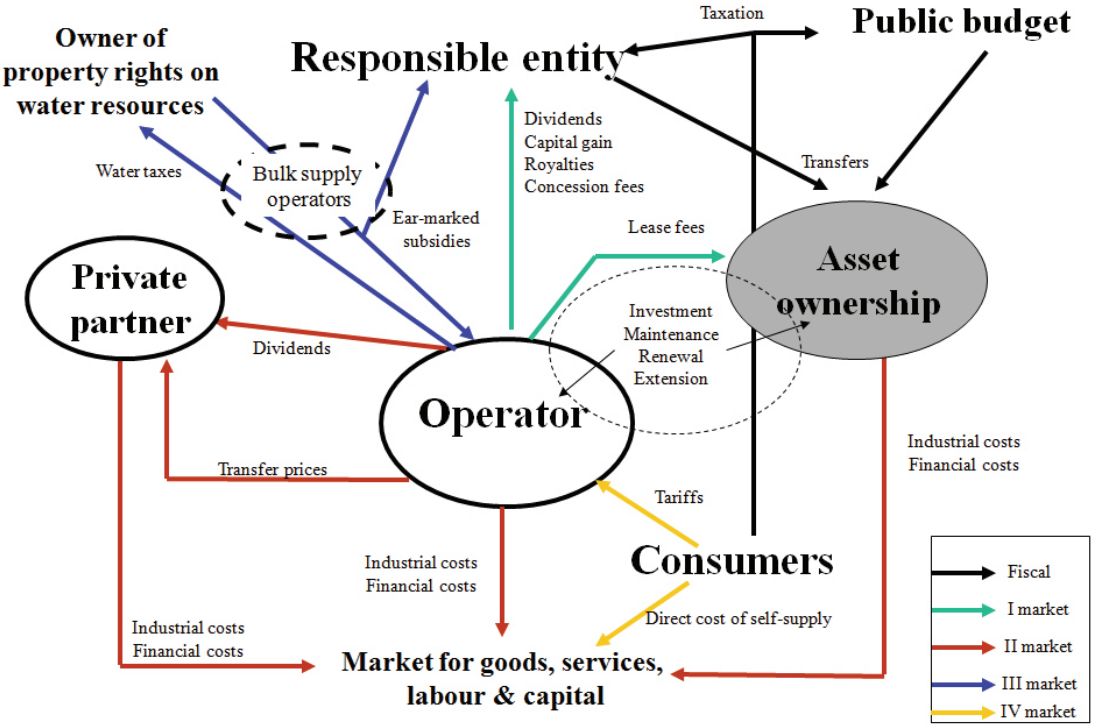


Figure 8. Financial flows across the value chain

4.3 Prices vs. taxes: a misleading opposition

Generally speaking, the provision of public services can be financed following a wide spectrum of solutions, ranging between the two extremes represented by market pricing and full fiscalization. The latter extreme assumes that the government finances service provision from the budget and taxpayers will provide the funds. The former extreme, in principle, should correspond to pricing at the marginal cost. Each customer would pay a price that equals both his marginal willingness to pay and the marginal cost of supplying that quantity. In network industries, the concept of marginal cost should be complemented by that of stand-alone cost – that is, the cost that would be required for supplying that customer alone.

In practice, it is not always possible or easy to consider each customer as isolated from the others; neither is it easy to choose the right parameter that determines a positive value for marginal costs. In many cases this could be water quantity, but in other cases, other variables should be considered, such as the number of

connections, the size of the network, pollution loads, abatement levels, quality requirements, etc. Water services also include public good components, where, by definition, no marginal costs occur.

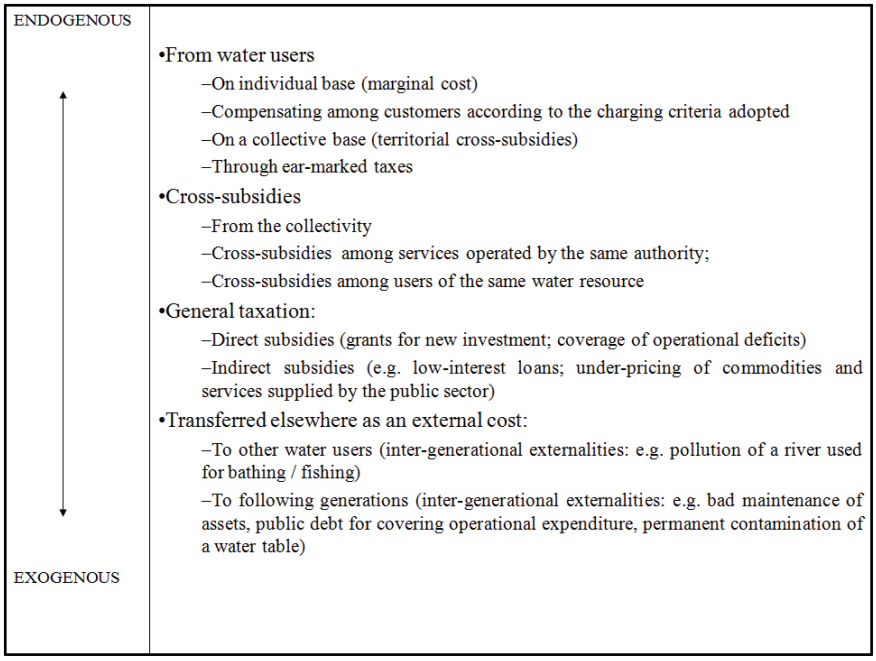


Figure 9. Alternative criteria for spreading the cost of water services

Using different tariff schemes in a way or the other further implies that some cross-subsidies are put in place. Cross-subsidies may arise, according to the instrument used, among the customers of the same network; among customers of different areas; among users of water services and other services (in the case of multi-utilities).

The economic theory of taxation stresses that a continuum occurs between economic prices and taxation, since both the former and the latter may be based on different criteria. Even the dichotomy between user charges and taxation is not always meaningful. We can imagine water charges that are calculated according to wealth indicators, such as the value of property, as well as taxes that are correlated with the marginal cost (e.g. abstraction or pollution charges). The difference may be subtle: for example, in Northern Europe, water charges – especially sewerage charges – are regarded as taxes, because connection is compulsory and the service does not have a commercial nature, even if water charges are aimed at recovering the cost and may be calculated on the base of consumption or pollution loads.

As we see in Figure 9, there are many intermediate solutions, all entailing some degree of cost recovery, but with compensation and cost-sharing mechanisms that involve communities of different sizes. Cost recovery could thus be intended strictly for each individual consumer or for groups of consumers (e.g. the ones served by the same water facility), or for larger territorial aggregates. Even in case of water costs being financed through the general budget (through taxation), some degree of FCR could be pursued (namely, an intra-generational recovery, in the sense that no water costs are transferred to the next generation). What really matters for a comparison among countries, therefore, is whether or not the premise of charging is the connection to the service, and whether the total revenues are calculated on the basis of costs to be recovered or not.

4.4 Accounting for financial cost

Financial costs represent the cost of inputs (labour, capital etc.) that have been used for providing the water service. In principle, these costs should result from the accounting of operators, provided that they have been appropriately calculated. In fact, this task is not always easy for many reasons.

First of all, it is reasonable to assume that at least some fractions of the value added of water services originate from non-competitive markets. This is due to the territorial monopoly in which utilities operate in each local market, but also to the economic rents that are contained in segments, such as good quality water resources (when privately controlled) or technological equipment. These complications should be considered in order to assess the true economic cost. In general, however, this complication is not too important, as water resources normally belong to the state and allocation rules are governed politically. Conversely, other inputs might be supplied by the public sector for free or at a subsidized price, and their value should be included as well. In all countries, the State supplies a lot of inputs in this way, such as research, education, vocational training, but also, for example, waterworks aimed at the provision of public goods such as flood protection or territorial planning. A further gap between market prices and true costs lies in the cost of capital, given the very long depreciation schedule of fixed assets.

However, in the case of long-lived infrastructure, such as water supply and sewerage facilities, private investors usually require much shorter repayment schedules, and thus higher interest rates, in order to achieve risk-return profiles that are comparable with the rest of the economy. On the other hand, the public sector can, and according to some, should, be less pessimistic and prudent. This myopic behaviour of private capital markets will mean that capital purchased on the market will have a higher price than its opportunity cost, measured by the social discount rate.

In comparison to public accounting procedures, which do not apply market interest rates, the adoption of a market interest rate causes dramatic increases of the final price. Should the market interest rate or a social discount rate be applied to such investments is a long-debated and never definitively resolved issue in public sector economics and more specifically in environmental economics. In theory, the use of market interest rates is appropriate only if private investors discount for the future correctly: many environmental economists argue that this is definitely not true in the case of natural resources, given the long term horizon and radical uncertainty about future development. Therefore, it seems justified to consider water artificial capital by the same standards as reproducible natural capital, given the sustainability issues that are associated with it; and therefore, apply the same discount rate that is applied to choices affecting natural capital.

It is also important to note that the financial cost can also entail an inter-generational dimension: who has to pay for the infrastructure and for its maintenance over time? If at time 0 a new facility is built and there are no public subsidies, the capital cost will be repaid during time: depreciation quotas will be calculated so that the generated financial cash flow will allow repaying the debt. At the end of the economic life, the value of the infrastructure will be zero; depreciation cash flows that have been set aside should allow reconstruction. In cases that this simple mechanism is not applicable because public intervention is necessary, some complications may arise. For example, if the initial investment is financed through public debt and this remains constant over time (meaning that it is never reimbursed, while bond owners continue

to receive perpetual rent), the corresponding cost will be shared among the current and the next generation. If the present generation fails to set aside enough resources for reconstruction, it will "consume" the value of something whose cost will continue to be paid by taxpayers of next generations. On the other hand, the next generation will have to create another debt, in addition, for financing the reconstruction.

Three general approaches can be found in international experience with respect to the assessment of capital costs. The approach used in Germany consists of a systematic revaluation of assets at their reinstatement value (that is, as if they would have to be reconstructed again), and the calculation of depreciation according to that value. Through this model, investment is constantly sufficient to cover the real depreciation of capital; in other words, the value of infrastructure remains constant over time. On the other hand, this model causes potential distortions if the service operator would use depreciation cash flows in order to finance other investments, and can place an undue burden on the generation that first realizes the infrastructure, which would, in fact, have to pay twice: once for the initial building of the infrastructure and once again for maintaining its value over time.

In turn, the approach used in the UK consists of calculating only investment that is required for preserving the value of infrastructure over time, i.e. what allows operators to fulfil their obligations to customers. In principle, the water service operator could receive infrastructure for free (the cost having been covered, for example, through public debt), with the duty to maintain it in good condition and to finance the necessary investment for ordinary and extraordinary maintenance, as well as reconstruction, from a certain point in time and onwards. This model is more fair to the generation that first realizes the infrastructure (since its capital cost has been socialized), but on the other hand requires that investment is actually sufficient. Since the operator is the only actor who really knows the efficiency of assets, there might be a risk of underinvestment and consequent devaluation of infrastructure along time. At a certain point, the operator will not be in the condition to continue operating it, and public investment will be required in order to rebuild the assets.

A further possibility, which is more often practiced in lease contracts, accounts only for ordinary and extraordinary maintenance. The first-time construction will be financed separately, with direct contribution of users through direct charges and taxes or more often through the public budget. The operator will use infrastructure until the end of its economic life. Financial costs, corresponding to loan reimbursement, are paid separately with an additional charge that is set aside for the owner of infrastructure and paid as lease fees.

4.5 Resource and external costs

With respect to external costs, again the concept is quite straightforward, but many empirical difficulties arise when a calculation is attempted.

Very little applied research has been conducted in recent years in order to assess the magnitude of external costs in a systematic way: a few insights from the available literature suggest that there is great variability according to local conditions and to the value of environmental functions requiring the non-use of water. In fact, what most studies have assessed is the *value of alternative non consumptive uses*, rather than the *marginal cost of water abstractions*. For example, they calculate the willingness to pay for fishing or bathing. Yet the linkage between, say, fishing downstream and producing hydropower upstream is not obvious everywhere: the impact depends on

local water balance, to which water abstractions may contribute positively or negatively, depending on where the abstraction and discharge points are located. It can be argued that the most critical cases are those in which massive uncontrolled abstraction from an aquifer occurs, rather than those which entail large and regulated surface water transfers. However, even this, very general, statement requires to be carefully assessed on-site.

Despite the spotlight nature of these studies and the impossibility to be conclusive at the present state-of-the-art, it seems quite clear that the magnitude of both resource costs and external costs is very much site-specific and dependent of seasonal aspects. When important recreational and landscape conservation dimensions are present, the value of this external cost might well be high enough so as to overcompensate the value of "productive" uses. Yet, this occurs only in special cases, while in normal ones, once there are no critical natural capital losses involved, the magnitude can be supposed as far lower.

In fact, the literature on monetary evaluation is quite unanimous in believing that empirical estimates of the "total economic value" at best can capture indirect use values (such as recreational use of water or landscape amenity), while non-use values and obviously non-economic values cannot be captured by available techniques, although they can be defined on a theoretical base.

In the end, while the theoretical definition of external cost is clear-cut, it is difficult to use it in practice for an assessment of the true cost in a specific case. In fact, most applied evaluation studies address the problem of measuring specific non-use values (e.g. the recreational and landscape value); yet it is not straightforward to associate this "value" to a "cost" that is generated by another specific water use (e.g. abstractions for irrigation), since the negative externalities for specific uses normally arise from a complex and interrelated set of other water and land uses, and a specific ad-hoc hydrological model is usually required.

For this reason, some authors have suggested a different approach, based on the idea of "cost of sustainability". According to this methodology, the "full cost" of water should be defined as the (theoretical) cost that should be encountered if water use was ecologically sustainable– that is, if all relevant environmental functions of water resources are guaranteed to the present and the next generation *and* enough investment is put in place in order to maintain the value of physical water assets over time. The application of this assessment methodology to some case studies of European urban water supply and sewerage has provided many surprises, since it has enlightened that the "true" cost is very often unaccounted for.

Other approaches refuse to impose a pre-determined evaluation criterion: analysis should start from the identification and measurement of environmental functions that are relevant for different stakeholders groups and of "governance issues" that emerge from the eventual clash between them. The "external cost" should therefore better considered as one among the possible indicators of the existence of a governance issue, which should be solved through a political process, rather than simply as a number to be added to the total cost.

For all of these reasons, considering resource and environmental costs as costs whose recovery might allow optimal allocation of water does not seem, at present, a practicable option. Further, we should consider that most water demands do not vary too much at the margin, but depend on structural variables that operate in the long run, such as the decision to equip farms for irrigation or the location of an industrial

facility. Once the use is established, it is normally very little sensitive to marginal variations of prices, at least until an exit threshold is reached.

In order to have an impact on long-run decisions affecting water demand, resource costs should be anticipated for a long time, and this is actually not possible since they depend, ultimately, on the size of all demands that will concern that particular resource in the future.

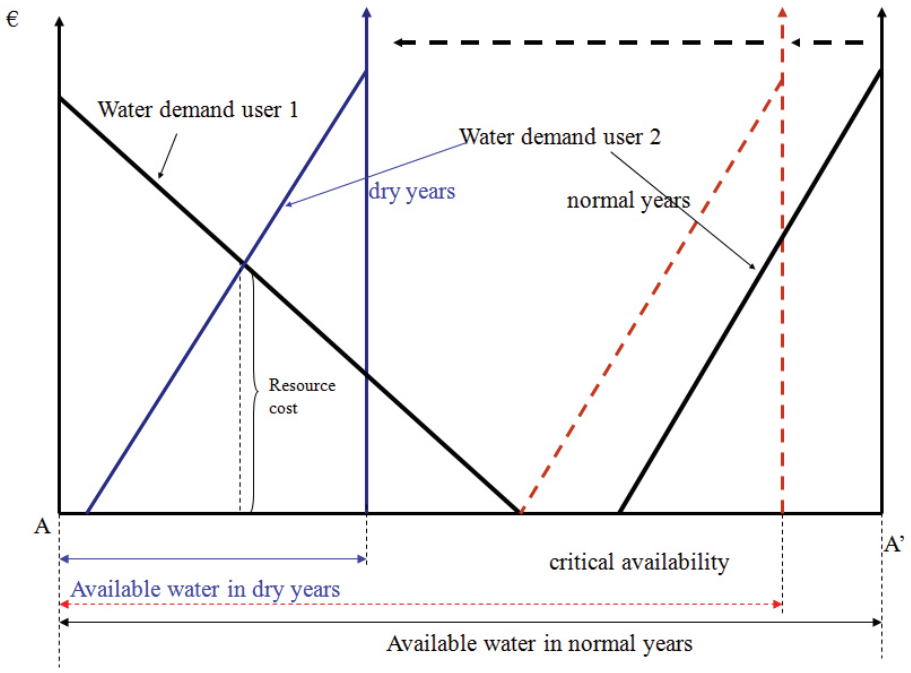
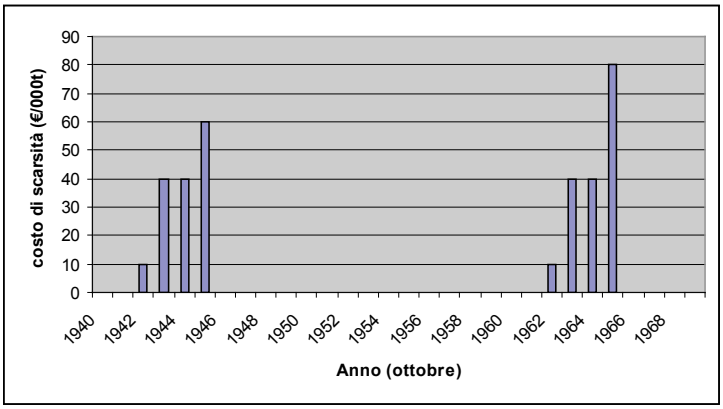


Figure 10. Site-specificity of resource costs



Source: Brouwer, 2004

Figure 11. An assessment of resource costs in the case of the Jucar basin in Spain, showing that the magnitude of costs vary significantly across time

5 GOOD AND LESS GOOD PRACTICES

During the past 15 years, water pricing in OECD countries has experienced an evolution whose main trends are:

- Gradual but stable increase of cost recovery, through water prices and direct endogenous sources (water taxes, water charges etc), paralleled by an

increasing role of market-based finance of new investment and corporatization of the water industry.

- Public finance, not disappearing at all, especially in Southern European countries, but keeping a residual role (e.g. for financing first-time capital expenditure).
- Diffusion of metering and volumetric pricing.
- Increased confidence with the use of environmental taxes (abstraction charges, discharge redevances, pollution taxes), though with a limited purpose.
- Drastic reduction of subsidies for non-household uses, especially for new investment.

International institutions, such as the OECD and the World Bank, have played a substantial role in generalizing these trends throughout the world economy. In Europe, this evolution is now stably rooted in the institutional framework of Directive 2000/60, which establishes pricing as one of the milestones of a water policy aiming at long-term sustainability.

Despite these evident trends, a comparative assessment of cost recovery patterns is nonetheless very difficult because of the aforementioned difficulties. Roughly speaking, almost everywhere, the retail sector is balancing costs and revenues (leaving apart sewage collection in some cases, which is nonetheless justifiable, since combined sewers are also used for stormwater management). However, it is not easy to assess whether the depreciation of existing assets and the investment for its renewal is high enough. Despite the fact that "official" figures from most European countries show a reasonable equilibrium for public supply, an assessment based on the reinstatement cost shows that recovery records are often much lower than expected.

Table 2 shows some overall figures estimated for some European countries. Actual cost recovery ratios seem still quite low in Mediterranean countries and much higher in Northern Europe and in France.

Table 2. Cost recovery of water services in some EU countries (elaboration from OECD, 1999)

Country	Cost Recovery
Portugal	18%
Greece	19%
Ireland	16%
Spain	25%
France	73%
E&W	92%
Germany	83%
Denmark	89%

The evolution towards a pricing strategy aimed at full cost recovery by no means represents a pure application of the economic rule of marginal cost pricing. Rather, in all countries, water pricing preserves, in a way or the other, many features of taxation (though in an earmarked fashion).

The British "water price", for example, is often paid in proportion of the size of private properties. The service cannot be suspended for those who do not pay and the

customer is not totally free to give up the connection and stay on his own. This possibility is only theoretical, since all are connected. The water charge is in fact a property tax, paid to the water service operator. Similarly, connection to sewage collection systems is usually compulsory in most EU countries, and it requires a compulsory payment to the service operator.

On the other hand, the French "water taxes" are in fact environmental prices, paid in proportion to water consumed or discharged, and used as an income source for financing water-related investment within the same River Basin.

As these examples show, the consideration of revenues as direct charges or as taxation is often a pure terminological convention. What really matters is who pays, for what purpose and how much, and what the customer actually obtains in exchange of they pay. Ultimately, whether the citizen has to pay for a public service as a user or as a taxpayer is by large a political decision, provided that in both cases it faces the same incentives to sustainability.

We can distinguish different alternative equalization schemes that can be considered as intermediate solutions between individual LRMC and complete externalization of the cost.

First of all, if FCR is adopted, it is normally intended only for industrial costs of the retail segment, while resource management is more often financed partly through charges, partly through the general budget and through undue transfers to future generations. England and Wales represent a partial exception since administrative costs are also charged through the abstraction and discharge fees (intended as cost-recovery instruments for the Environment Agency). Denmark, some German Laender and other Northern European countries have also started to apply environmental taxation with significant values. Nonetheless, the intention is to implement an incentive system, rather than to internalize external costs.

It is therefore evident that a significant part (if not 100%) of external costs is normally not accounted for. Despite the success of the past 30 years in environmental regulation, virtually no European country could claim to have reached a pattern of water use or waste management that is fully sustainable for the environment. This unsustainability is partially suffered by the present generation itself (polluted rivers) and partially transferred to future generations (e.g. accumulation of pollutants in soils and groundwater, eutrophication of lakes, land-filling of waste). If we take the implementation of the Urban Wastewater and Water Framework Directives as a proxy for what should be done in order to achieve environmental sustainability, the EU as a whole is at least 150,000 million € away from the recovery of this cost.

Even if we concentrate on industrial costs only, the recovery rate varies considerably. Where considerable investment in new infrastructure is needed, State subsidies are generally used for financing first-time capital expenditure. At the moment this occurs notably in Southern European Member Countries. Yet all countries, in one way or the other, have used the public budget for providing the initial capital for infrastructure development. Even countries like the UK, that have now reached some equilibrium with this respect, have subsidized water infrastructure in the past, and the effect of this subsidy is still perceivable in reduced prices[5]. In fact, the British consumer pays only the capital cost of *new* investment that is basically a marginal improvement to an

[5] At the moment of privatizing the Regional Water Authorities, their debt was cancelled by the Government in order not to cause prejudice to the selling of water assets on the market.

already consolidated network of facilities. In Southern Europe, where considerable effort is carried out, especially for sewerage and for compliance with the Urban Wastewater Directive, the European structural funds are playing a fundamental role.

The use of public budgets is certainly the most typical and obvious way to ensure some perequation of the cost of water. Yet there are also alternative mechanisms that do not require public intervention. This occurs for example on a territorial base. The regionalization of water undertakings in Britain (completed in 1973) and the ongoing concentration process in Italy, which will lead in the medium term to 80-100 undertakings from the existing 13,000, were both inspired by the idea that a larger management unit allows the spreading of cost amongst a larger number of consumers, thus statistically compensating for areas with high and low marginal costs of supply.

An alternative strategy is the use of earmarked taxes that remain "internal" to the water economy, even though they enact a compensation mechanism between areas. This is best exemplified by the French *Agences de l'Eau* that mobilize, through abstraction and discharge taxes, nearly 15% of the whole expenditure for water. This money is given back to municipalities and water users in order to support water investment, at no interest. A similar mechanism, though on a smaller territorial scale, operates when collective associations are created for managing water-related issues, even including different water users. These are quite common in central Europe and even in Italy, for the sake of urban and rural drainage, irrigation, sewerage and occasionally water supply.

A third possibility, particularly widely used in Southern Europe, is to adopt different financing mechanisms for the basic infrastructure needed for the "local" service and resources management.

While the former can be considered as a normal local service, the general budget contributes to larger infrastructure projects, with the aim of "evening out" the availability of natural resources. The public agency responsible for the large infrastructure later sells its services to local operators for free or at a "political" price. Similar financing practices are common for large water storage and transfer schemes in Spain and Southern Italy, and also for sewage treatment and waste disposal. Countries with many institutional layers, like Italy or Germany, have generated this way a deeply-entrenched system, to which any territorial level contributes in many different ways with a high degree of flexibility.

A fourth case is represented by cross-subsidisation among different utilities at the municipal or inter-municipal level. This model is well exemplified by the German *Stadtwerke* and by the Italian equivalent of *aziende municipalizzate*, that have commonly managed financial flows arising from different utilities, in order to compensate amongst services. While sewerage has typically been a net beneficiary of these cross-subsidies, a notable difference between Italy and Germany lies in the fact that the former has long subsidized water supplies out of other services (gas and electricity above all), while the latter has intended water supply as a source rather than a destination of cross-subsidies.

It is thus evident that subsidies – or in other words deviation from the "economic first best", theoretically represented by the LRMC principle – are largely adopted, and can hardly be eliminated. Their heterogeneous nature makes it very difficult to engage into a meaningful comparison of the cost recovery policies adopted in different countries.

Nonetheless, there is also increasing awareness that ill-conceived subsidy schemes can have serious shortcomings, since they can encourage over-capacity and discourage municipalities and individuals, both from feeling fully responsible for service assets, and for their proper use and maintenance. Either because of this understanding of the shortcomings of subsidies or because the use of the fiscal leverage has been further reduced by budget restraints, most countries have reviewed or are reviewing their policies in this respect.

The trend observable in Europe shows an increase in the cost-recovery potential of charging schemes, together with a higher transparency of subsidies and the search for incentive-related structures, for example, through a generalized adoption of co-financing measures and performance-based subsidies. Even countries like Italy, whose attitude to the use of the public budget has been more favorable than others, is re-orienting itself towards FCR, which is now explicitly required by law 36/1994. , However, during the transition phase, the public budget continues to sustain at least part of capital expenditure, in order to avoid too drastic price increases.

Nevertheless, this trend is constrained by the emerging social opposition to price increase. Water services are acquiring an unexpected weight in Europeans' household budgets. If the cost of water and waste disposal services becomes visible in the overall average expenditure, this will be far more true for low income households, since the demand for environmental services is very weakly correlated with income.

The price of water and sewerage, as well as of waste management, is becoming more and more a hot and delicate issue of public policy, thus requiring a sensible approach towards the achievement of cost recovery.

Environmental economics has fully analyzed the potential benefits of using taxes and other economic instruments in order to foster the internalization of external costs. Among these instruments, levies on water consumption and discharge taxes, both affecting the water price, are often advocated in order to reduce both consumption and pollution loads.

However, a deeper analysis suggests that this effect is not guaranteed. In fact we should consider water management as a complex system: users do not normally approach the resource directly, but rather through collective services. Both collective services and water users employ technologies and assets that are produced by the industrial system. Finally, the demand does not simply originate from individual preferences, but is influenced in many ways by other public policies (e.g. the effects of common agricultural policies on the demand for irrigation). For these reasons, environmental taxation and other environmental economic measures only have an indirect effect on water users. These effects can interact in many ways, and not always positively and coherently, with the strategies of actors located in the other parts of the system. Since transactions among various actors in the system are imperfectly regulated by the market, the effect of policy actions crucially depends on the targets chosen. For example, increasing-block tariffs could well discourage individual consumption. On the other hand they might provide an incentive for water supply operators to sell more water, since their revenues would depend on the quantity sold.

At the same time, we have to consider that the demand elasticity for household water and for sewerage is quite low, especially if certain uses, such as garden irrigation and swimming pools are not considered. Opportunities for saving water in the

household are generally linked to the purchase of new equipment (e.g. flush toilets, electric devices, new household appliances). A policy action targeted on the suppliers of these goods might have more favourable results. The situation is similar in the case of effluents affecting the water environment. For example, the successful policy for the reduction of nutrient loads towards the Northern Adriatic Sea in Italy has been achieved partly with end-of-pipe measures, but for the large part, with the ban on less-than-90%-biodegradable detergents. The industry that produces the equipment necessary for the various stages of production and use of water is again in the best position for investing in RTD and generate innovation, thus improving the overall performance of the system in the long run. It is hard to believe that water and sewerage prices by themselves could have a significant effect on this kind of innovation process.

Regulatory policies aimed at reducing price increases could “sterilise” the effect of environmental taxes. Moreover, since the reduction of environmental impact largely depends on the investment made by water supply and sewerage operators, environmental taxes per se would not provide an incentive to generate such investment if they do not explicitly address this purpose. Utility operators could just pass them on to consumers through raised prices, with limited effects on consumers’ behaviour due to low demand elasticity.

Another important point that should be mentioned here is that the impact on water resource capital is typically very sensitive to the location and timing of abstractions and discharges. It is not the quantity of water itself or the pollution load that matters, but how the individual resource is affected. In general, the elasticity in water demand is much lower than that for a particular water resource use (e.g. a specific river or aquifer), and this becomes more relevant the larger the territorial base is. The water operators rather than the final users are those who are in the best position for choosing which waters to use and when are. Thus, environmental policy measures should best target their reactions instead of those of the final consumers.

Therefore, it comes as no surprise that there are European countries with different purposes behind these instruments than simple “pigouvian” taxes.

Some countries, notably Denmark, have conceived environmental taxes basically as revenue-making fiscal instrument, even if some “double-dividend” can be expected from this strategy.

Germany to a certain extent, and especially France with its 6 *Agences de l’Eau*, adopt water taxes with the aim of creating budgets to be spent for the sake of environmental policy in general (Germany) or for co-financing investment in the water sector within the same River Basin (France). Also, in Italy, revenues arising from abstraction charges end up in the budget of River Basin authorities and are spent on river management purposes (however, the total amount is negligible).

In the UK, revenues from these taxes are used for financing the administrative functions managed by the Environment Agency in the field of water. In other words they aim to cover part of the resource management costs (namely quality monitoring, pollution control, licensing procedures).

Another interesting innovation, more extensively practised in the USA but which is generating increasing interest in Europe, is the development of market-like approaches for water use rights. This is regarded, in particular, as a promising solution for meeting short-term water stress and can entail negotiations for the use of

a certain reservoir and for additional environmental protection measures (e.g. the German *Wasserpfennig* arrangement).

6 CONCLUDING REMARKS: LESSONS FROM THE INECO PROJECT

There are two dominant views about water pricing and economic instruments in the main water policy debate. Both are fundamentally wrong, and misunderstand the basic issues behind it.

According to the first view, which we can label as “Water Washington Consensus”, water stress is fundamentally a problem of wrong economic signals. Getting the price right is the only thing to do; then, problems will be solved automatically. Inefficient allocation derives from lack of economic support to decision, and thus Cost-Benefit Analysis should be widely adopted as a support for decisions. Also, this view poses a strong stake in favour of a commercialization of water services, seen as a remedy to inefficient public management and vulnerability of state decisions to capture from lobbies. Water pricing in a more market-like water allocation system is thus presented as a sort of “magic stick” that can solve all problems.

The opposite view (the “Water Anti Globalism”) sees instead pricing and economic instruments as the prelude to the privatization of water resources, and therefore of a management of water that denies social rights, allowing water companies to speculate over an essential good.

A more balanced view, like the one adopted in this paper, considers pricing as a useful instrument, provided that the different aspects of water sustainability are taken into account, and trade-offs among them duly considered. The economic is an important – say fundamental – dimension, but not the only one.

Also, we must be aware that the response of stakeholders to economic incentives is not obvious, and there is need to carefully understand in each context what the likely outcomes will actually be. Responses differ according to the target group (e.g. final consumers, producers), and have also important differences in the short and long run. Therefore, adopting certain measures such as a temporary price increase in order to face seasonal water stress, will have completely different impacts than in the case in which they are intended to face long-run structural issues.

Different policy objectives also imply rather different pricing design. For example, volumetric rates are well suited for reducing demand, but not as a way to recover infrastructure costs.

The use of economic instruments is also constrained by affordability and political acceptability. Affordability is an important constraint, even in developed countries, but should not be overstated. We should distinguish collective affordability, namely, the capacity of a community to devote a certain share of its GDP on water, from individual affordability, which particularly concerns poor households. While the former is mostly a matter of graduality, the latter usually implies tariff design aimed at a fair cost sharing, even if this means lower incentive potential. Also, an important aspect concerning collective affordability is the cost of capital. The interest rate paid on capital is by large a more important cost driver than operational efficiency. Therefore, the issue of how to allocate the economic risk of investments is the most critical aspect to regulate.

Table 3. Alternative water tariff structures and performance respect to sustainability targets (from OECD, 2009)

	Ecological sustainability	**Economic efficiency**	**Financial sustainability**	**Equity / affordability**
Uniform license fee	Very poor. No incentives to water saving	Acceptable as a way to recover the fixed cost; inefficient if MC component is relevant	Potentially OK, but commitment to cost recovery required Avoid political determination of fees	Very regressive
Non-uniform flat rate	Poor, unless rates are eventually calculated according to specific circumstances (eg surface of gardens; swimming pools; water recycling devices)	Acceptable as a way to recover the fixed cost; inefficient if MC component is relevant	As above, provided that total revenues are guaranteed	Potentially good effects, provided that criteria used correspond to personal wealth
Uniform volumetric rate + stdng charge	High, depending on the marginal rate + individual metering	Potentially the best solution provided r = SRMC and fixed charge = lump-sum; particularly suited in case SRMC is constant (eg electricity, reagents)	Good	Potentially good effects, provided that criteria used correspond to personal wealth
Uniform volumetric rate	As above; higher, since std charge = 0 means marginal rate >	Not very efficient especially for capex; inefficiency depends on demand elasticity (the lower e, the lower inefficiency)	Good	Encourages connection
Uniform volumetric rate + rebate	As above Highest if rebates take into account specific circumstances (eg surface of gardens; swimming pools; water recycling devices)	As above; In turn, could be efficient in combination with a positive fixed fee (idea: r = SRMC; fixed cost redistributed including a rebate for the poor)	Good	Progressive and useful for reducing impact on poor Best if rebate is targeted; otherwise, distributive effect depending on income elasticity

	Ecological sustainability	Economic efficiency	Financial sustainability	Equity / affordability
Traditional IBT + st charge	Highest, provided that metering is individual and marginal rates in the upper blocks are high	Potentially the best solution provided r = SRMC and fixed charge = lump-sum; particularly suited in case SRMC is increasing (eg costly extra supply to be purchased)	Good potential for FCR Attention in case of a sudden move from flat charges to IBT: consider effect on demand	Regressive, according to demand elasticity to income
IBT + exact occ. amendment	Highest, provided that metering is individual and marginal rates in the upper blocks are high	As above	As above	Reduces impact on large families
IBT+ default 1st block + targeted subsidies to low income	Highest, provided that metering is individual and marginal rates in the upper blocks are high	As above	As above	Not very useful; subsidies tend to miss the target. Subsidized block not targeted to the poor
Additional temporal tariff	Not very useful unless used as a complement to bans to certain uses (eg garden irrigation)	Good for reducing demand in peak periods and optimizing capacity use	No effect (unless extra revenues are used for compensating RC)	Potentially regressive: poor more likely to give up using water in peak/stress periods

But the reality of Mediterranean countries seems to show that affordability (at least collective affordability) is not critical: investing in a more efficient water management system and preventing the overexploitation of resources is feasible and could be well acceptable even for the poor, provided that tariffs are designed accordingly. Instead, political acceptability is a more critical issue, in countries that have been for a long time accustomed to the typical “vicious circle of low funding”.

In Mediterranean countries, differently from continental and northern Europe, two aspects emerge as priority for water policy. The first is the still predominant self-supplied (or at least unregulated) model for approaching the resource, either concerning groundwater or discharges into water courses. This is leading to a generalized problem of resource depletion and overuse. Modernizing the water management system requires investing in water supply, treatment and wastewater reuse facilities.

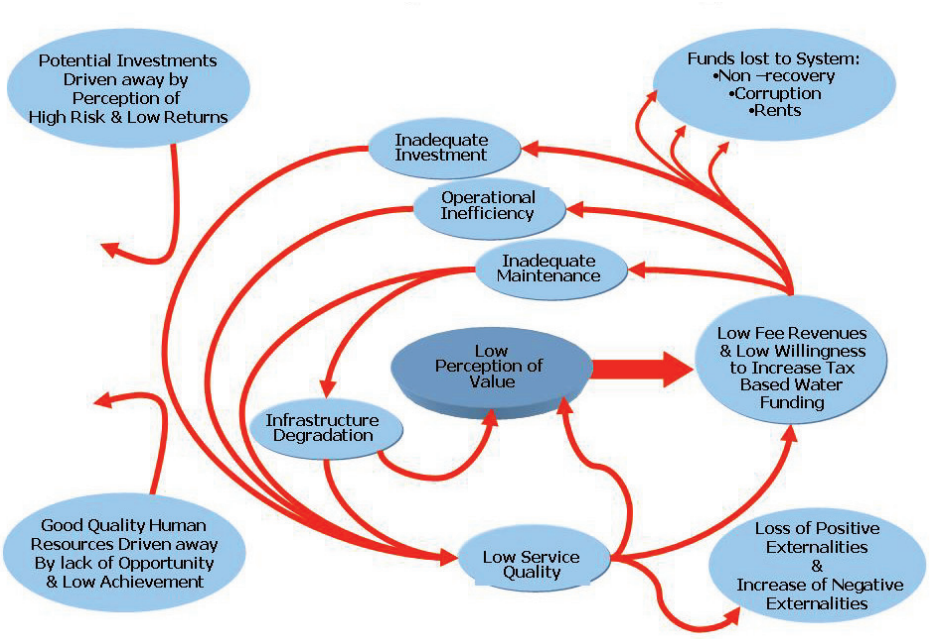


Figure 12: The vicious circle of low funding (adapted from OECD, 2009)

Therefore, the approach suggested by the EU on full cost recovery and economic marginal cost pricing is not necessarily the most effective solution. In turn, priority should be devoted to: (i) a sound infrastructural policy focused on the need to gather cheap capital from the market and ensure debt repayment; in this phase, a recourse to fiscal or semi-fiscal approaches to water pricing seems more promising than FCR based on volumetric pricing; (ii) discouraging overuse of resources, not only by introducing and enforcing taxation and economic instruments, but also promoting cooperation among uses and reinforcing institutions at the river basin scale, aimed at fostering inter-use water sharing.

In this perspective, pricing will be for sure a fundamental instrument, provided that (i) it is designed in a way that is functional to priority targets and (ii) it is accompanied by the creation of a “virtuous circle of political confidence”, allowing to invert the “vicious circle of low funding” discussed above. Public participation, stakeholders’ involvement and more openly debated strategies for improving management of water services will be a fundamental tool in this respect.